

# ECOSYSTEM MARKETS *NEW MECHANISMS TO SUPPORT FORESTRY*

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## Ecosystem Markets: New Mechanisms to Support Forestry

### Introduction

With the growing interest in global warming, climate change, and the influence that human activities have on our environment, there are increasing opportunities for market-based mechanisms to support responsible forestry and environmentally beneficial land use decisions. An increasingly common market-based mechanism is the “carbon credit” which links marketplace values with the sequestration of carbon. Additional market opportunities exist and are in development for other ecosystem products and services, including payments for water, soil protection, and habitat enhancements. Although carbon credits are currently grabbing the headlines, the take home message from the evolving “ecosystem marketplace” is that the time may be right for implementation of economic tools that link environmental cause-and-effect relationships and to more robustly reward the full range of environmental stewardship values. There is also a growing need to develop tools to effectively measure and monitor these marketplace transactions.

### Background

Forests are traditionally valued for the basic goods they provide, including timber and fiber. However, forest ecosystems provide a broad range of products and services, many of which generally are not directly valued in the marketplace, including sequestration of carbon, moderating local climates, filtering air and water resources, and providing habitat for wildlife. These ecosystem services and other benefits of forests are frequently overlooked and undervalued in economic models and policymaking.

Since nearly 60% of the forests in the United States that contribute to providing these benefits are privately owned, these benefits are threatened by the economic pressures that drive land use conversion. When forests are converted to other land uses, including urban development or agriculture, not only is the timber growing opportunity lost, but many other ecosystem services are lost as well.

To help balance the pressures to convert forestlands to other uses, there is increasing interest in market-based payment mechanisms for recognizing the benefits that forest ecosystems provide. Developing mechanisms include payments for carbon sequestration, watershed management, and biodiversity.

#### Market-based Mechanisms

- Public payments
- Private contracts
- Tax incentives and subsidies
- Credit trading supports by a regulatory cap
- Eco-labeling and consumer actions

Because some ecosystem services have global impacts and markets, while others are local in scale, there is potential for ecosystem service markets to operate at a range of scales. For instance, the market for carbon has developed at a global scale while payments for water related services are frequently structured at a regional level.

The largest ecosystem services payment program in the United States is the U.S. Department of Agriculture's Conservation Reserve Program (CRP). The program provides landowners annual payments to set aside erosion prone lands and thereby reduce sedimentation in lakes and rivers and provide wildlife habitat. Other federal agencies and government programs are also active in ecosystem services. In 2003, the U.S. Fish and Wildlife Service (USFWS) established guidance for "Conservation Banks" which aim to protect habitats for endangered species.<sup>1</sup> The structural basis of conservation banking is the U.S. Endangered Species Act (ESA), and banks have been established with public and private landowners around the country. The USDA-Forest Service is also exploring approaches to incentivizing environmental stewardship and examining opportunities to support market-based mechanisms for ecosystem services.<sup>2</sup>

Different approaches to valuing ecosystem services are useful to address different situations. Combining public programs and incentives with private investments can help increase the impact and resulting benefits. Working in concert, efforts to value ecosystem services can help raise public awareness, support private lands stewardship, encourage ecosystem restoration and protection, and begin to emphasize the need to reduce consumption and manage human impacts.

### **International Framework**

Based upon international agreements, there are at least four broad categories of established ecosystem services: carbon sequestration, water and wetlands, biodiversity and wildlife, and landscape aesthetics or ecotourism. By one count, there are currently more than 300 markets for ecosystem services operating around the world.<sup>3</sup>

The leading international framework for ecosystem services is the United Nations Framework Convention on Climate Change (UNFCCC) that was signed at the 1992 Earth Summit.<sup>4</sup> Since that time, 192 countries have ratified the Convention, including the United States. The Convention focuses on climate change and participating governments commit to gather and share information about greenhouse gas emissions and national policies and best practices.

The UNFCCC includes two important pieces, the Convention on Biological Diversity and the Kyoto Protocol.<sup>5</sup> The Convention on Biological Diversity provides a structure for biodiversity related ecosystem services, and the Kyoto Protocol provides the leading opportunities for carbon sequestration markets.

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<sup>1</sup> <http://www.fws.gov/policy/library/03-11458.pdf>

<sup>2</sup> <http://www.fs.fed.us/ecosystems-services>

<sup>3</sup> For a directory, see The Katoomba Group's Ecosystem Marketplace: <http://ecosystemmarketplace.com>

<sup>4</sup> <http://unfccc.int/2860.php>

<sup>5</sup> For the purposes of simplifying the discussion, only these two international structures are discussed in this report. Additional international agreements related to ecosystem services include the Ramsar Convention on Wetlands, the Convention on Migratory Species of Wild Animals, and the UN Convention to Combat Desertification.

*The Convention on Biological Diversity*

The Convention on Biological Diversity (CBD) is based on three broad goals: biodiversity conservation, sustainable use of the components of biodiversity, and the fair and equitable sharing of benefits arising from the utilization of genetic resources.<sup>6</sup> Since its establishment, the Convention has provided a framework for exploring measures and incentives that can be used to support the conservation and sustainable use of biological diversity, including market-based mechanisms.

The CBD requires the adoption of “economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity.” Through guidance provided by the CBD, further recommendations regarding the use of incentives have been developed that recognize the potential role and benefits of placing economic value on biodiversity. Policy and regulation are also important tools for providing basic protections and the necessary structure to manage incentive programs.

*The Kyoto Protocol*

The Kyoto Protocol<sup>7</sup> requires industrialized countries to implement policies and measures for reducing greenhouse gas emissions to at least 5 percent below 1990 levels by the end of 2012. A global market for carbon credits and projects has arisen largely as a result of the Kyoto Protocol and is a significant development in the marketplace for ecosystem services.

Within the Kyoto Protocol there are three “mechanisms” that create cap-and-trade models and are the basis of the mainstream carbon market. The mechanisms include Emissions Trading, Joint Implementation, and Clean Development. The Clean Development Mechanism (CDM)<sup>8</sup> is referenced most frequently and is distinguished by its focus on carbon credits that result from financing carbon reduction projects in developing countries. This mechanism is viewed as a key link between developed and developing countries. In 2006, CDM traded credits totaled \$5 billion (USD) and accounted for 450 million tons of reduced carbon dioxide emissions (MtCO<sub>2</sub>e).

One of the recognized limitations of the Kyoto Protocol as it currently exists is that it only authorizes carbon credits resulting from afforestation and reforestation activities.<sup>9</sup> The mechanisms currently exclude soil carbon storage, carbon sequestration resulting from active forest management, carbon storage within long-lived wood products, and avoided deforestation or prevented land conversion.

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<sup>6</sup> <http://www.cbd.int/>

<sup>7</sup> [http://unfccc.int/kyoto\\_protocol/items/2830.php](http://unfccc.int/kyoto_protocol/items/2830.php)

<sup>8</sup> <http://cdm.unfccc.int/index.html>

<sup>9</sup> The term afforestation refers to establishing a new forest where one did not previously exist or has not existed for a long time, and reforestation is the restoration or replanting of a forest on a site that was recently forested. The CDM guidance includes a time period of 50 years to meet the afforestation threshold. [http://cdm.unfccc.int/EB/022/eb22\\_repan16.pdf](http://cdm.unfccc.int/EB/022/eb22_repan16.pdf)

Attention to carbon storage within wood products is increasing in environmental policy discussions with recognition that about one-half the dry weight of wood is carbon. The storage of enormous quantities of carbon within wood products is likely to be reflected in subsequent carbon policies. Less certain is formal recognition of the large carbon implications of low-energy intensive wood products manufacturing as compared to the high-energy intensity of potential substitute products; this reality translates to substantial avoidance of carbon and other emissions from fossil fuel combustion.<sup>10</sup>

**Forestry Practices that Increase Carbon Sequestration on Forestland**

1. Afforestation of agricultural land
2. Reforestation of harvested or burned timberland
3. Modification of forestry management practices to emphasize carbon storage
4. Adoption of low impact harvesting methods to decrease carbon release
5. Lengthening forest rotation cycles
6. Preservation of forestland from conversion
7. Adoption of agroforestry practices
8. Establishment of short-rotation woody biomass plantations
9. Urban forestry practices

Source: Stavins and Richards (2005).

The Kyoto Protocol and the CDM will be available for comment in 2012 and opportunities for expanded forestry project recognition may be included in the review. In the meantime, organizations are able to develop credits that can be sold outside of the Kyoto defined marketplace. Efforts to develop markets for more diverse forestry projects continue to move forward. In late 2007, the World Bank announced the “Forest Carbon Partnership Facility” (FCPF) to assist developing countries in efforts to reduce emissions from deforestation and land degradation.<sup>11</sup> The UNFCCC has also begun exploring how carbon is stored in harvested wood products.

The United States has not ratified the Kyoto Protocol; however, individual states and regions within the country have organized systems for participating in the global carbon market. The U.S. carbon market has developed on a primarily voluntary basis. Forestry-based carbon projects have been an important component in this market. The first regulation of carbon dioxide in the United States occurred in Oregon in 1997 when new power plants were required to reduce their emissions directly, through offsets, or through payments to The Climate Trust, a non-profit created to implement CO<sub>2</sub> offset projects. Trading in greenhouse gas (GHG) emissions has been occurring in the U.S. since 2003.

There are increasing calls for a national system of greenhouse gas (GHG) regulation in the United States to allow for more comprehensive and consistent participation (Table 1).

<sup>10</sup> Garcia et al. (2006)

<sup>11</sup> <http://carbonfinance.org/>

**Table 1 Proposed GHG Legislation in the U.S.**

Proponent	Type	Scope	Target Level	Price Cap	Offset
McCain and Lieberman	Cap and Trade	Electricity, transportation, industry and large commercial facilities	Stabilization at 2000 level by 2010	NA	Upto 15% including sequestration and international markets
Bingaman	Intensity target with trading mechanisms	Fuel Producers, importers and emitters of non-fuel GHGs	2.4% below BAU intensity	\$7 per ton (+5% annually)	Domestic credits including sequestration. Upto 3% international credits
Feinstein	Cap and Trade	Large stationary sources, including utilities, oil and gas and transportation facilities	2006 levels in 2010, 92.75% of 2006 level in 2020	NA	25%, domestic and international including farming and afforestation
Waxman	Cap and Trade	Large emitters	Stabilization at 2000 levels, 2% annual reduction from 2010 to 2020	NA	Not defined
Kerry and Snowe <sup>19</sup>	Cap and Trade	Passenger vehicles, the U.S. to derive 20% of its electricity from renewable sources	Freeze GHG emissions in 2010. Then reduce annually to a goal of 65 percent below 2000 emissions levels by 2050	NA	Not defined

Source: Ruddell *et al.* (2006)

## Carbon Credit Markets in the United States

There are four leading mechanisms currently operating in the U.S. that allow participation in the carbon market, including the Chicago Climate Exchange, the Department of Energy's National Voluntary Reporting of Greenhouse Gases Program, the California Climate Action Registry, and the Regional Greenhouse Gas Initiative.

### *Chicago Climate Exchange (CCX)*

Established in 2003, the Chicago Climate Exchange (CCX)<sup>12</sup> was the world's first global venue for emission trading and offsets. The CCX has established protocols for quantifying greenhouse gas credits, aggregating them, and selling them through binding commitments. The CCX forestry program recognizes afforestation, reforestation and "forest enrichment projects" initiated on or after January 1, 1990 on non-forested or degraded forestland. There are also opportunities to recognize forest conservation projects occurring on sites that are contiguous with forestation activities.<sup>13</sup>

<sup>12</sup> <http://www.chicagoclimateexchange.com/>

<sup>13</sup> For more information: <http://www.chicagoclimateexchange.com/content.jsf?id=242>

In December 2007, the CCX Committee on Forestry approved new protocols for carbon sequestration associated with long-lived wood products and managed forests.<sup>14</sup> The CCX requires that forest projects provide evidence of sustainable management by being certified as meeting the standards of the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), American Tree Farm System Group Certification program or a scheme endorsed by the Programme for the Endorsement of Forest Certification schemes (PEFC).<sup>15</sup>

The CCX includes several membership categories and has experienced rapid membership growth. From a membership of 127 in 2006, the CCX now has well over 300 members.<sup>16</sup>

#### *Department of Energy's National Voluntary Reporting of Greenhouse Gases Program*

The Energy Policy Act of 1992 includes Section 1605(b), which established a voluntary reporting program for greenhouse gas emissions and reductions.<sup>17</sup> In 2006, the Department of Energy issued revised guidelines for the program to be implemented in 2007. The program has been operating since 1994 with over 200 utilities, industries, and other entities reporting on an annual basis. The revised guidelines aim to establish a national registry supported by tools for estimating emissions and encouraging conservation activities. The Forest Appendix for the program includes extensive regional look-up tables for estimates of carbon stocks.<sup>18</sup>

#### *California Climate Action Registry*

The California Climate Action Registry (CCAR) was signed into law in 2006 and is a non-profit voluntary registry for greenhouse gas emissions. The CCAR provides guidance on how to quantify and certify qualifying carbon offsets. The first forest carbon project registered with CCAR included 2,100 acres of working forestlands and the participation of The Pacific Forest Trust and the van Eck Forest Foundation. A similar project for the 23,000 acre Garcia River Forest has been developed by The Conservation



**Members:** Entities with direct greenhouse gas (GHG) emissions. Members make a legally binding commitment to the CCX Emission Reduction Schedule.

#### **Forest Products**

Abitibi-Consolidated  
Aracruz Celulose S.A.  
Arcelor Mittal Florestas Ltda  
Cenibra Nipo Brasileira S.A.  
International Paper  
Klabin S.A.  
Masisa S.A.  
MeadWestvaco Corp.  
Neenah Paper Incorporated  
Stora Enso North America  
Suzano Papel E Celulose SA  
Tembec Industries Inc.  
Temple-Inland Inc

For the complete listing of CCX members:  
<http://www.chicagoclimatex.com/content.jsf?id=64>

<sup>14</sup> <http://www.chicagoclimatex.com/info/advisories/2007/2007-18.pdf>

<sup>15</sup> <http://www.carbon.sref.info/registering/ccx-forest-offsets.pdf>

<sup>16</sup> <http://www.chicagoclimatexchange.com/content.jsf?id=64>

<sup>17</sup> [http://www.usda.gov/oce/Global/global\\_change/gg\\_reporting.htm](http://www.usda.gov/oce/Global/global_change/gg_reporting.htm)

<sup>18</sup> [http://www.usda.gov/oce/Global/global\\_change/Forestryappendix.pdf](http://www.usda.gov/oce/Global/global_change/Forestryappendix.pdf)



Fund, Nature Conservancy, and California Coastal Conservancy. Scientific Certification Systems (SCS), an independent third-party auditing firm, reviewed both projects for compliance with the CCAR requirements.

Through state law, CCAR is required to encourage carbon sequestration through the creation of incentives for forest conservation, reforestation, and responsible forest management. The California protocols include several key requirements for forestry projects:

- Dedicated permanently to forest use through the use of perpetual conservation easements;
- Promote and maintain native forests; and
- Utilize natural forest management practices that do not jeopardize water quality, biodiversity and species habitat.

### *Regional Greenhouse Gas Initiative (RGGI)*

The Regional Greenhouse Gas Initiative (RGGI) is a ten state<sup>19</sup> effort in the Northeast to develop a regional strategy for reducing CO<sub>2</sub> emissions. The Initiative is scheduled to launch in January 2009 with a focus on requiring fossil fuel based power plants to offset their impacts. The goal is to cap power plant CO<sub>2</sub> emissions at 2009 levels and to reduce emissions by 10 percent by 2019.

The initiative currently includes afforestation as the only forestry offset category. There are opportunities for additional offset standards to be developed. The Northeast is already 67% forested and therefore afforestation opportunities are recognized to be limited. Several partners, including Environment Northeast (ENE), the Maine Forest Service, Manomet and the Maine Department of Environmental Protection are developing recommendations to support the recognition for forest management and avoided deforestation within RGGI.

**Table 2 – Forest Project Types Within the U.S. Registries**

<b>DOE 1605(b) Registry (Voluntary)</b>	<b>California Climate Action Registry (Voluntary)</b>	<b>Chicago Climate Exchange (Voluntary)</b>	<b>RGGI Registry (Mandatory – active in 2009)</b>
Managed forests, forest restoration, afforestation, reforestation, agroforestry, short-rotation woody biomass plantations, low-impact harvesting, protecting existing forests from conversion to other uses, and urban forestry.	Forest conservation, conservation-based management, and reforestation.	Afforestation and reforestation, forest conservation, managed forests, and urban forests.	Afforestation.

Source: Ruddell et al (2006)

<sup>19</sup> Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont



*Additional Offset Efforts in the U.S.***Georgia Carbon Sequestration Registry**

Launched by the Georgia Forestry Commission in 2007, the Georgia Carbon Sequestration Registry aims to “provide forest landowners, municipalities, and public and private entities with an official mechanism for the development, documentation, and reporting of carbon sequestration projects undertaken in Georgia.” The registry provides a record of stored carbon on registered forestlands but does not deal in carbon offset sales.

**Midwestern Regional Greenhouse Gas Accord**

In November 2007, the governors of nine states<sup>20</sup> and the Premier of Manitoba signed the Midwestern Regional Greenhouse Gas Reduction Accord as a step toward the formation of a regional cap-and-trade system.<sup>21</sup> The agreement includes a commitment to form a Work Group within two months, set targets for greenhouse gas emission reductions within eight months, and complete development of a cap-and-trade agreement within twelve months. The Accord also included the resolution to join The Climate Registry (see below).

**Western Climate Initiative**

The Western Regional Climate Action Initiative (WRCAI) formed in February 2007 includes six states and two Canadian provinces.<sup>22</sup> It is a regional cap and trade effort and aims to reduce GHG emissions to 15 percent below 2005 levels by 2020. The design of the system is expected to be completed by August 2008 and may correspond with the launch of The Climate Registry (see below).

**The Climate Registry**

As of February 2008, thirty-nine states, and additional Tribes and Provinces, have signed on to The Climate Registry<sup>23</sup>, a large scale effort to “provide an accurate, complete, consistent, transparent and verified set of greenhouse gas emissions data from reporting entities, supported by the robust accounting and verification infrastructure.”

Currently, the collaboration is focused on voluntary reporting and information gathering. However, it is possible that it could evolve to become a cap-and-trade system that helps standardize and harmonize the various systems currently operating in North America.

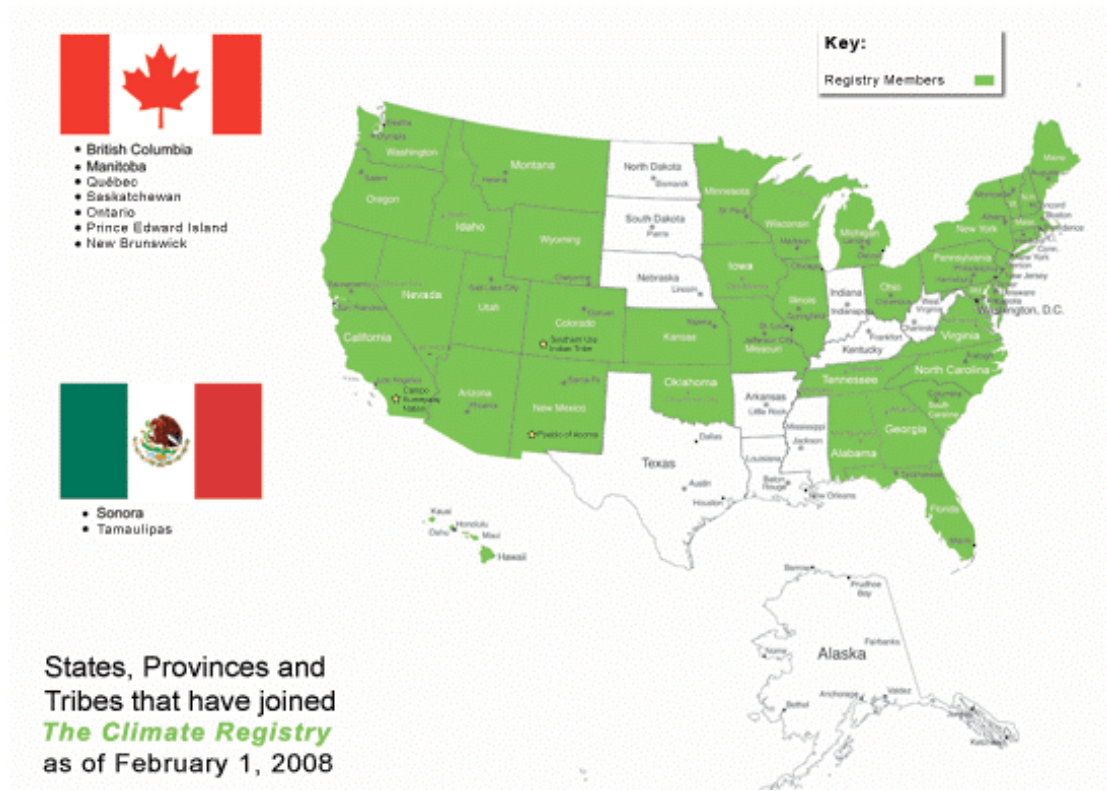
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<sup>20</sup> Wisconsin, Minnesota, Illinois, Indiana, Iowa, Michigan, Kansas, Ohio, South Dakota

<sup>21</sup> <http://www.midwesterngovernors.org/govenergynov.htm>

<sup>22</sup> California, Washington, Oregon, New Mexico, Arizona, Utah, Manitoba, and British Columbia

<sup>23</sup> <http://www.theclimateregistry.org/>

**Figure 1. Participants in The Climate Registry**

Source: <http://www.theclimateregistry.org/>

## Markets for Water

Carbon and GHG cap-and-trade systems aren't the only markets for ecosystem services. Another area of interest is water – including water quality and quantity.

When some of America's oldest and largest cities were being developed, efforts were undertaken to protect the watersheds that serve the residents of those cities. Both Boston and New York bought land within their water source areas and established relationships with private landowners in those watersheds to ensure the protection of the water resources. Active management and regulation of land use in supply watersheds can help control treatment costs and runoff rates.

Today, New York City has the world's largest unfiltered surface water supply. It provides 1.3 billion gallons of water per day to meet the needs of more than 9 million people. The system includes a watershed of nearly 2,000 square miles. Approximately 95 percent of the total water supply is delivered by gravity with only five percent requiring regular pumping to achieve desired pressure. The use of a primarily gravity fed system results in consistent and manageable operating costs despite fluctuations in energy costs.<sup>24</sup> The City's annual report summarizes the achievements of the Watershed Protection Program and reviews water quality indicators and trends.

<sup>24</sup> [http://www.nyc.gov/html/dep/html/watershed\\_protection/html/history.html](http://www.nyc.gov/html/dep/html/watershed_protection/html/history.html)

A study conducted in 2002 found that the amount of forest cover in a watershed correlates with reduced water treatment costs for utilities using surface water supplies. The results show that for every 10 percent increase in forest cover (up to 60 percent total forest cover), water treatment and related chemical costs decrease by approximately 20 percent (Table 3).

**Table 3.**  
**Water Treatment and Chemical Costs Based on Percent of Forested Watershed**

Percent of Watershed Forested	Treatment and Chemical Costs per Million Gallons	Percent Change in Costs	Average Treatment Costs per day at 22 Million Gallons
10%	\$115	19%	\$2,530
20%	\$93	20%	\$2,046
30%	\$73	21%	\$1,606
40%	\$58	21%	\$1,276
50%	\$46	21%	\$1,012
60%	\$37	19%	\$814

Source: de Brun (2007)

The Pinchot Institute for Conservation and several other partners are collaborating on an effort in the Chesapeake Bay to establish the “Bay Bank” as marketplace for ecosystem service credits related to reducing non-point source pollution and other negative water impacts.<sup>25</sup>

Growing recognition of the connection between land use and water is encouraging municipalities and local governments to partner with land trusts, landowners, and other stakeholders to address water quality opportunities.

### Air Quality in Urban Areas

It is well known that urban air quality can impact human health. Allergies, asthma, bronchitis, and related conditions have all been linked to airborne pollutants. The good news is that there is strong evidence of the mitigating impacts that land use, open space, and vegetation management can have on local and regional air quality.

#### **N.C. governor proposes water-conservation plan**

Tuesday, March 11, 2008  
Charlotte Business Journal

N.C. Gov. Mike Easley has unveiled a three-part legislative package to modernize the state's public-water systems, mandate water conservation and upgrade the state's response to water emergencies.

"We cannot let up on our conservation efforts, and that is why today I am announcing a public-awareness effort to encourage citizens to save as much water as possible now, make water conservation a way of life in North Carolina and make our state drought-proof," Easley says.

The package would change conservation mandates, including prohibiting policies that cut rates for customers when they use more water.

**[www.savewaternc.org](http://www.savewaternc.org)**

<sup>25</sup> [http://www.pinchot.org/current\\_projects/baybank](http://www.pinchot.org/current_projects/baybank)

Urban trees provide distinct benefits related to air quality:

- Microclimate effects, including temperature reductions
- Removal of air pollutants
- Reduced energy consumption in heating and cooling buildings

Various studies have quantified the role of urban trees in pollution removal. In areas with 100 percent tree cover, as much as 15 percent of ozone and sulfur dioxide are removed.<sup>26</sup> Pollution removal by urban trees in the United States has been estimated at 711,000 metric tons annually, a service valued at \$3.8 billion.<sup>27</sup>

Urban trees also assist in moderating climates and reducing the “heat island” effect. The USDA Forest Service estimates that every 1% increase in canopy cover results in maximum mid-day air temperature reductions of 0.07 to 0.36°F (0.04° to 0.2°C).<sup>28</sup>

The Urban Forest Effects (UFORE) Model developed by the Forest Service is a tool for quantifying the effects and benefits of trees in urban areas.<sup>29</sup> The model can be used to quantify pollution removals, carbon sequestration, effects on building energy use and other functions.

### Eco-Tourism

Eco-tourism is defined as “responsible travel to natural areas that conserves the environment and improves the well-being of local people.”<sup>30</sup> This type of tourism offers the opportunity to highlight natural amenities while targeting a customer group that is actively seeking conservation-based experiences.

Many countries and U.S. states have active eco-tourism initiatives. In Minnesota, Renewing the Countryside, a non-profit organization based in Minneapolis, established “Green Routes” in 2004. The seven routes that have been developed highlight opportunities for unique and “place-based” dining, shopping, and travel experiences throughout the state.<sup>31</sup> In 2007, legislation in Minnesota established a statewide travel green initiative.

### Forest owners investigate nature-based tourism

By BARBARA COYNER Freelance Writer

COEUR D’ALENE, Idaho – Looking to raise a little cash from the family forest? Maybe offer winter sleigh rides or family reunions in the great outdoors? Family forest owners and a number of forestry consultants explored ecotourism possibilities as part of a family forestry workshop offered by the University of Idaho Extension Services.

“Some nature-based tourism businesses can be long-term sustainable propositions,” said Miles Phillips, Ecotourism Program Specialist with the Texas Cooperative Extension in Corpus Christi. “Today’s urban population has a disconnect with the outdoors and they need a convenient way to get to it. Sometimes they even need to be hand-held because they don’t know what they’re looking for. You need to show them nature.”

<http://www.capitalpress.info/Main.asp?SectionID=67&SubSectionID=792&ArticleID=15291>

<sup>26</sup> A pollution removal calculator can be found at <http://www.fs.fed.us/ne/syracuse/Tools/tools.htm>

<sup>27</sup> Nowak et al (2006).

[http://www.fs.fed.us/ne/newtown\\_square/publications/other\\_publishers/OCR/ne\\_2006\\_nowak001.pdf](http://www.fs.fed.us/ne/newtown_square/publications/other_publishers/OCR/ne_2006_nowak001.pdf)

<sup>28</sup> <http://www.epa.gov/hiri/strategies/vegetation.html>

<sup>29</sup> <http://www.fs.fed.us/ne/syracuse/Tools/UFORE.htm>

<sup>30</sup> <http://www.ecotourism.org/>

<sup>31</sup> <http://www.greenroutes.org/>

**The Bottom Line**

With growing interest in global warming, climate change, and the influence that human activities have on the environment, there are increasing opportunities for market-based mechanisms that support responsible forestry and other environmentally beneficial land use decisions.

An increasingly common market-based mechanism is the “carbon credit” which links marketplace values with the sequestration of carbon. Additional market opportunities exist and are in development for other ecosystem products or services.

Although carbon credits are currently grabbing the headlines, the take home message from the evolving “ecosystem marketplace” is that the time may be right for implementation of economic tools that link environmental cause-and-effect relationships and to more robustly reward the full value of environmental stewardship. There is also a need to continue to develop the tools to measure and monitor these marketplace transactions in a credible way that ensures meaningful benefit.

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