

Registries and research: climate change mitigation and forestry in the United States

A. Tuttle and K. Andrasko

The United States, having no cap-and-trade national policy, is experimenting with a variety of offset approaches.

The United States has actively pursued a technology- and project-based approach to addressing greenhouse gas emissions since the climate change issue emerged prominently around 1990. This approach has been dually driven by greenhouse gas reduction projects developed by electric utility companies and the private sector, and by research on emission reduction and sequestration conducted by federal government agencies and non-governmental organizations (NGOs).

This path, since 2001, has been outside the global context of the Kyoto Protocol which figures prominently for most developed countries. The United States alternative has emerged from the country's market-based tradition, private landownership patterns and complex political context. No federal cap on emissions has been mandated, largely because of congressional and Bush Administration concerns about the economic impacts of a cap-and-trade system, and the limited participation of developing countries in the existing global reduction target agreement.

As a result, climate change mitigation activities in the United States focus on:

- emerging voluntary greenhouse gas reduction and registry programmes that record emission reductions by companies and other entities;
- research on advanced technologies in energy and other sectors to reduce emissions and increase carbon sequestration (both geologic and terrestrial);
- sectoral initiatives for voluntary commitments to reduce emissions from an entire sector (e.g. the aluminium and forest products sectors).

Efforts to advance climate change mitigation in the United States are consequently highly diverse, decentralized and experimental, featuring learning by doing. A wide range of players, including states (e.g. California, Oregon and Washington), several major cities (e.g. Seattle, Washington; Salt Lake City, Utah; Portland, Oregon), private companies, trade associations (e.g. the American Forest and Paper Association), NGOs, federal agencies and sectoral partnerships are actively engaged in greenhouse gas mitigation efforts at all scales and in various sectors, including forestry.

This article outlines some of the climate change mitigation policies at the national and subnational levels and identifies forest-related initiatives being developed and implemented to help meet United States climate goals.

FORESTRY AND CARBON STOCK TRENDS IN THE UNITED STATES

The United States comprises a vast forest estate of about 226 million hectares of forest land (FAO, 2001) and is both a major world exporter and importer of forest products. The federal government has ownership and management responsibility for about one-third of United States forest land, with two-thirds owned by state, local and private entities.

The Forest Service of the United States Department of Agriculture (USDA-FS) is the primary agency charged with developing estimates of forest carbon stock and flux (change in stocks) for the United States. The data are incorporated into the annual national greenhouse gas inventory, which tracks changes in the

Andrea Tuttle is a visiting faculty member at the College of Natural Resources, University of California at Berkeley, United States, and former Director of the California Department of Forestry and Fire Protection.

Kenneth Andrasko is Senior Sequestration Expert, Office of Atmospheric Programs, United States Environmental Protection Agency, Washington, DC, United States.



Data on forest carbon stock and flux are collected by the USDA Forest Service and incorporated into the annual national greenhouse gas inventory (Great Smoky Mountains)

country's greenhouse gas emissions and is published in support of the United Nations Framework Convention on Climate Change (UNFCCC) (US EPA, 2005a). In recent years, USDA-FS has developed a wealth of primary data on forest carbon budgets and carbon storage in wood products, as well as tables for converting tree diameter and other parameters to biomass at the state and forest permanent plot levels (e.g. Smith, Woodbury and Heath, 2004; Jenkins *et al.*, 2004).

Several counter trends are influencing carbon stocks in United States forests. Decades of fire suppression and changes in federal forest policy have resulted in unnaturally high forest stocking, elevated fuel levels and severe wildfires in recent drought years. The National Fire Plan (see USDA-FS, 2005) and Healthy Forests Restoration Act (United States Government, 2003) have recently mobilized major fuel reduction efforts, and wood products research now focuses on utilizing small logs and woody biomass. Research to measure the effects of wildfire on carbon stocks and to explore means of substituting biomass for fossil fuel is also under way.

A new trend in forest land use is also emerging. During the twentieth century United States forest cover increased

as abandoned crop and pasture lands reverted to forest. Now the conversion of private forest land to suburban development is becoming an increasingly prominent source of land-use change. Trends predict that some 44.2 million acres (17.9 million hectares) of private forest lands will see dramatic increases in housing development in the next three decades (Stein *et al.*, 2005). Ownership of large industrial holdings is especially changing in response to global market competition in timber and pulp. Timber Investment Management Organizations, Real Estate Investment Trusts and other forms of investment forestry have entered the forest land market, with real estate development a prime part of the portfolio. Forest carbon stocks will increasingly be affected as roads, homes and commercial centres displace forest cover and photosynthetic sequestration (Best and Wayburn, 2001). Intensified management in remaining production forests may compensate for lost timber volume, but this may require more carbon-intensive inputs (e.g. advanced clonal seeding stock, fertilizer) and management (alternate silvicultural treatments). The net outcome is still unclear, and these opposing forest trends over time will be a key influence in the United States forest carbon budget.

A COMPLEX POLICY LANDSCAPE: ACTION ON MULTIPLE LEVELS

Federal level

In official policy statements by the White House and State Department, the United States Government has reaffirmed its commitment to UNFCCC and its central goal, to stabilize atmospheric greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate system. Since backing away from ratification of the Kyoto Protocol in early 2001, the government has implemented a policy comprising three major approaches.

First is slowing the growth of greenhouse gas emissions. In February 2002 the government adopted a wide-ranging strategy to reduce the greenhouse gas intensity (i.e. greenhouse gas emissions per gross domestic product) of the American economy by 18 percent by 2012. In the United States Government view, terrestrial sequestration (e.g. agricultural and forestry sinks) remains a significant mitigation option as long as it is properly measured and monitored.

Second is laying the groundwork for current and future actions by developing new greenhouse gas reducing technologies for the use of coal, renewable energy sources, geosequestration (such as pumping CO₂ gas into abandoned oil wells) and others in a wide range of federally funded programmes.

The third element is working with other nations to develop an effective global response. The State Department and other federal agencies have been pursuing bilateral climate change relationships and partnership initiatives with other countries.

Significant budget commitments have been made to realize these goals. The budget request submitted to Congress for

the fiscal year 2006 proposes US\$5.5 billion for climate change programmes and energy tax incentives (US\$250 million more than 2005). This includes nearly US\$3 billion under the Climate Change Technology Program to accelerate development and deployment of greenhouse gas reduction technologies. In the agriculture and forest sector, this includes evaluation of potential technologies such as precision agriculture (matching fertilizer and other inputs to soil characteristics) or use of advanced seedling clonal varieties. Another nearly US\$2 billion under the Climate Change Science Program would support enhanced use of remote sensing data to improve resolution of carbon flux estimates for the North American carbon cycle, development of decision-support tools in forest management, and adaptation to potential climate change impacts.

A number of individual departments are carrying out initiatives with implications for forestry. The following are some examples.

Department of Energy. The Department of Energy (DOE) began its Section 1605(b) voluntary greenhouse gas emission reduction activity registry in 1995. Its structures and guidelines have been under review since 2002 for enhanced accuracy, reliability and verifiability of greenhouse gas reductions reported. USDA played a major role in producing new methodologies and guidance documents for reporting agricultural and forestry activities, including soil conservation, afforestation, forest management and biofuel use. Revised registry guidelines are expected to be finalized in 2006 (see US DOE, Office of Policy and International Affairs, 2005).

Department of Agriculture. USDA announced in June 2003 that it would provide targeted financial incentives for land management practices that remove carbon from the atmosphere or reduce greenhouse gas emissions. The USDA



The state of Oregon has authorized the marketing of forest carbon credits from both state-owned and private forests as part of an incentive programme combining forest management with climate goals (managed Pinus ponderosa in eastern Oregon)

Conservation Reserve Program and the Environmental Quality Incentives Program support increased crop and grazing land conservation, practices to reduce emissions from agriculture, sustainable forest management and the use of biomass energy.

Environmental Protection Agency. The United States Environmental Protection Agency (EPA) supports analysis of accounting and mitigation potential for forestry and agricultural activities in an array of economic and climate change models. The objective is to enhance consideration of forest management as a mitigation option by improving forest data, cost estimates, treatment of competition for land use across agricultural, forest and biofuel options, and handling of technical issues. For example, EPA has funded development of carbon sequestration project methodologies to address baseline setting (establishing credible business-as-usual projections of forestry activity for the area where mitigation is planned) and leakage (off-site changes in greenhouse gas emissions resulting from on-site activities, such as deforestation forced elsewhere by on-site forest protection), as well as case studies in the United States, the Russian Federation, Mexico, India and Southeast

Asia. Some EPA findings to date for the United States (US EPA, 2005b) include the following.

- The estimated greenhouse gas mitigation potential of afforestation, forest management and cropland soil carbon management via low-tillage systems and wood energy is significant. National mitigation potential is estimated to average almost 630 million tonnes of CO₂ per year (or 170 million tonnes of carbon) under one scenario of a carbon price incentive of US\$15 per tonne of CO₂ (or \$55 per tonne of carbon).
- Agricultural soil and forest management (lengthened rotation periods, intensified use of inputs, etc.) dominate mitigation activities at low carbon prices (US\$15 or less per tonne of CO₂), while afforestation and biofuels dominate at prices above US\$15.

State-level initiatives

Alongside national activities, individual states have become fertile grounds for climate initiatives. States have largely

been free to design their own approaches, using combinations of regulations and incentives (see Pew Center on Global Climate Change, 2005a). The primary focus has been to reduce fossil fuel emissions at their source, mainly through greater efficiency in power generation, transportation and industrial processes. At least 22 states have raised the requirements for renewable energy in their utility portfolios (i.e. wind, solar and biofuels), and many have adopted standards for more efficient appliances, buildings and state automobile fleets (e.g. California Air Resources Board, 2005). Most programmes take guidance from *The Greenhouse Gas Protocol: a corporate accounting and reporting standard* (WRI/WBCSD, 2004), which aims to harmonize international greenhouse gas accounting standards so that trading schemes and programmes are compatible.

In addition to energy conservation, a growing number of states are also considering sequestration in their forests as they develop climate action plans (see Chan and Forbes, 2005; FAO, 2004), with a variety of approaches for increasing forestation and recording emissions.

Increasing forestation. In 1997, Oregon pioneered legislation requiring new power plants to offset part of their CO₂ emissions by paying into a climate mitigation fund whose authorized uses include forest restoration and tree planting. The fund is administered by a chartered non-profit organization, the Climate Trust (see www.climatetrust.org). The current portfolio will offset 1.6 million tonnes of carbon dioxide from US\$4 million invested in offset projects. Oregon has also authorized the marketing of forest carbon credits from both state-owned and private forests as part of an incentive programme combining forest management with climate goals (Cathcart, 2000; State of Oregon, 2004). Forestation projects have been implemented by the utility sector in other states as well (see Box below).

Registry approach. Greenhouse gas registries provide a formal mechanism for entities to record emission reductions and demonstrate their early actions. As part of its Climate Action Registry, California recently adopted industry-specific procedures for forest landowners to report changes in carbon stocks in their managed

forests (see Box on p. 46). A key element is the recognition that preventing forest loss can be as important to climate change as increasing average stocks per unit area – a consideration that is not currently taken into account in the Kyoto Protocol. Georgia's new forest carbon registry is developing standards emphasizing wood products as a reportable sink (Georgia General Assembly, 2004). Pennsylvania, Wisconsin and Maine, in collaboration with the Pinchot Institute for Conservation (see www.pinchot.org), forest landowners and The Nature Conservancy, are examining how to establish registry standards for mixed hardwood stands.

Key dimensions to be considered when incorporating forestry activities in registries include:

- eligible activities (e.g. afforestation, reforestation, use of native versus non-native forest species, preservation of old-growth versus managed younger stands, requirement for permanent easements, treatment of wood products);
- requirements for measuring and monitoring;
- methods and standards for setting baselines and estimating leakage.

Carbon and conservation in the Mississippi bottomlands

More than 80 percent of the forests in the Mississippi River Valley, which once stretched over 26 million acres (10.5 million hectares), have been lost to agriculture and development. Funding to restore portions of the ecologically diverse alluvial forests has always been meagre – until emission offsets became important to electricity producers. Concerned about potential future climate-related regulations, major utilities began working with land trusts and federal agencies in the mid-1990s. Now more than 65 000 acres (26 300 ha) have been reforested in the region (Cusick, 2005). Utilities pay for tree plantings under the guidance of ecosystem specialists and retain rights to additional sequestered carbon. Such projects can offer significant environmental benefits to fish, wildlife and watersheds as well as carbon.

Some examples (Pew Center on Global Climate Change, 2005b):

- American Electric Power, working with the Conservation Fund and DOE's Climate Challenge Program, has planted nearly 22 000 acres (8 900 ha) with 19 million mixed hardwood and conifer trees at a cost of approximately US\$5.7 million. Projected CO₂ sequestration is 4.7 million tonnes. Emissions and offsets are reported in DOE's voluntary reporting registry (US DOE, Energy Information Administration, 2005).
- Entergy, in partnership with the Trust for Public Land and the United States Fish and Wildlife Service, is helping to purchase 2 900 acres (1 175 ha) of land adjacent to the Tensas River Wildlife Refuge in Louisiana for restoration and management as a wildlife refuge. This will sequester an estimated 800 000 tonnes of CO₂ over the next 70 years (Trust for Public Land, 2005).
- Cinergy has funded the purchase of trees for a 300-acre (121 ha) reforestation project being managed by the Nature Conservancy in Indiana. The project will sequester approximately 75 000 tonnes of carbon dioxide annually.

Regional efforts and carbon credit exchange

As states gain experience, linkages are developing across state boundaries. Oregon, Washington and California are sharing efforts to harmonize climate programmes through the West Coast Governors' Global Warming Initiative (see www.ef.org/westcoastclimate) and the West Coast Regional Carbon Sequ-

stration Partnership (see www.westcarb.org). Joint efforts include research to improve forest and fire carbon accounting. In the east, New York, New England and mid-Atlantic states have formed the Regional Greenhouse Gas Initiative (RGGI, see www.rggi.org) to develop a regional cap-and-trade system for greenhouse gas credits and an emission trading market. Further linkages between West

Coast states and RGGI, now under discussion, could bring together the ingredients for a bi-coastal offset market, possibly allowing forest offsets to meet some portion of an emission reduction obligation.

The Chicago Climate Exchange provides an existing mechanism for conducting trade in greenhouse gas reductions (see www.chicagoclimatex.com). The currency is the Carbon Financial Instrument (CFI); 1 CFI is equal to 100 tonnes of CO₂. Forest carbon credits from changes in above-ground biomass and forestry offset projects are eligible for reporting and trading. Trading volume is low because of the lack of caps and a United States market, but the system is a practical demonstration for investors of the mechanics and potential for carbon trading.

California forest protocols

The recently adopted reporting standards of the California Climate Action Registry (see www.climateregistry.org) address in a pragmatic way the key issues raised in international forest discussions, including additionality, baseline, pools reported, permanence and leakage. Key elements are the following.

- Managed forests, not just forests set aside for protection, are eligible for reporting.
- Reporting is limited to activities using native forest species and natural forest management.
- Additionality above a business-as-usual baseline must be demonstrated in order to generate carbon credits.
- "Business as usual" is defined as management that complies with all state forest practice and resource laws, which are highly prescriptive.
- Entity-wide reporting of biological and non-biological emissions is required to avoid selective reporting of only the most favourable projects with a positive sequestration balance.
- Required carbon pools for reporting are tree biomass, standing dead biomass and lying deadwood. Optional pools are herbaceous understorey, soil, litter and wood products.
- Permanence is addressed by requiring a permanent conservation easement preventing forest land development for sequestration projects.
- The reporting standards are stringent and third-party certified, and the state pledges to stand behind the validity of the reductions should future regulations or carbon markets emerge.



A TUTTLE

ISSUES IN PROJECT APPROACHES TO MITIGATION AND REGISTRIES

Given the significant reliance on voluntary greenhouse gas reductions in the United States, many entities have invested in the analysis of technical and policy issues surrounding emission offsets. Key issues include baseline setting; establishing additionality of greenhouse gas benefits beyond business as usual; leakage; permanence; and measurement, monitoring and verification methodologies and precision (see Table for a perspective on three of these issues based on a recent EPA analysis). Addressing these issues will be a major challenge in the United States for the coming years, as newly emerging programmes issue guidance, receive their first few years of mitigation reports and assess if they have found a reasonable balance between rigour and participation rates. Other than DOE's 1605(b) voluntary emission reporting programme, other programmes have relatively little experience with reporting. The challenge is to develop guidance that allows credible, transparent and quantifiable reporting that is relatively consistent across entities and mitigation activities, yet is not

Overview of major implementation issues for forestry activities and projects

Mitigation activity	Leakage potential and estimates ^a	Baseline setting feasibility	Reversal risk of greenhouse gas benefits (permanence)
Afforestation	Moderate USA average: 28% Range for 11 regions: 18–42%	Credible baseline likely, as adequate spatial and temporal resolution data largely available Involves observable land-use change	Moderate, if timber or land prices change or major natural disturbances occur (fire, pests)
Forest management	Likely via reduced afforestation No estimates available	Difficult to observe practices via remote sensing Includes many practices by forest type	Moderate, if timber or land prices change or major natural disturbances occur (fire, pests)
Protection (avoided deforestation)	Moderate–high If harvesting, 9–92% If no harvesting, 8–73%	Likely to require baseline deforestation rates by forest type and region, projected into future Involves observable land use change	Low if there is legal protection and it is enforced High in the case of susceptibility to wildfire, uncertain legal status, major commodity price changes, etc.

^aLeakage estimated by comparing United States total of all forest and agriculture mitigation activities at a given assumed carbon price to individual mitigation activities (e.g. afforestation).
Source: Adapted from US EPA, 2005b.

so complex and onerous that reporting becomes burdensome and expensive.

IN SUM

Many climate activities are under way throughout the United States so it will be well poised to take advantage of any eventual changes in climate policy and maturing carbon markets in the country and internationally. The United States is building a strong base of research, technology and institutional procedures to reduce and offset greenhouse gases through cost-effective approaches.

Forest carbon sequestration by itself will not reverse global climate change. But with 45 to 60 percent of all terrestrial carbon in the world stored in forests, and one-third of the United States forested, forest mitigation activities are a key tool in the climate toolbox. The capability of forests to remove and store CO₂ from the atmosphere remains an important part of the global carbon balance. The environmental, social and economic benefits from forests provide additional reasons to protect them and enhance their management.

Owing to its complex policy landscape

and market economy, the United States is emerging as a rich source of experimental, activist approaches to evaluating forest climate-change mitigation activities, methodologies and incentives. Its pilot activities to implement and measure mitigation activities at the project, company, state and federal scales are just beginning to provide the data and insights necessary to guide United States decisions by stakeholders at all these levels as carbon markets and policies mature in the years just ahead. ♦



Bibliography

Best, C. & Wayburn, L.A. 2001. *America's private forests: status and stewardship*. Washington, DC, USA, Island Press.

California Air Resources Board. 2005. *Climate change: final rulemaking package for AB 1493 (Pavley)*. Available at: www.arb.ca.gov/cc/cc.htm

Cathcart, J.A. 2000. Carbon sequestration. *Journal of Forestry*, 98(9): 32–37. Available

at: egov.oregon.gov/ODF/PRIVATE_FORESTS/docs/CarbonSequestration.pdf

Chan, M. & Forbes, S. 2005. *Carbon sequestration role in state and local actions*. DOE/NETL-2005/1212. National Energy Technology Laboratory, United States Department of Energy. Available at: www.netl.doe.gov/publications/carbon_seq/slfinal_1.pdf

Cusick, D. 2005. Forest conservation, energy, endangered species and climate change. *River Crossings*, 4(4): 13–14. Available at: www.ux.cerc.cr.usgs.gov/MICRA/River%20Crossings%20144.pdf

FAO. 2001. *Global forest resources assessment 2000 – main report*. FAO Forestry Paper No. 140. Rome.

FAO. 2004. *Climate change and the forest sector: possible national and subnational legislation*, by K. Rosenbaum, D. Schoene & A. Mekouar. FAO Forestry Paper No. 144. Rome. Available at: www.fao.org/docrep/007/y5647e/y5647e00.htm

Georgia General Assembly. 2004. *Georgia Sequestration Registry. SB 356*. Available at: www.legis.state.ga.us/legis/2003_04/sum/sb356.htm

Jenkins, J.C., Chojnacky, D.C., Heath, L.S. & Birdsey, R.A. 2004. *Comprehensive database of diameter-based biomass regressions for North American tree species*. Research Paper NE-319. Newtown Square, Pennsylvania, USA, USDA Forest Service, Northeastern Research Station.

Pew Center on Global Climate Change. 2005a. *What's being done... in the states*. Arlington, Virginia, USA. Internet document: www.pewclimate.org/what_s_being_done/in_the_states/

Pew Center on Global Climate Change. 2005b. *Carbon sequestration and offsets solutions*. Arlington, Virginia, USA. Internet document: www.pewclimate.org/what_s_being_done/in_the_business_community/sequestration.cfm

Smith, J.E., Woodbury, P.B. & Heath, L.S. 2004. Forest carbon sequestration and products storage, and Appendix C-1. In *U.S. Agriculture and Forestry Greenhouse Gas Inventory: 1990–2001. USDA Technical Bulletin*, 197: 80–93, C-1.

- State of Oregon.** 2004. *ORS 526.780—Oregon Revised Standards*. Available at: www.oregonlawyer.com/ors/Statute_Details.cfm?Statute=526.780
- Stein, S.M., McRoberts, R.E., Alig, R.J., Nelson, M.D., Theobald, D.M., Eley, M., Dechter, M. & Carr, M.** 2005. *Forests on the edge: housing development on America's private forests*. Gen. Tech. Rep. PNW-GTR-636. Portland, Oregon, USA, United States Department of Agriculture, Forest Service, Pacific Northwest Research Station.
- Trust for Public Land.** 2005. *2,900 acres added to Tensas River Refuge (LA)*. Available at: www.tpl.org/tier3_cd.cfm?content_item_id=19580&folder_id=211
- United States Department of Agriculture Forest Service (USDA-FS).** 2005. *National Fire Plan*. Internet document: www.fireplan.gov
- United States Department of Energy (US DOE), Energy Information Administration.** 2005. *Voluntary reporting of greenhouse gases 2003*. DOE/EIA-0608(2003). Washington, DC, USA. Available at: www.eia.doe.gov/oiaf/1605/vrrpt
- United States Department of Energy (US DOE), Office of Policy and International Affairs.** 2005. *Enhancing DOE's Voluntary Reporting of Greenhouse Gases (1605(b)) Program*. Washington, DC, USA. Internet document: www.pi.energy.gov/enhancingGHGregistry/index.html
- United States Environmental Protection Agency (US EPA).** 2005a. *Inventory of U.S. greenhouse gas emissions and sinks: 1990–2003*. Final version. EPA 430-R-05-003. Washington, DC, USA. Available at: yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2005.html
- United States Environmental Protection Agency (US EPA).** 2005b. *Greenhouse gas mitigation potential in U.S. forestry and agriculture*. Washington, DC, USA, November 2005. EPA 430-R-05-006. Available at: www.epa.gov/sequestration
- United States Government.** 2003. *Healthy Forests Restoration Act of 2003*. H.R.1904. Washington, DC, USA, Government Printing Office.
- World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD).** 2004. *The Greenhouse Gas Protocol: a corporate accounting and reporting standard*. (Revised edition.) Available at: www.ghgprotocol.org ◆