Forest Carbon Offsets in the United States

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Forests provide numerous ecosystem services that benefit society. One that is in the forefront is the important function of helping to maintain the carbon balance in the earth's atmosphere. Growing trees take carbon dioxide from the atmosphere and convert it to organic carbon through the process known as photosynthesis. While trees can also release carbon dioxide through decomposition and cellular respiration, healthy growing forests usually have net gains in carbon and act as carbon sinks.

Carbon storage of trees is usually measured in carbon dioxide (CO₂) equivalent. Total carbon weight in trees can be computed from dry weight of tree biomass by dividing by 2 as trees are roughly fifty percent carbon based on dry weight. Carbon weight can then be converted into CO₂ weight by multiplying by 3.67, based on the molecular weights of carbon and carbon dioxide.

According to Birdsey (1992), 731 million acres of forest ecosystem in the U.S. stores 192.7 billion metric tons of CO₂ as organic carbon. Of this total, 31 percent is stored in trees, including stems, limbs, leaves, and roots. The other 59 percent is found in the soil of forest ecosystems.

The carbon storage capacity of trees differs by tree species, tree age, geographic location, and management intensity. The annual increase in carbon storage in a well-stocked forest of common commercial tree species in the U.S. varies from 1 to 5 or more metric tons of CO₂ per acre per year. Since carbon storage in trees is proportional to tree biomass weight, traditional silvicultural practices intended to increase volume for wood products are compatible with increasing carbon storage capacity of trees. As such, managed stands will store carbon at a faster rate than slower growing natural stands of the same species (Birdsey, 1992). When trees reach maturity and volume growth slows or stops, additional carbon sequestration no longer occurs.

Because of the effectiveness of forests as carbon sinks, carbon stored in forests is often accepted as offset credits in carbon emission control systems. Today's carbon market in the U.S. is a developing, voluntary market since there is no national, regulatory greenhouse gas reduction scheme. However, many local, state, and regional systems and registries for reducing greenhouse gas emission exist, including the Regional Greenhouse Gas Initiative in several northeastern states, the Department of Energy National Voluntary Reporting of Greenhouse Gases Program (the 1605(b) program), and the California Climate Action Registry. These systems and registries lead to opportunities for carbon credits from forestry carbon offset programs.

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Carbon credits from forestry offset programs can be used in carbon cap and trade schemes to reduce human-caused carbon dioxide emissions from the atmosphere. Forest landowners can gain financially by selling carbon credits to emitters through various voluntary markets, ranging from easements with non-governmental organizations to negotiating directly with carbon dioxide emitters (Ruddell et al. October 2006).

The Chicago Climate Exchange (CCX), which began its GHG trading operations in 2003, is North America's only active, voluntary and legally-binding trading system to reduce emissions of greenhouse gases. CCX members make a voluntary, but legally binding commitment to meet annual GHG emission reduction targets of 6 percent by 2010. Those who reduce below the targets have surplus allowances to sell or bank. Those who emit above the targets comply by purchasing CCX Carbon Financial Instrument® (CFI™) contracts. Demand for credits is supplied by member emitters, while supply is provided by member emitters who have exceeded their required reductions, or by offset providers.

Entities that meet certain CO₂ emission rates can directly join the CCX Greenhouse Gas (GHG) trading system by becoming a member. Individual forest landowners can participate in providing offsets through an aggregator. An aggregator is a CCX-registered entity that pools smaller projects to allow them to be marketed on the exchange. Forestry is one of several types of CCX offset projects.

Within the forestry offset program, there are three main protocols—afforestation, sustainably managed forests, and long lived wood products. Under the afforestation protocol, land must have been planted after 2002 and in a non-forest use for the previous ten years. Landowners must also maintain a commitment to keeping the land in forest for at least 15 years from the date the lands are enrolled in the protocol. Carbon credits are awarded based on annual increases in carbon stocks as determined by CCX carbon accumulation tables or by direct measurement. Trees may not be cut during the 15-year period. There are other terms and conditions that landowners need to consider.

Under the protocol for sustainably managed forests, forest owners must provide evidence of sustainable forest management through a system such as the Sustainable Forestry Initiative, including the American Tree Farm System, the Forest Stewardship Council, or through other programs approved by CCX. Forests do not need to be afforested from non-forest lands under this protocol. Owners must make a 15-year commitment of sustainable management and sign a letter of intent to do so. Since this protocol is for managed forests, owners must provide documentation of net increases in carbon storage. A baseline of carbon storage must be established in order to measure or model annual net increases.

Under the long lived wood products protocol, net carbon increases are determined by percentage of carbon remaining in wood products in use and landfills at the end of 100 years. All claimed carbon storage in the long lived wood products protocol must be produced from sustainably managed forests as evidenced by certification schemes approved by CCX. Participants must report harvest quantity and percentages in the

categories of softwood sawtimber, softwood pulpwood, hardwood sawtimber, and hardwood pulpwood. Using Department of Energy technical guidelines, CCX has developed factors that convert volume of wood harvested in each category to the quantity of carbon in use and in landfills at the end of 100 years.

The three forestry offset protocols were established to encourage carbon sequestration through three different means. The afforestation protocol is to stimulate the expansion of future forested land base, the sustainably managed forests protocol is to promote the sustainable management of current and future forests, and the long lived wood products protocol is to encourage the longevity of carbon storage in wood products. The three forestry offset protocols can work in tandem to maximize carbon storage in forests and wood products. Figure 1 shows an example of the shares of CO₂ stored in forest and long lived wood products during a rotation of a loblolly pine plantation established from a pastureland, based on the three CCX protocols.

All aggregated pools must obtain verification by a third-party, CCX-approved independent verifier. Verifiers ensure that project protocols are properly followed and that the appropriate volumes of carbon dioxide are being recorded. All offset projects are subject to an initial verification and subsequent annual verifications.

References

Richard A. Birdsey, 1992, Carbon Storage and Accumulation in United States Forest Ecosystems. United States Department of Agriculture Forest Service. Northeastern Forest Experiment Station, Radnor, PA General Technical Report W0-59 August 1992.

Ruddell, S., M.J. Walsh, and M.Kanakasabai. 2006. Forest Carbon Trading and Marketing in the United States. North Carolina Division of the Society of American Foresters.

Figure 1. Carbon Credits from a Loblolly Pine Plantation in East Texas by Protocol

Note: This figure represents carbon in CO2 equivalent from simulated growth of one acre of loblolly plantation, site index 60 (year 25).