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Forests, Carbon, and Global Climate Change

Carbon Sequestration

Forestry carbon offsets offer an innovative mechanism to stimulate the forestation of thousands of acres of underproducing forestland. In 1999, Oregon's Forest Resource Trust received $1.5 million from the Klamath Cogeneration Project, a natural gas–fired electricity and steam generation plant, for the forestation of 2,400 acres of underproducing nonindustrial private forests (NIPF). This forestation effort will accrue 1.16 million metric tons of carbon dioxide emission offsets over a 100-year period. To encourage landowners to turn their land into productive forests that sequester carbon, the trust pays the full costs of the forestation. Landowners can use their new forests for any purpose, including timber production, but give up any claim to the carbon offsets. The offsets are passed back to the Klamath project as part of its emission offset portfolio.

By James F. Cathcart

Nonindustrial private forests (NIPF) provide environmental, economic, and social benefits to Oregon. Approximately 166,000 family forest landowners hold between 1 and 5,000 acres of forestland—4.5 million acres (16 percent) of Oregon's forestland. But as in most states, NIPF landowners in Oregon are not managing their lands to full potential. Statewide, more than 775,000 acres of land is considered underproducing: It was once forested or is capable of growing forests but is not currently occupied by a manageable stand of trees or seedlings.

To assist NIPF landowners in the forestation of underproducing lands for timber production, wildlife habitat, water quality, and other purposes, in 1993 Oregon legislators voted unanimously to create the Forest Resource Trust (Oregon Revised Statutes, Title 44, Chapter 526, Sections ORS 526.700–775, available online at http://landru.leg.state.or.us/ors/526.html). The legislation was developed by then–Secretary of State Phil Keisling, based on the recommendations of landowners, forest industry representatives, bankers, environmental interests, and government agencies. The trust won support easily because Oregonians have a long history of investing in their forests, as exemplified by the unprecedented 1949 public bond measure to reforest 224,000 acres of wildfire devastated forestland known as the Tillamook Burn (Oregon Department of Forestry 1997). The trust legislation set the goal of foresting 250,000 acres of underproducing lands by the year 2010—a $150 million investment.

The Forest Resource Trust works as a venture capital arrangement between the Oregon Board of Forestry and NIPF landowners. Landowners are obligated to pay back the cost of forestation only if the forest created with the trust is commercially harvested. Under the trust contract, landowners manage the forest according to an agreed-upon plan that schedules site preparation, tree planting, seedling protection, and competitive release practices necessary for the stand to reach free-to-grow sta-

Photos courtesy of Oregon Department of Forestry

Turning underproducing forestland into healthy stands is the goal of the Forest Resource Trust. Under the program, landowners who have (shown from left to right) abandoned fields of brush, old Christmas tree farms, or marginal cropland can receive financing for the costs of establishing productive forests that sequester carbon.

A Working Example in Oregon

tus. In exchange, the trust pays for up to 100 percent of the cost of forestation and absorbs all losses due to natural catastrophe or any financial impacts under the contract due to increased state or federal regulation. Both the landowner and the trust share the market-related risks of future stumpage prices. For the first 25 years, landowners can exercise a buyout option and pay back the trust at a loan rate of 6.8 percent. There is no obligation to harvest under the trust contract, and if the forest is not cut, the contract sunsets after 200 years. Lands requiring reforestation following timber harvest are not eligible.

In 1995, 21 landowners entered into $514,000 worth of contracts covering 22 trust projects for the forestation of 974 acres of underproducing land in western Oregon. Five years later, 20 of these projects, covering 828 acres, are now approaching free-to-grow status, the threshold where the forestation effort has successfully established a young stand to be managed as a healthy, productive forest.

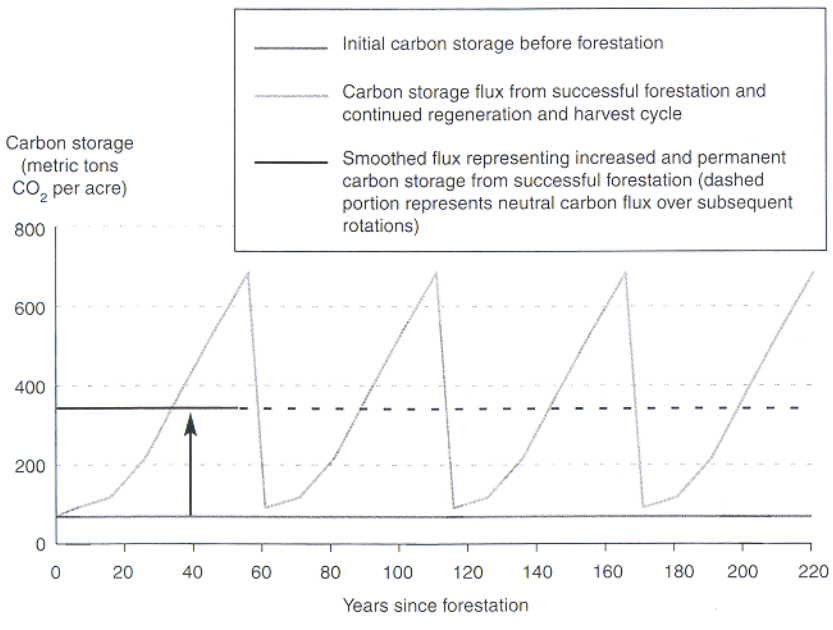
Enter Carbon Monies

However, in 1995 the Oregon legislature also changed course and removed $2.5 million from the trust to fund other spending priorities. Much to their disappointment, 12 landowners seeking to enroll 724 additional acres in the trust went unfunded. The challenge facing the trust was to find a new source of funding—a source more secure and reliable than state appropriations.

PacifiCorp, a utility company based in Portland, had in the early 1990s begun contracting with landowners to provide funds for the forestation of underproducing forestlands in exchange for future carbon dioxide emission offsets. With the establishment of the Forest Resource Trust, PacifiCorp saw the advantage of entering into a single agreement with the Oregon Board of Forestry in exchange for the carbon offsets arising from trust projects with individual landowners. In 1994 PacifiCorp invested $75,000 in the Forest Resource Trust in exchange for an estimated 145,000 metric tons of carbon dioxide emission offsets. This type of carbon investment was inspired by the Forest Resource Trust Advisory Committee's recommendation that a carbon clause be added to the department's implementing administrative rules (Boutard 1994; Oregon State Board of Forestry 1994):

> In consideration of the benefits received under the contract, the landowner acknowledges that the Board of Forestry retains ownership of and is the exclusive agent for marketing carbon offsets that result from trust fund payments, provided such marketing does not interfere with or affect the harvest and sale of forest products by the landowner (Oregon Administrative Rules, Chapter 629, Division 22, OAR 629-22-700(2)).

In 1999 the trust was revitalized with a $1.5 million investment in carbon dioxide emission offsets from the Klamath Cogeneration Project, a public-private partnership between the City of Klamath Falls and PacifiCorp's nonregulated affiliate, PacifiCorp Power Marketing. The agreement rep-



SOURCE: Adapted from Birdsey (1996), Appendix 3, Table 21.

Figure 1. **Permanent carbon storage from the forestation of underproducing lands managed for timber production over a perpetual even-aged harvest and reforestation cycle.**

resented the largest transfer of funds for a US forestry carbon offset project. This investment was part of a larger $4.5 million carbon dioxide emission offset portfolio required in the site certificate for the natural gas–fired 500-megawatt electrical power and steam cogeneration plant (Carver et al. 1997; Energy Facility Siting Council and City of Klamath Falls 1998).

The $1.5 million investment was initially forecast to produce 1.52 million metric tons of carbon dioxide emission offsets from the forestation of 3,125 acres of underproducing lands (Oregon Office of Energy 1996). The state Department of Forestry revised this forecast to 1.16 million metric tons from 2,400 acres to allow for funding program administration and technical assistance. The 1.16 million metric tons will offset 2.8 percent of the plant's emissions, or 11 percent of the offsets provided through the entire mitigation portfolio.

Qualifications of the Trust

The Forest Resource Trust was accepted as a carbon dioxide emission offset project because the forestation of underproducing lands would produce carbon dioxide emission offsets that are additional, measurable, permanent, reliable, and not subject to leakage.

Additional. The baseline for Forest Resource Trust projects is the condition of the land before forestation. For the most part, the underproducing lands are occupied by pasture, agricultural crops, light to heavy brush, or scattered to dense noncommercial tree cover. Oregon has no law requiring that these lands be converted to healthy, productive forest. Also, federal cost share programs, such as the Forestry Incentives Program and the Stewardship Incentive Program, do not have enough funding to keep pace with landowners' demands for financial assistance. Absent the monies provided through the Forest Resource Trust, these areas would remain underproducing.

Measurable. If a carbon dioxide emission offset cannot be estimated and registered, there is no commodity available for sale, trade, or direct use as mitigation for carbon dioxide emissions. Fortunately, forest inventory procedures are well established, and models allow extrapolation of merchantable board-foot or cubic-foot yield to total biomass expressed in the amount of carbon storage (e.g., Birdsey 1996). Growth-and-yield models that take into account species composition, site quality, management actions, and stand structure provide a basis from which to forecast or estimate the amount of carbon stored as a result of stand development following forestation.

Permanent. Carbon dioxide emission offsets accrued through forestation projects involve the long-term sequestration and storage of carbon in above- and below-ground carbon pools. Depending on the landowner's objectives, the stored carbon can accumulate and span several decades, even centuries. Even if the timber is harvested and some of the stored carbon is released back into the atmosphere through slash decomposition and soil disturbance, not all the carbon gain is lost: carbon storage is further extended when wood is used in the form of solid wood products in home and building construction.

Reliability. Reliability was crucial to the trust's acceptance as a carbon dioxide emission offset program. Through its network of foresters working out of field offices, the Oregon Department of Forestry has the infrastructure to conduct landowner outreach and technical assistance—the one-two combination necessary to get lands enrolled and successfully forested. Foresters can also oversee monitoring efforts that measure the actual amount of carbon stored over time. Centralized staff provides the infrastructure to administer Forest Resource Trust contracts and account and report carbon dioxide emission offsets as they accrue. Risks from losses due to wildfire, insects, and diseases are pooled across several landowners and geographic locations. The Oregon Forest Practices Act, which requires reforestation following any commercial timber harvest, ensures that harvest-related carbon emissions are replaced through the carbon sequestration and storage in the subsequent stand.

No leakage. Leakage would occur if the forestation of underproducing lands triggered the conversion of established forest to nonforest use elsewhere.

There is little potential for leakage in this case because most of the acreage forested under the trust is not being actively used. For example, the conversion of old pasture, abandoned brush, or marginal agricultural land to forest is not taking away from the land base used for producing high-valued range and agriculture crops. However, if forest conversion did cut into that land base, land values for range and cropland could increase, stimulating the loss of forestland to these uses elsewhere. By definition, underproducing lands are not being well utilized and represent an inefficient allocation of land use. Forestation of underproducing lands simply moves these lands toward a more efficient allocation of use and thus does not trigger the loss of forestland elsewhere.

Carbon Accounting

The Forest Resource Trust's $1.5 million from the Klamath Cogeneration Project demonstrates that the forestation of underproducing lands is a credible way to generate carbon dioxide emission offsets. To measure, report, and credit actual carbon benefits, the Forest Resource Trust is adopting a stock-flow approach to carbon accounting, in which the carbon dioxide emission offsets are calculated as the forest grows, but the total amount is limited by the long-term average amount of carbon stored over repeated timber harvest and regeneration cycles.

The cyclical carbon storage and release flow over many rotations can be smoothed to represent an average, constant flow *(fig. 1)*. The amount illustrated represents a permanent net decrease in atmospheric carbon dioxide roughly equal to half the amount of carbon storage accrued during the first rotation minus the amount of carbon initially present before forestation. This amount of carbon storage determines the amount of permanent carbon dioxide emission offsets that can be credited from a given project area.

Figure 2 diagrams the carbon accounting system. The link between the monies invested in the trust and the carbon dioxide emission offsets attributed to those funds is the forestation project area. The carbon offsets credited to the contributed funds are determined by the carbon storage performance of the forest developing on the acres financed under the trust with those monies. As such, the larger the carbon investment in the trust, the greater the pooling of stand risks across many landowners spanning a wide geographic region.

For each forestation project, the first stage is to account for the initial loss of carbon from the site due to the removal of existing vegetation, such as brush or low-valued trees, and any soil disturbance from site preparation. The second stage is to measure actual stand conditions when the stand becomes free-to-grow. The third stage is to project the stand's yield without management activities, such as thinning, and the fourth stage is to convert the stand's yield to total carbon stored at five-year projection increments. This provides an estimate of the stand's ability to store carbon based on its established condition at free-to-grow.

The fifth stage is to monitor the stand's development by conducting a cruise every five years for the first 35 years, perhaps every 10 to 15 years thereafter. The sixth stage is to compare the stand's projected condition with the stand's actual condition (as measured by the cruise) and calculate the actual amount of carbon stored as an adjustment to the projected carbon storage. The effects of midrotation management treatments are accounted for based on how actual stand conditions either exceed or fall below projected, unmanaged conditions.

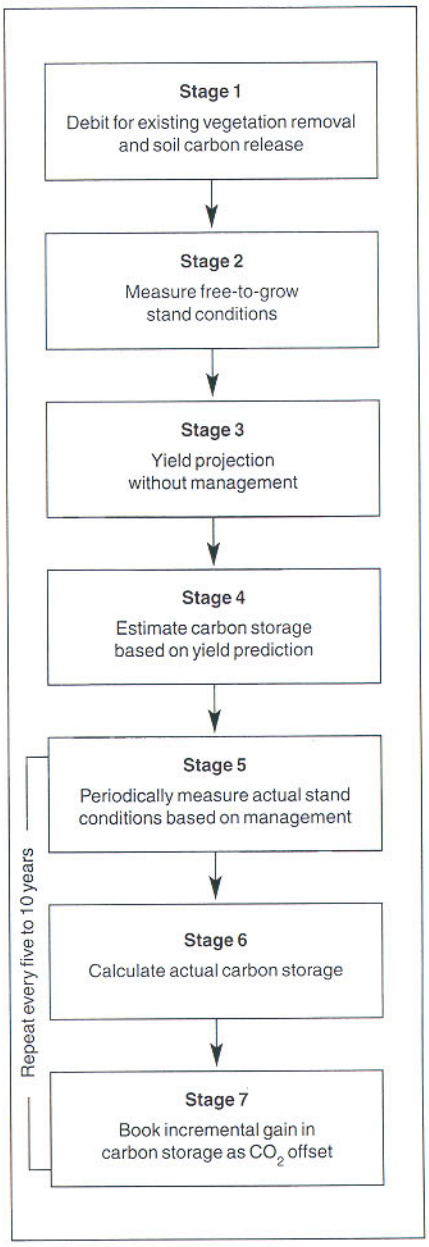


Figure 2. **The carbon accounting system**

Booking the Offset

The biggest challenge is converting what is measured and verified in the carbon account into a tradable paper asset that can be registered and transferred to the carbon investor for sale or trade or, in the case of the Klamath Cogeneration Project monies, retired as a mitigation credit toward greenhouse gas emissions. Specifically, booking carbon dioxide emission offsets raises two interrelated questions:

- When can the offset be measured, booked, and registered for transfer or sale or retired for use as mitigation for emissions? The proposed approach is to book and report the carbon dioxide emission offsets as they accrue in the developing forest stand. The carbon dioxide emission offsets would be reported as incremental gains in carbon storage every time the forest stand is measured (i.e., every five years). New offsets could be booked and reported only if the measurement of forest carbon exceeded the total amount of offsets booked and reported from previous measurements to the extent the cumulative total of booked offsets did not exceed the level of permanent carbon storage.
- What is the responsibility for that

Courtesy of Oregon Department of Forestry

Planted in 1994, 90 acres of young Douglas-fir forest grow in the Willamette Valley of western Oregon. The PacifiCorp Forestry Carbon Offset Project sequesters CO_2 from the atmosphere to offset emissions generated from the burning of fossil fuels.

offset after it is booked and registered? Most stands will be subject to timber harvest at some point, and there is always some risk from wildfire, insects and diseases, and other losses. What if monitoring shows that the carbon stored corresponding to some of the offset has been released into the atmosphere from early timber harvest, a catastrophic loss, or a change in land use? This concern is addressed by including mechanisms that ensure that the booked carbon dioxide emission offset represents permanently stored carbon.

Permanent Carbon Storage

The venture capital requirements of the Forest Resource Trust provide a strong disincentive for the premature harvest of forest stands created under the trust. Specifically, the trust contract requires that if commercial timber harvest occurs, a minimum amount of volume needs to be harvested before the contract is satisfied and the state withdraws its interest in the forest stand or subsequent stands. The minimum, or expected, volume under the contract is set at the clearcut volume corresponding to an economic rotation age of the forest stand: ages 55 and 60 for high and medium sites for Douglas-fir, respectively. The trust uses these ages when determining the minimum amount of permanent carbon storage arising from the forestation of underproducing lands *(fig. 1)*.

The reforestation following timber harvest requirements of the Oregon Forest Practices Act provide assurance that the booked carbon dioxide emission offsets represent permanent storage of carbon. The regeneration and timber harvest cycle following the first-rotation harvest provides a perpetual replacement of the carbon storage released to the atmosphere from the harvest of the first rotation. That is, after the first rotation, the carbon storage flux on these lands is neutral, with regeneration and growth in each subsequent rotation replacing the carbon lost from the harvest of the preceding stand.

Of the total carbon dioxide emission offsets that can be booked and transferred, sold, or retired as mitigation, 20 percent will be retained and registered in the name of the Forest Resource Trust. The retained offsets form an insurance pool that can be drawn on to replace booked offsets that are lost because of early harvest, natural catastrophe, or land-use change to nonforest.

Opportunities for Other States

Recognizing the carbon sequestration benefits of forestry, Senator Ron Wyden (D-OR) and Senator Larry Craig (R-ID) have introduced a carbon and forestry bill in the Senate, the Forest Resources for the Environment and the Economy Act, S 1457.

This act provides startup monies for state forestry agencies to establish a revolving loan fund program for the forestation of underproducing lands. The revolving loan fund program in S 1457 is patterned after the Forest Resource Trust with additional provisions for financing midrotation forestry practices that increase the carbon sequestration and storage ability of forests. In all cases, practices that are additional, measurable, permanent, reliable, and relatively leakproof would be the only practices eligible for loan monies. Much like the Forest Resource Trust, the revolving loan fund programs should attract private sources of carbon offset monies because many states are developing energy plant siting and reporting standards based on overall carbon dioxide emissions (US EPA 2000).

Despite the policy logjam on forestry, land use, and land-use change under the Kyoto Protocol on climate change, consortia of utility companies are actively seeking credible carbon dioxide emission offset projects. The Canadian Greenhouse Emissions Management Consortium (GEMCo 1999), for example, is seeking market advantage by voluntarily offsetting greenhouse gas emissions. At an investment cost of $2 to $10 per metric ton of carbon dioxide emission offsets produced, the forestation of underproducing lands through programs like the Forest Resource Trust is emerging as an attractive market choice as well as a significant new source of capital for improving forest management on NIPF lands.

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