Criterion 5

Maintenance of Forest Contribution to Global Carbon Cycles

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Carbon is a global concern because increasing carbon-containing gases in the atmosphere may lead to climate change. Tracking carbon in forests helps scientists study the global carbon cycle and will verify the results of adopted mitigation measures. The carbon stored in forests and forest products mitigate the amount of carbon released into the atmosphere, which may help delay global climate change.

Inventory of Carbon in Forest Ecosystems

Growing forests naturally store carbon. Forest ecosystems store carbon in vegetation, the forest floor, and soil. The carbon cycle in forest ecosystems includes carbon fixation through photosynthesis and carbon emissions through respiration, the decay of organic matter, and combustion due to fire. The age and vigor of forest vegetation affects the rate of carbon sequestration in a forest ecosystem and the overall inventory of stored carbon. Trees represent the most dynamic component of this carbon pool (figure 24).

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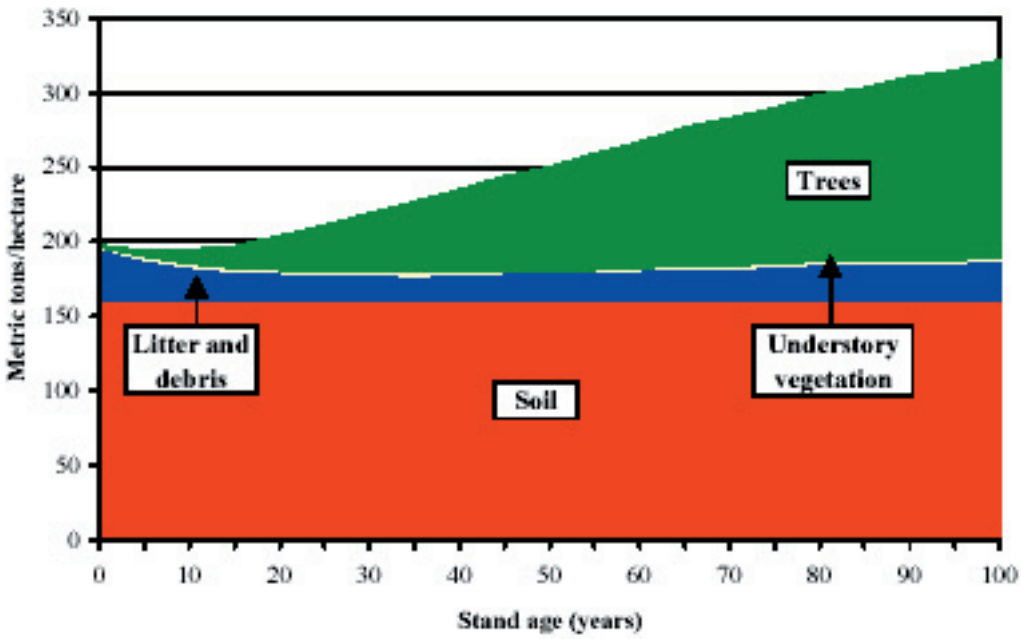

Figure 24. **Estimated forest carbon stores in a maple-beech-birch forest type in the Northern United States** (on fully stocked timberland under average management after final clearcut harvest) (Data from Birdsey 1996).

Northern U.S. forests, biomass of standing large trees is 2,920 million tons, biomass in stumps and roots is 1,166 million tons, and biomass in saplings is 1,074 million tons (McWilliams and others 2000). Trees are generally about 50 percent carbon. Overall, only about 41 percent of the standing tree biomass in the Northern United States is in the main stem of merchantable live trees (trees greater than 12.5 cm diameter at breast height) (figure 25).

- Eighty percent of the standing tree biomass in the Northern United States is comprised of hardwood species.

- The largest proportion of the total carbon inventory in Northern U.S. forests is found in the soil. In 1992, the soil carbon and litter layer component of Northern U.S. forests was approximately 63 percent of the total forest carbon pool.

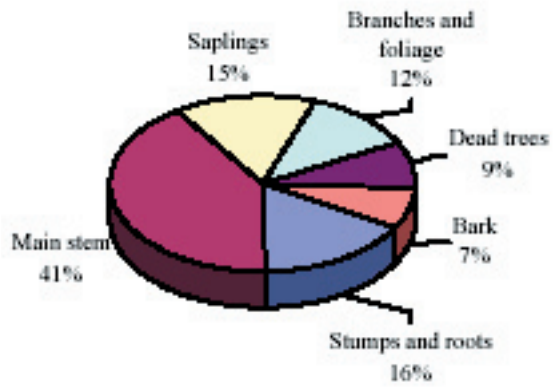

Figure 25. **Estimated distribution of biomass for trees in Northern U.S. forests, 1997** (McWilliams and others 2000).

Changes in Forest Carbon Inventory

Changes in forest carbon inventory in the Northern United States are affected by the rates of forest growth, harvest activity, loss of forest land due to conversion to other land uses, and loss of forest cover due to fire or other natural disturbances. In the absence of harvesting or other disturbance, carbon inventories in forests change relatively slowly and are difficult to measure over a short period of time.

- The carbon inventory in Northern U.S. forests is higher than in forests of any other region of the United States (figure 26). The carbon inventory was 13.4 billion metric tons in 1992 and is projected to increase to 17.6 billion metric tons by 2040. An underlying factor is that Northern U.S. forests are not harvested as heavily compared to growth as forests in the South and West.

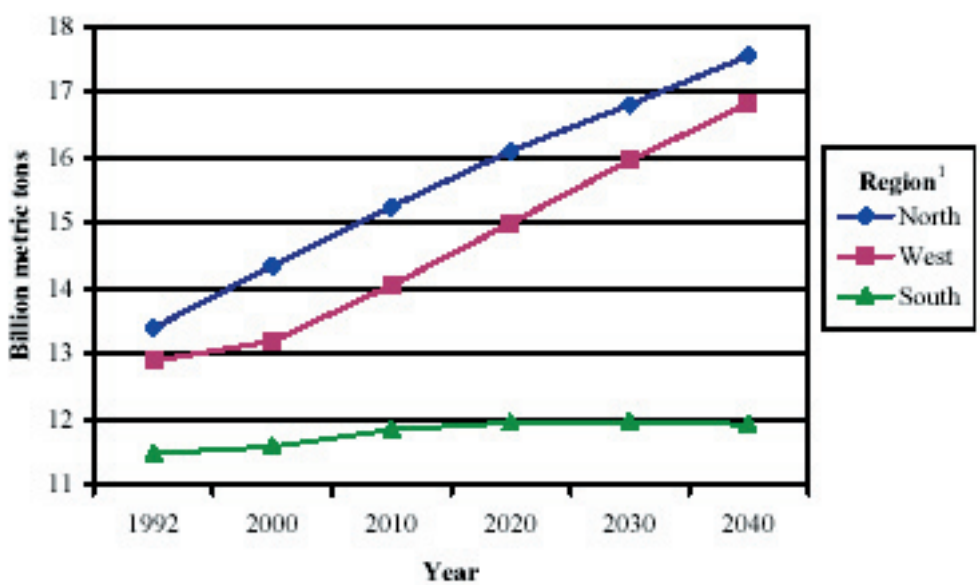

Figure 26. **Forest carbon inventory projections by regions of the conterminous United States** (Birdsey and Heath 1995).

[1]North–Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin

West–Alaska, Arizona, California, Colorado, Hawaii, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming

South–Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia

Carbon in Wood Products

Carbon from forests can remain stored in wood products long after forests are harvested.

- While forest harvesting will decrease the carbon inventory on the harvested site, the overall effect on the total amount of stored carbon will depend on the ultimate use of the harvested wood.
- Harvested carbon can be tracked in four general categories: wood products, landfills, wood burned for energy as a substitute for fossil fuel, and carbon emitted from wood that is not used as an energy source (figure 27).

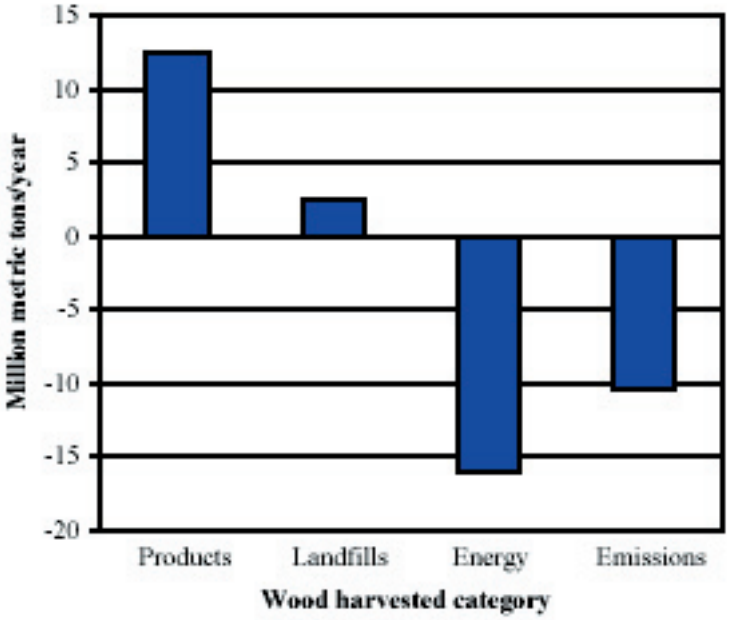

Figure 27. **Estimated average annual carbon change in harvested wood from Northern forests by category, 1980-1990.** Negative carbon change indicates release of carbon into the atmosphere (Heath and others 1996).

- The temporal dynamics of carbon stored in managed compared with unmanaged forest stands makes it difficult to provide advice for maximizing carbon storage for the Northern United States as a whole.