MEMO

To: Agriculture and Forestry Working Group, Maine Climate Change Process
From: Environment Northeast and Maine Forest Service
Date: May 6, 2004 DRAFT
RE: Carbon Sequestration in Forests

This memo lays out a series of policy recommendations that Maine Forest Service (MFS) and Environment Northeast (ENE) propose the AFWG consider to recommend to the stakeholders. This memo proposes four approaches to promote opportunities for increased carbon sequestration in and reduced carbon emissions from forests:

1. Recommendations on specific kinds of forest harvesting practices most likely to advance the goal of carbon sequestration.
2. Expansion of Maine's efforts to develop markets for small and low value trees with end products that replace materials with higher embodied energy or displace fossil fuels.
3. A research program to examine how Maine's forest could be managed to maximize carbon sequestration and develop markets for offsets from terrestrial carbon sinks.
4. An assessment of the potential for durable wood products to retain carbon, displace other construction materials and provide additional sources of revenue for Maine landowners.

The memo further recommends four high priority inputs to model that are consistent with the policy recommendations in the memo:

1. Early commercial thinning
2. More regular, lighter harvesting
3. Increased stocking on understocked forest lands
4. Active management to maintain and increase the softwood component of forest stands.

1. Carbon Sequestration in Maine Forests

Goal

Carbon sequestration activities in Maine forests should increase terrestrial storage, reduce releases of carbon through improved timber harvesting practices, and strengthen forest conservation efforts.

Description

Environment Northeast and Maine Forest Service
Forest Carbon Sequestration Approaches in Maine

Carbon is removed from the atmosphere by the growth of plants. A portion of this carbon is stored within vegetation and soils. On undisturbed lands, the total amount of stored carbon increases over time until the mature forest naturally releases about the same amount of carbon through mortality and decay captured through photosynthesis each year. According to statistics compiled by Dr. Richard Birdsey of the USDA Forest Service, forests in the northeastern United States typically continue to increase the amount of carbon stored in vegetation and soils for at least 120 years. Today, the MFS estimates that about 1.4 Billion Metric Tons of Carbon Dioxide Equivalent are currently stored above ground in vegetation, which is equivalent to more than ____ years of the state's carbon emissions. Maine's forested landscape removes about ___ MMTCE/year (equivalent to about __ % of current carbon emissions) from the atmosphere. Land conversion releases about __ MMTCE/year; timber harvesting releases about ___ MMTCE/year.

A wide range of changes in land and forest management practices could potentially reduce or avoid carbon releases, increase the annual volume of carbon removed from the atmosphere by Maine's landscape and thus increase the amount of carbon storage, or sinks. Increasing such carbon sinks beyond business as usual levels presents an important bridge opportunity to remove carbon from the atmosphere at relatively low cost, while technology evolution lowers the costs of reducing carbon emissions in other sectors.

Well-designed carbon sequestration programs can generate other significant environmental benefits. Conserving, restoring and sustainably managing forest lands protects water quality, fish and wildlife habitat, and can conserve native forests. This is especially important, as climate change must be addressed in the context of the entire range of threats facing our environment. Many species and habitats, already at risk from other pressures, likely will be pushed beyond their natural ability to adapt by the pace of climate change. It is vital that measures taken to reduce greenhouse gas emissions should complement and enhance other environmental priorities. Furthermore, as carbon sequestration involves the enhancement or restoration of an important ecological function, it is a conservation issue in a fundamental sense; not just in an ancillary or collateral sense.

A. Forest Management Strategies to Sequester Carbon

The following forest management practices are likely to produce the most effective carbon impacts and should be included in any modeling:

1. Encourage light to moderate timber harvests that capture anticipated mortality (material likely to die and decompose between harvests at longer intervals). Maintain a largely intact forest canopy and encourage vigorous growth to sequester carbon. In younger stands, harvests should remove suppressed trees or trees losing their competitive position in the canopy; while in older stands, harvesting can involve removing dominant, but decadent, trees.

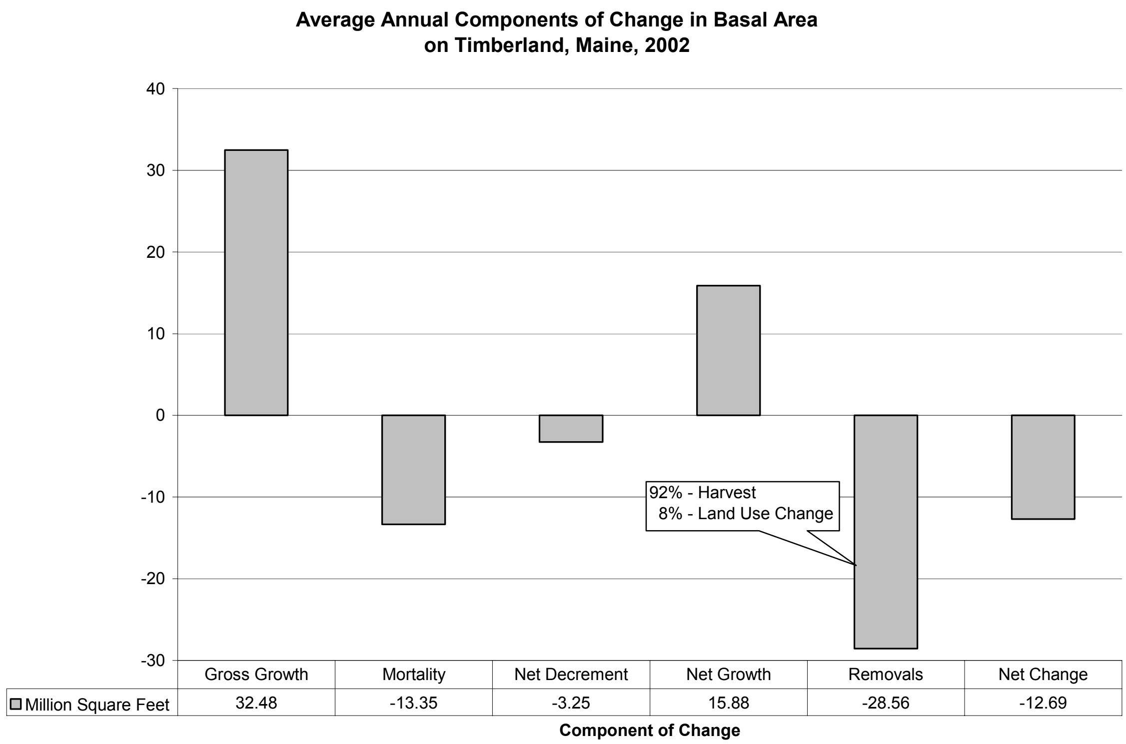
   This approach to forest management can have several benefits. It can:

i) reduce forest emissions;

ii) increase growth rates of and sequestration by residual trees; and,

iii) provide material to substitute for nonrenewable alternatives, thus avoiding the emissions needed to produce them while sequestering carbon at the same time.

The figure that follows shows the relative magnitude of growth, harvest, and mortality in Maine's forests. However, it does not include size classes too small to be considered merchantable



Source: Components of Change Estimates for Growing Stock, Maine Forest Service, 2002

The thinnings and partial harvests not only could remove material that would otherwise die and decompose, but would also retain vigorous trees to continue sequestering carbon, and enhance their growth by freeing them from competition (not by keeping a closed canopy in the immediate post-harvest stand).

These carbon-enhancing harvests should focus on mature stands as well as stands that are, regardless of age, stagnated due to overstocking. Light to moderate harvests, in addition to stimulating growth of a residual stand, maintain soil and litter storage of carbon. Light to moderate harvests are also conducive to production of wood products suitable for durable uses when crop trees are mature (e.g., high quality saw and veneer logs for furniture and building materials). To maximize the benefit achieved, such efforts should favor the most productive sites. In addition to economic incentives, encouraging such harvests may involve educational programs for landowners, and potentially the certification of loggers trained and committed to undertaking timber harvests that minimize the impacts of harvests on other forest values (e.g., aesthetics, wildlife, habitat, etc.). The Master Logger Certification Program offers a model for such efforts.

Documenting the additional carbon sequestered from these efforts likely will prove challenging, as it involves assumptions about what harvests would normally have taken place to secure a given volume of wood and how these harvests would have affected carbon storage and carbon releases at multiple levels within the stand. In addition, the literature is far from clear and unanimous in predicting the magnitude of increased carbon storage from these management techniques. These uncertainties could be reduced with further work.

2. Regenerate stands promptly after harvests. As part of this effort, foster development of advanced regeneration of commercially desirable species to speed recovery of harvested sites.

3. Encourage early commercial thinning; keep young stands growing vigorously by early commercial thinning entries; and, if possible, develop markets for the wood from these thinnings so that they become profitable.

4. Favor management for longer-lived species (red oak, white pine, red spruce, hemlock, cedar), as they sequester more carbon than other types of stands (e.g., in thinning or selective harvests, retain these species in the residual stand, and use harvest methods which favor regeneration of these species.[1]

5. Increase the average stocking on actively managed lands to increase carbon storage.

6. Increase stocking of understocked stands – favor commercially desirable species used for durable wood products. While there is not a large acreage of poorly stocked stands, better stocking, particularly in crop trees, would increase carbon sequestration.

7. Continue to monitor Maine's successful efforts to minimize soil erosion on timber harvesting operations.

2. Expanding Markets for Small and Low Value Trees

The kind of carbon friendly timber harvesting outlined above will at least be facilitated by the development of expanded markets for small and low value trees; and, in the absence of payments for enhanced carbon sequestration, may be completely dependent upon them. Maine and the other three Northern Forest states already are working to expand such markets. The Advanced Engineered Wood Composite Center at the

[1]This concept needs additional research, as the literature did not make clear whether the higher carbon levels in these species resulted from higher volumes per acre or from higher carbon content per cubic foot of wood. Both factors may be involved.

University of Maine in Orono is a world-class research and testing facility aimed at finding new uses for low value wood. The River Valley Development Council is working to build a commercial pyrolysis plant that will convert low value wood and residues into bio-oil and ultimately high value chemicals and hydrogen. MFS has one staff member working to expand markets for small and low value trees. The North East State Foresters Association, made up of the State Foresters of New Hampshire, New York, Maine, and Vermont, is currently engaged in a project aimed at identifying the most promising prospects for increasing the use of such material and developing two business plans within each state for how the use of such materials could be expanded. But more is needed to provide incentives for the low impact, carbon friendly forestry involved in light, frequent harvests. The focus is to capture for productive use trees that would otherwise die and decompose in the forest and will free residual trees to grow vigorously. Such markets could include using small and low value trees in the manufacture of durable wood products and the displacement of fossil fuels. To positively impact atmospheric GHG levels, biomass fuels should be derived from waste materials that cannot be used for durable wood products (i.e., would otherwise be landfilled) or is derived from trees that would otherwise die and decompose in the forest.

3. Support a Research Study to Examine the Potential for Carbon Sequestration and Reducing Carbon Emissions for Maine's Forests and the Role that Carbon Offset Markets Could Play in Achieving These Ends

The MFS and ENE have proposed to undertake a project to assess:

- The potential to sequester more carbon in Maine's forest stands by increasing stocking;
- The potential to reduce CO_2 emissions from Maine's forests by removing material that would normally die and decompose during stand development;
- The potential to reduce CO_2 losses from forest soils where hardwoods have replaced softwoods;
- How these practices would affect other forest values (e.g., site productivity and wildlife habitat);
- How the issues of additionality and leakage might be addressed within the context of carbon offset projects in Maine.
- What levels of financial incentives would be necessary to achieve all or part of these potentials;
- What prices in carbon offset markets would be needed to provide the necessary financial incentives to achieve the full potential of Maine's forests to sequester carbon.

In preparation for this effort, MFS has conducted a reconnaissance level analysis to assess the order of magnitude and financial incentives likely to be needed to accomplish the objectives of sequestering more carbon in Maine, retaining soil carbon stores, and reducing CO_2 emissions from Maine forest stands. The results of this preliminary analysis indicate that tens of millions of tons of added storage and emissions reductions are likely to be possible at levels carbon markets are likely to reach in the foreseeable future. For example, the price estimates for increasing carbon stored in merchantable trees were developed by calculating the net present value of wood involved with increased stocking levels and assuming that landowners will be indifferent if the financial rewards they could achieve by either harvesting wood or leaving it on the stump to store carbon are essentially equal. Similar calculations have been done for thinnings not normally conducted on Maine's forest lands, and site conversion to reestablish softwood sites.

Based on growing interest and activities, it appears that carbon markets have the potential to reach at least the lower boundaries of the levels needed to support these activities in the near future. In conjunction with a fuel reduction project already funded by the USDA Forest Service, and by working with representatives of the scientific community to insure that the results are based on the best science available, the assessment should:

- Explore the options identified above for carbon sequestration and emissions reductions based upon the scientific record and expert opinion, and refine the preliminary estimates of storage and emission reductions referred to earlier;
- Assess how forest landowners would respond to different levels of incentives for changes in forest management. This would include the results of an opinion survey conducted as part of the project;
- Evaluate potential synergies between carbon sequestration and fuel reduction projects supported by the National Fire Plan in wildland urban interface areas;
- Make recommendations to address the issues of additionality and leakage in forest management carbon offset projects, and how the approaches taken in forest management projects compare with those in agriculture or other offset projects;
- Estimate the prices for carbon offsets needed to change various aspects of forest management in Maine and reduce atmospheric greenhouse gas levels.

4. Durable Wood Products

The substitution of durable wood products for other materials is potentially beneficial because of the carbon that wooden building materials sequester and for the energy use they avoid. For example, steel, aluminum, plastic, bricks, and concrete have high-energy requirements by comparison with wood. The embodied energy, or the amount of energy used to produce a given material, varies from product to product. The following are estimates of embodied energy for typical building materials:

- Simple sawed wood product: 3 Giga Joules per Mega gram (GJ Mg -1)
- Plywood: 14 GJ Mg -1
- Steel: 20-25 GJ Mg -1
- Plastic: 60-80 GJ Mg -1
- Aluminum: 190 GJ Mg -1

Most energy used in the manufacture of these materials comes from sources that emit significant greenhouse gases. Unless materials are produced using energy from clean renewable or non-fossil sources, products with lower embodied energy are responsible for lower greenhouse gas emissions.

In addition, durable wood products, which are used for furniture or construction and are in use for decades or more, sequester carbon as they sit in a home or office building. We recommend that this information be included in an education campaign about climate change, and what consumers can do to minimize their impacts. Voluntary programs should encourage individual and business consumers to consider sustainable certified wood products when buying furniture, building homes, and other structures. In addition, the state in its procurement process should lead by example and maximize its purchase of wood products. To ensure that increased use of timber results in a benefit to the environment, wood products should be certified as originating from well-managed forest lands.

Increased use of locally grown and manufactured durable wood products could also be a benefit to Maine's forest products industry and thereby help prevent the conversion of timberland into commercial or residential use.

5. Recommendations on Forest Management Options

In response to the memo dated April 22, 2004 from Jack Kartez and Tom Peterson, MFS and ENE propose the following priorities for forest management options. Reference is made to the variables outlined in the Kartez/Peterson memo: type of action; forest type; landownership type; levels and timing; and type of biomass use.

1. Early Commercial Thinning (ECT)

Apply to all forest types and all landowner classes. Over the next 5 years, treat 50% of the 400,000 acres estimated to be available for ECT. Treat an additional 50% of a new subset of 400,000 acres over the subsequent 5-year period. Estimated Forest Product Output: 20% durable wood products; 60% pulp/OSB ("oriented strand board"), and 20% biomass energy.

2. More regular, lighter harvesting

Apply to all forest types and all landowner classes. Goal: capture 50% of current decay on forest floors within 10 years. This would yield approximately 2 cubic feet of wood per acre per year. Estimated Forest Product Output: 45% sawlogs; 48% pulpwood and 7% biomass chips (the average mix of the reported harvest of forest products over the past 7 years).

3. Increased Stocking

This measure focuses on increasing overall stand stocking, by management practices that promote current Poorly Stocked Stands (10% - 34% stocked) into Moderately Stocked Class Stands (35% - 64% stocked).

Goal: Manage and promote 25,000 acres per year from the Poorly Stocked Class to Moderately Stocked Class over the next 10 years (250,000 acres in total). Apply to all forest type groups, focusing on desirable species, and available to all landowner classes.

4. Active management to maintain and increase the softwood component of forest stands

Two million acres of spruce-fir forests, predominately located in northern Maine, transitioned from a softwood forest type to a hardwood forest type as a combined result of the spruce budworm epidemic in the 1970's and 1980's and subsequent salvage harvesting. Softwood Forest types have soil carbon sequestration rates significantly higher than for hardwood forests (for example, the Spruce-Fir forest type group has an associated value of 193 tons of organic carbon tons/hectare, compared to an associated value of 140 for the maple/beech/birch forest type group). Implementing a structured conversion process back to an assignment as a softwood forest type will increase the soil sequestration values of a substantial portion of Maine timberlands.

Goal: transition 85% of 2 million acres currently classified as a hardwood forest type to a softwood forest type by 2020.

Contact Information

- Maine Forest Service
    - Alec Giffen
      Alec.giffen@maine.gov
      207-287-2791
- Environment Northeast
    - Dan Sosland
      dsosland@env-ne.org
      (207) 236-6470