Carbon Sequestration and Its Impacts on Forest Management in the Northeast
Developed for the North East *State* Foresters Association
December 19, 2002

Disclaimer: This is not a position paper. It is intended to provide a factual basis for interested people in the NEFA region to discuss the carbon sequestration issue.

Issues

Discussions about forests and their relevance to the carbon sequestration issue are in their infancy. Definitions are varied, standards are not yet set, science is incomplete, and much deliberation ensues about fundamental components of the issue. As a result, the current debates are highly politicized and it is not even clear forum issues are to be worked on. Some debates are happening at the state legislative level, others within the Congress, while others still occur in international settings. Until some of the fundamental definitions and standards are set, there will be substantial politics associated with this issue. This paper attempts to separate current conjecture with fact, thereby allowing the reader to understand how best to begin discussions on the subject.

NEFA's Interest in Carbon Sequestration

NEFA is most interested in encouraging better stewardship of the forests of Maine, New Hampshire, Vermont and New York. In that regard, the interest in carbon sequestration is focused on the role forests might play in the sequestering of carbon through forest management activities. Providing information to landowners and policy makers about which forest management activities sequester the most carbon is an important service to the landowners and society.

NEFA will continue to keep current on the rapidly evolving carbon sequestration field in order to play this important role.

Introduction

As increases in greenhouse gasses in the atmosphere contribute to concerns over climate change, interest in the role of forests in the global carbon cycle is growing as a public policy issue. Human-caused increases in carbon dioxide emissions, primarily as a result of combustion of fossil fuels, are considered by many to be a leading cause of the buildup of greenhouse gasses (including but not limited to carbon dioxide) in the atmosphere. Greenhouse gasses are believed to warm the atmosphere by allowing sunlight to reach the surface of the earth, but preventing some heat from escaping the earth's atmosphere, acting in effect as an insulating blanket. According to scientific literature, there is a consensus that under existing policy scenarios global mean temperature will increase by 1ºC by the year 2025 and 3ºC by the year 2100.

The purpose of this paper is not to review the possible causes or impacts of climate change, but rather to explore possibilities for forest managers in the Northeastern states (particularly New York, Vermont, New Hampshire and Maine) to participate in carbon

mitigation measures – namely carbon sequestration through forest management. By increasing inventories of "trapped carbon", carbon removed from the atmosphere and not released again, forest managers may be able to help buffer the effects of carbon emissions elsewhere (e.g., carbon dioxide emissions from utilities or transportation). Through this activity, some speculate that forest managers may be able to receive financial benefit -- in effect selling another product off of their land -- and thus increasing the economic viability of sustainable forest management in the region.

This paper reviews current knowledge regarding carbon sequestration through forest management, and explores the possibility that forest landowners and forest managers may be able to benefit financially from such activities. As this is an emerging area of public policy, the knowledge and "rules of the game" are evolving rapidly, and there may be significant opportunities to influence how forests are viewed and used as carbon sinks. Whenever possible, information specific to the Northeast or the NEFA states (NY, VT, NH and ME) is presented.

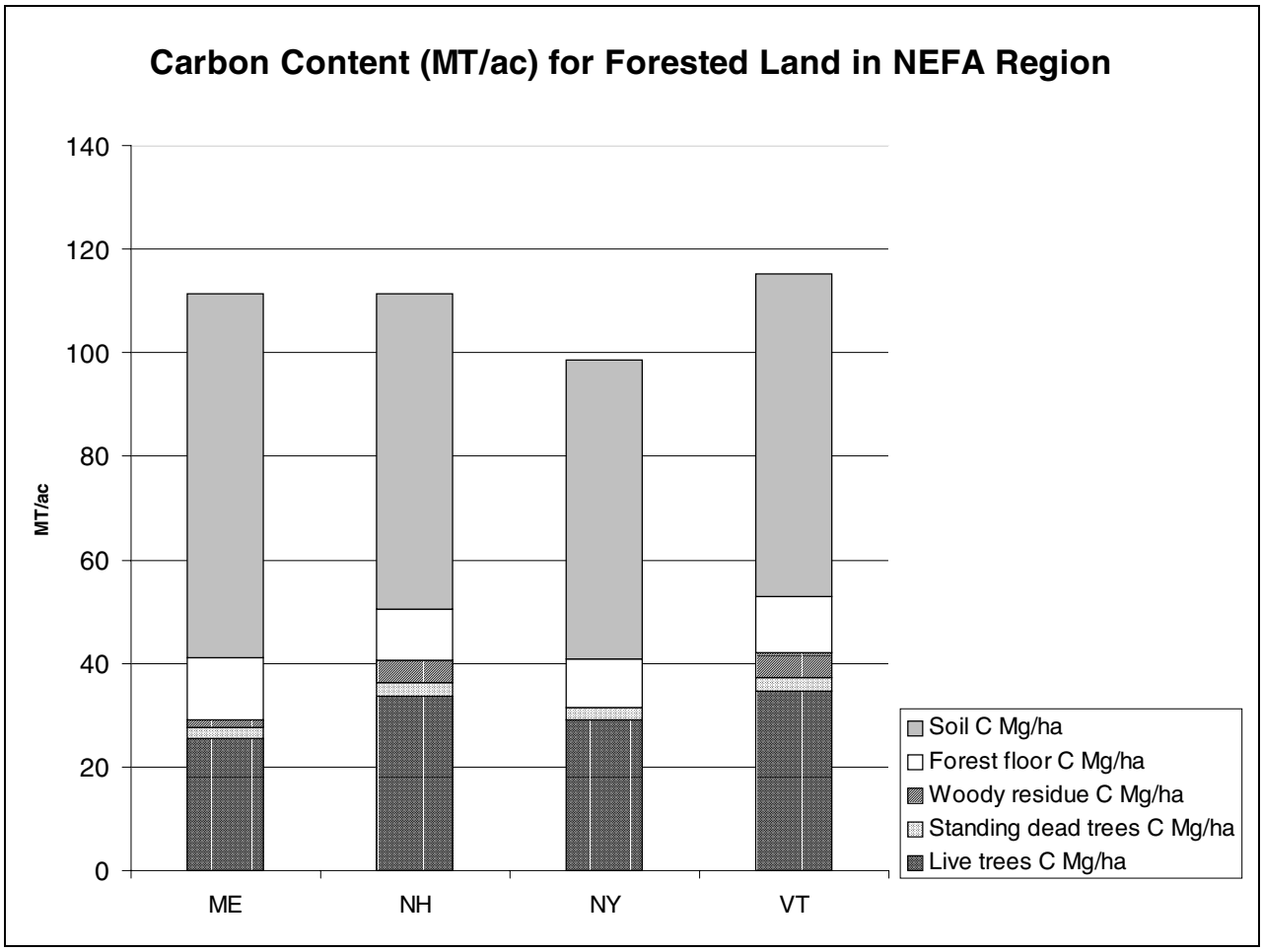
Background

As climate change and potential regulations to curb its impact grow in importance to U.S. policy makers and business leaders, many are considering forests as a low-cost method to reduce atmospheric carbon. Because trees are roughly 50% carbon (dry weight), increases in standing timber are directly correlated with increases in bound carbon.

Forest growth naturally stores, or "sequesters" carbon, and the carbon remains in the wood after it is processed into a product. Activities that increase the biomass accumulation in a forest or in forest products increase carbon sequestration. It is for this reason that policy makers are looking at ways to use forest growth as an inexpensive way to mitigate increasing carbon emissions. Many policy makers see natural carbon sequestration, in forests and by other means, as only a temporary mitigation measure – perhaps an effort spanning 50 years -- while new technologies to permanently store mass quantities of carbon are developed.

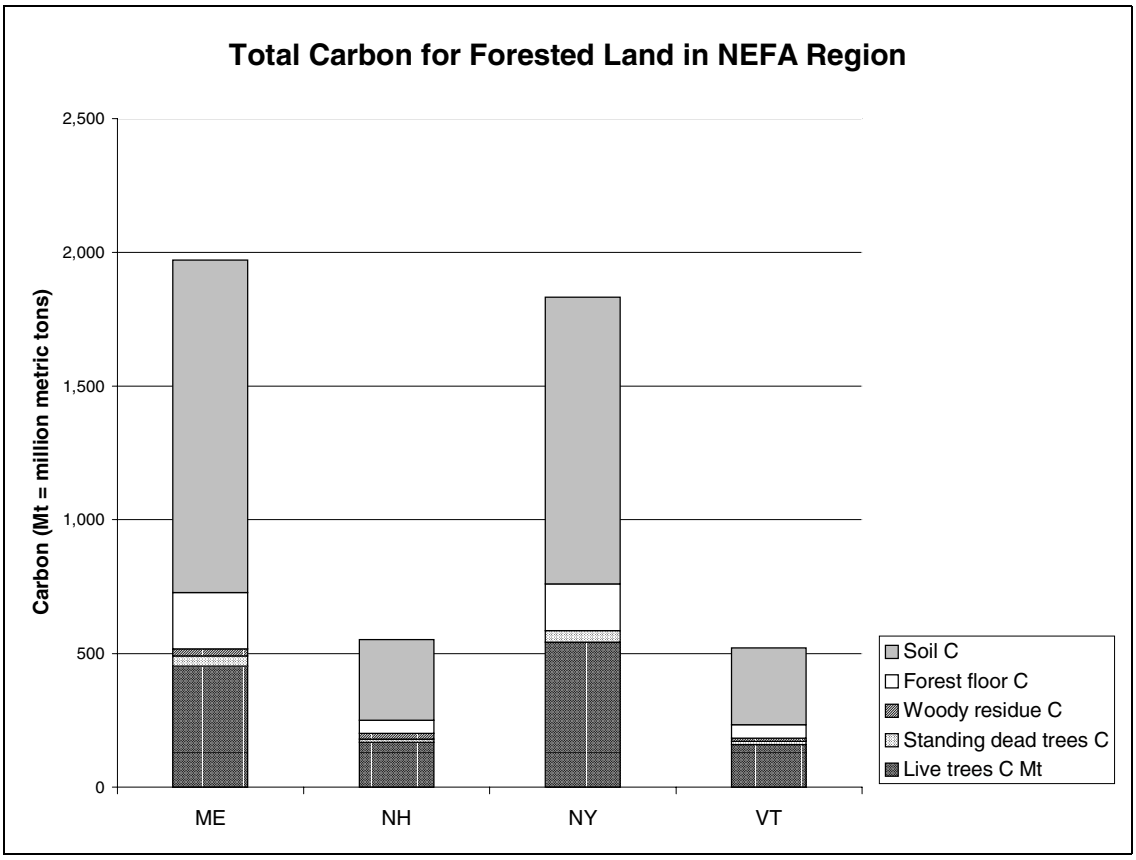
Carbon Sequestration in the Northeast

Using information derived from the Forest Inventory and Analysis (FIA) the USDA Forest Service has developed information showing carbon content per unit of forestland. Forestland in the NEFA states has an average carbon content of 106 metric tons per acre (MT/ac). [A metric ton is 2,204.62 pounds, roughly 1.1 times the weight of our standard ton.] This includes all carbon in the forest, including live biomass, dead and down trees, and soil carbon (Heath, personal communication).



Source: Heath, 2000

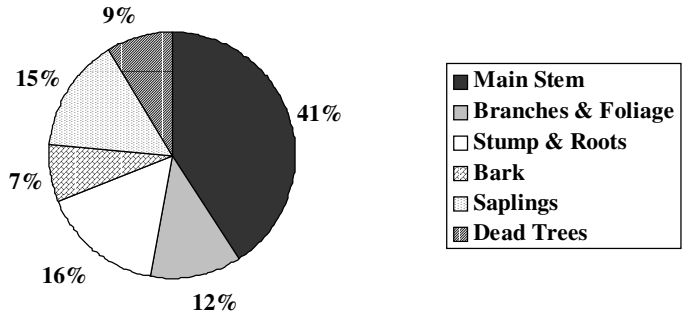
When viewed by state, Maine and New York have the greatest total carbon sequestered. This is logical, as these states have the greatest amount of forestland.



Source: Heath, 2000

While it is clear that soil carbon is a significant contributor to carbon stores in the Northeast, live trees are also a major contributor. However, it is important to note that for all standing tree biomass in a typical northern forest, only 41 percent of the biomass (and presumably a similar portion of the carbon) is contained in the main stem. This is important to consider, because it is almost always the main stem that is converted to long-lived products, while other sections are left in the forest to decompose or consumed in ways that release the carbon back to the atmosphere.

Composition proportions of standing tree biomass estimated for Northern U.S. forests, 1997



Source: Williams et al, 2000

Opportunities for Forest Management

There are two ways that terrestrial ecosystems can contribute to carbon sequestration:

1. Ecosystems can be protected from land-use changes to assure that carbon sequestration patterns and activities for that ecosystem type will continue (contemplates set-asides and managed land), and
2. Ecosystems can be manipulated to increase carbon sequestration beyond naturally occurring levels, including carbon stored in harvested products.

Obviously, these are not mutually exclusive strategies – a single parcel of land may be conserved as forestland and managed for forest products. Processing wood into long-lived products, such as lumber, can also enhance carbon sequestration from terrestrial ecosystems. For example, carbon stored in wood and harvested in the 1900's, converted into lumber and used in construction of homes that are still standing is still sequestered,

and will remain out of the atmosphere until that wood fully decays, burns, or is otherwise released into the atmosphere.

Urban afforestation also contributes to the sequestering of carbon.

There is little concrete information on how different management strategies frequently used in the Northeast impact carbon sequestration activities. Management strategies that encourage larger trees, employ harvest methods that reduce waste and damage to residual trees, and minimize soil disturbance during harvest all improve carbon sequestration activities.

Information from the Union of Concerned Scientists shows that following a harvest (method undefined but assumed to be clearcutting based on Strong, 1997 – see below), forest carbon -- all carbon in trees, shrubs, coarse woody debris and soil -- is either lost to emissions, stored in wood products, or stored on-site. Following a harvest, an estimated 32.5% of forest carbon is released to the atmosphere within five years. Another 32.5% is stored in long-lived forest products, with an average annual loss of 2% to decay or disposal and an estimated 35% of forest carbon remains stored on-site, either in unharvested material, forest soil, or coarse woody debris. The key finding here is that for a site harvested with clearcutting, roughly two-thirds of the forest carbon is not stored in forest products following a harvest, and individuals seeking to maximize carbon benefits of a forest should recognize this.

Harvest method is likely important in describing these after harvest carbon budgets. A Wisconsin study (Strong, 1997) suggests that in northern hardwoods where the harvests have been light to moderate thinnings (partial cuttings), total carbon stored in tree stems will increase over time. This would suggest that landowners should be able to manage their forests, including periodic harvests, while increasing sequestered carbon.

Strategies that increase carbon sequestration *above naturally occurring levels* may allow landowners to build carbon inventories. The principal has been established that "if you grow carbon, you own the carbon", and this may provide landowners opportunities to grow and sell "carbon credits", based upon their management or conservation activities. Landowners and others may already voluntarily register their carbon sequestration activities, providing them with the ability to turn these into tradable carbon credits at some later date.

Carbon trading presently exists at some levels, but observers indicate that viable trading of credits in a mature market is at least five years away. The Chicago Climate Exchange (www.chicagoclimatex.com) is building a system that will allow the sale and purchase of carbon credits in an open and transparent marketplace. Forest products companies International Paper, Temple-Inland, Mead-Westvaco, and Stora Enso presently participate in the development of this exchange.

Until a transparent and mature marketplace develops, highly speculative transactions will occur. Already, some forest landowners report being compensated for carbon

sequestration activities, with payments ranging from $1 to $10 per ton (roughly $0.50 to $4.50 per cord) of sequestered carbon. However, the long-term usefulness of these credits, and their acceptance in regulatory arenas, has not yet been tested.

A law passed in California in 2002 will allow landowners to voluntarily register forest projects that can be shown to reduce greenhouse gases such as carbon dioxide in anticipation of the day when such registered carbon may be traded or sold. In New Zealand, beginning in 2007, a carbon tax will push up fuel costs but help the country meet targets under the Kyoto climate change agreement. This new law (2002) will also allow only the government to take credit for sequestered carbon on forest lands, public or private.

Major issues forest landowners face in developing carbon credits acceptable in the marketplace include:

1. Verification of growth rates and other supporting information (though this can likely be solved by using FIA information);
2. Establishment and measurement of forest growth above "naturally occurring" levels of carbon sequestration (i.e., it is unlikely that landowners will be compensated for "what would have happened with no action"); and
3. Assurance of long-term removal of carbon from the atmosphere, not simply removal for a short period of time or delayed release (there is not presently agreement on what constitutes "long-term").

Because of these challenges, it is likely that large forest land owners, most likely industrial owners, will be in the best position to use a carbon marketplace, if one develops. Larger landowners have several advantages that will help them access a carbon credit market more quickly:

1. Existing forest measurement systems and baseline data are often in place;
2. Organizations are often large enough to support staff dedicated to new projects such as this;
3. Have holdings large enough to justify the commitment to a system, taking advantage of economies of scale that smaller landowners may not be able to.

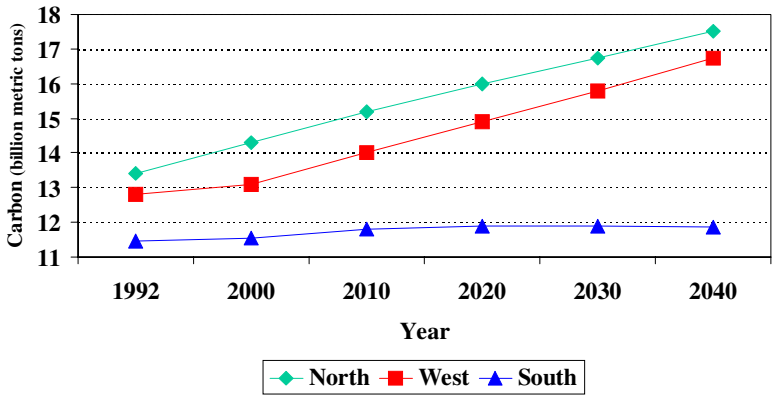
However, ongoing activities in the agricultural sector -- where serious consideration is being given to paying farmers to temporarily sequester soil carbon through no till practices – indicate that small non-industrial landowners may be able to achieve some level of compensation for practices that store carbon. For this reason organizations that represent small landowners, as well as organizations that recognize the importance of small non-industrial landowners to the forest products industry and environmental stewardship, would be well advised to begin raising awareness of this issue at this time. While actual funding streams may be years off, the ability of small non-industrial landowners to access this money may depend upon actions taken now.

Challenges in the Northeast

Forest landowners in the Northeast face additional challenges in earning money through the sale of carbon credits. Industry observers were quick to point out that New England has a "mature resource base", and that capture and sequestration of new carbon is relatively low compared to other areas. Because the relationship of growing stock to carbon sequestration is quite strong, there may be limited opportunities for capture of new carbon. Industry observers familiar with forest growth patterns suggest that the Southeastern U.S. will capture the lion's share of any payments associated with carbon growth.

However, the scientific literature does not necessarily support this belief. Figures prepared by the USDA Forest Service (Heath, 2000) show that the North (an area including but much larger than New England) will continue to lead the nation in carbon inventory, while the South will have only minor increases. This is because although northern forests do not grow as quickly as forests in the South and West, they are not usually harvested as intensively, either. Further, forest carbon inventories account for all carbon in the forest (i.e., not only standing biomass carbon, but carbon in the soil and litter layers of the forest).

Forest carbon inventory projections by regions of the United States (source: Heath, 2000)



Perspectives of the National Environmental Community

The national and international environmental community does not have a unified view on the role of forests and forest management in carbon sequestration. In a stakeholder review conducted with the Department of Energy in 1999, there was no agreement by leading national environmental organizations on whether sequestration activities, including but not limited to forest management, should be credited under the (now sidelined) Kyoto Protocols or other international agreements.

Areas where the environmental community expressed reservations about carbon sequestration focused on measurement and monitoring of sequestration activities, long-term stability of the stored carbon, and creation of "perverse incentives" in the name of carbon sequestration (the example given was the harvesting of old-growth forests in order to encourage increased growth rates). There appears to be some level of consensus within the environmental community that if carbon sequestration activity is credited because of forestry, the forest should be "permanently protected" (term not defined) to assure longevity of the stored carbon. Given the increasing amount of managed land owned by conservation organizations or privately owned land subject to conservation easements in the region, this may present some future opportunities for Northeastern landowners that other regions (with less non-public land under some form of "permanent protection") are not as well positioned to take advantage of.

In 2000, while advocating for increased set-asides of 42 million acres of "roadless areas" on National Forests, The Wilderness Society (TWS) argued that one reason to assure these areas were not managed for forest products was the carbon sequestration benefits they provide. According to a publication prepared for TWS, "in their current condition, 42 million acres of roadless lands…annually provide between $490 million and $1 billion in carbon sequestration services." (Loomis, 2000). While not certain that this financial figure is realistic, a number of observers indicated that to the extent this is accurate, there is little reason to believe that – so long as the land was managed sustainably and soil carbon protected – active management of these areas would have a negative impact on carbon sequestration activities.

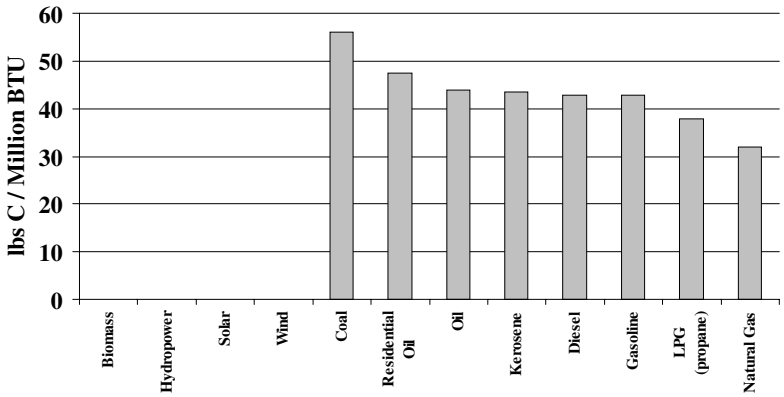
One overriding concern expressed by members of the environmental community is that while carbon sequestration efforts may be important, there is concern that they shift the focus away from what many environmentalists see as the real issue – emissions as a result of fossil-fuel use. To the extent that carbon sequestration activities are viewed as an alternative, and not a supplement, to reductions in emissions of greenhouse gasses, many environmental organizations will likely oppose such efforts.

Substitution of Wood Products for Other Products

When compared with materials that wood products often compete against – aluminum, steel, plastics and concrete – wood measures favorably from a carbon standpoint. This is true because production of wood products is often less energy-intensive than other products, and because stored carbon in wood products provides environmental benefits.

Using woody biomass to create electricity also has carbon benefits when used to produce electricity. While carbon is emitted when wood is combusted to run turbines, it is offset by forest growth when fuel is procured from sustainably managed forests. In the graph below then, biomass shows up as a carbon neutral fuel type for electricity generation.

Carbon Emissions From Electricity Production, by Fuel Type

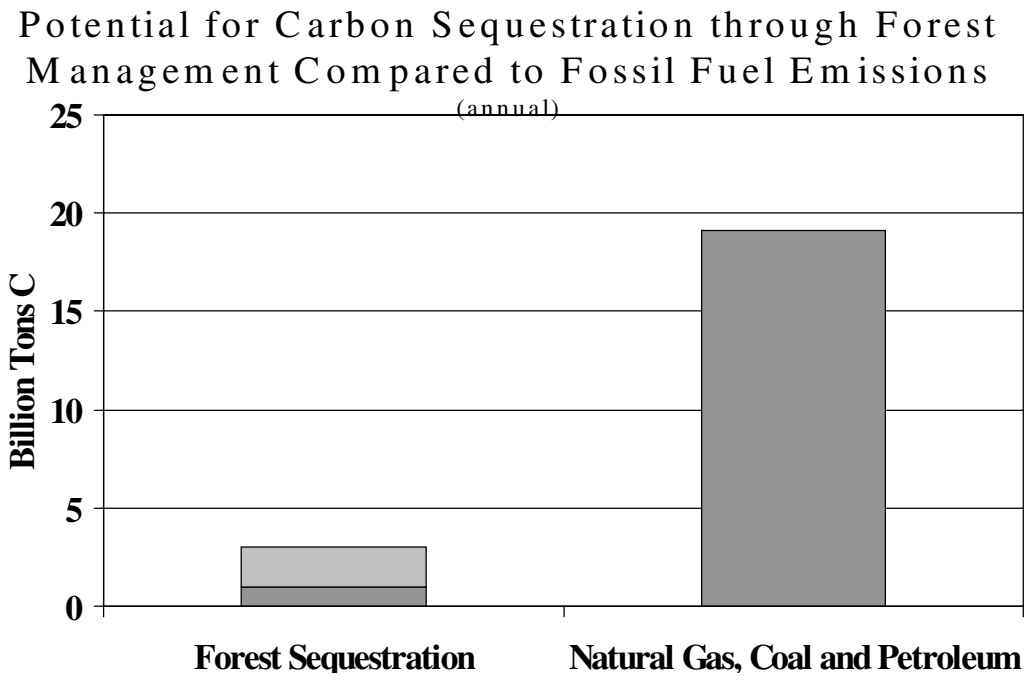


Note: Biomass releases about 42.8 pounds of carbon for each 100 pounds of dry wood combusted, but an equal amount of carbon is sequestered over a 60 – 100 year re-growth period.

Source: Maine State Planning Office and University of Maine, 2000

Forestry within the Framework of Climate Change

It is estimated that changes to forest management worldwide could sequester an additional 1-3 billion tons per year. While this is impressive, it does not match the annual emissions produced by emissions from fossil fuels.



Source: U.S. Department of Energy, Office of Science & Office of Fossil Energy, 1999

Conclusions

While forestry has the potential to sequester large amounts of carbon, it is not yet clear if or how this will be used to mitigate greenhouse gas emissions in the future. NEFA is well positioned to monitor the development of carbon credit markets and other forestry incentives. NEFA will continue to follow this issue and encourage landowners and forest industry to increase their involvement in this issue, helping to make certain that the Northeastern perspective is considered when policy is made concerning carbon sequestration and forest management.

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