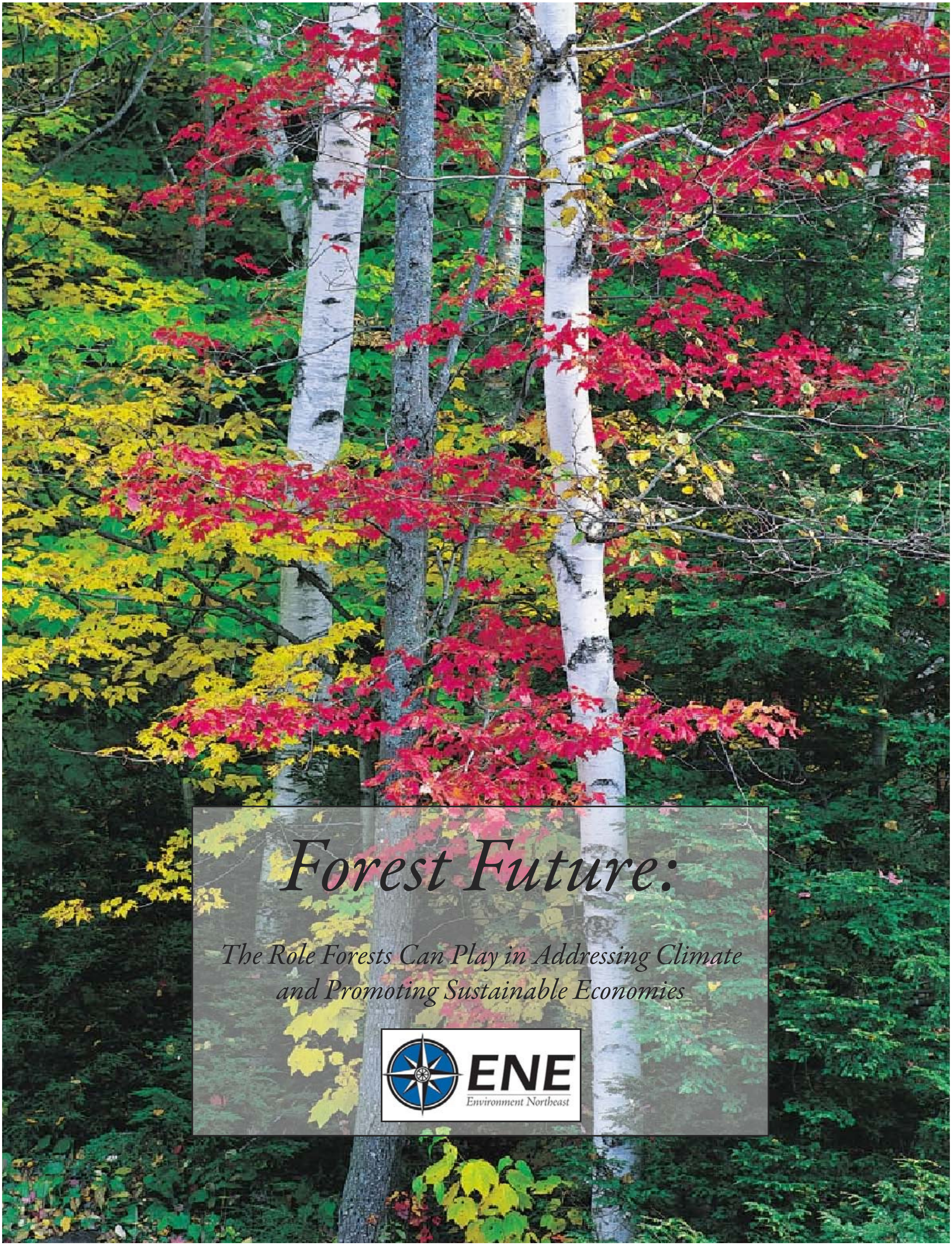

Forest Future:

The Role Forests Can Play in Addressing Climate and Promoting Sustainable Economies

ENE

Environment Northeast

ENE (Environment Northeast) is a non-profit organization that researches, develops, and advocates innovative policies that tackle environmental challenges while promoting sustainable economies. We are at the forefront of efforts to combat global warming with solutions that promote clean energy, clean air, and healthy forests. ENE has five offices in the region as well as an active presence in Washington, D.C. and Ottawa, ON.

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We would like to thank the Davis Conservation Foundation, Merck Family Fund, New York Community Trust, and the Steve Leuthold Family Foundation for their support of ENE's forest climate work.

Cover Design: Stacey M. Warner, Warner Graphics

Introduction

"The facts of climate change and the implications for forest management have become increasingly clear. I believe history will judge the leaders of our age by how well we respond to climate change…. forests and forestry [must] play a key role in this essential discussion and contribute in a significant way to a proactive set of short- and long-term solutions." -Gail Kimbell, former Chief, U.S. Forest Service

Forests and land use play a critically important but not widely understood role in climate change policies. U.S. forests currently store the equivalent of 27 years of all U.S. greenhouse gas emissions in trees. Annually, land in the U.S currently absorbs (sequesters) 13-14% of total U.S. greenhouse gas emissions – a figure larger than annual emissions from U.S. commercial and residential sectors combined. Forests provide up to 86% of this sequestration (absorbing 11.4% of U.S. greenhouse gas emissions in 2008), with the remainder coming primarily from urban trees and agricultural soils. When eastern forests leaf out in the spring, atmospheric scientists in Hawaii can measure carbon decreasing in the atmosphere.

Forests also play a critical economic role. Forest support economic activity in rural communities across the country in the form of traditional activities like saw mills, pulp and paper production and firewood. Forests play an equally important economic and social role in tourism and recreation. People travel to see fall foliage and fill campgrounds, hiking trails and associated local businesses. Forests are ecological workhorses that clean our air, protect our water, and shelter the wildlife and rich biodiversity of the region.

New emerging markets offer the promise of supplementing or replacing older industries. Many of these emerging markets are driven by environmental goals such as payments for carbon stored in forests and sustainably managed forest harvesting for small scale biomass electric generation and potentially biofuels.

U.S. Forests and Climate

- U.S. forests sequestered 11.4% of U.S. emissions in 2008.
- Sequestration could be doubled through changes in forest management.
- Without policy incentives, U.S. forests may become a net source of emissions.
- U.S. forests are a vital and underutilized climate strategy.

As states, regions and the country work to reduce emissions from the energy and transportation sectors, attention to conserving and enhancing carbon sequestration and storage in the forest sector is critical.

U.S. Forest Service scientists have estimated that U.S. forest carbon sequestration could be doubled through forestland conservation and sound management, but trends today suggest that we are currently on track to lose more than 50 million acres of U.S. forests over the next several decades. Without intervention, the nation's forests could become a net source of emissions. For example, the amount of forest clearing that has occurred in just the state of Maine is equal to putting some 200,000 cars on the road. The future of this rich forest carbon asset is uncertain – and entirely up to us.

This report sets out two main forest carbon strategies that will optimize our invaluable forest carbon resource, along with key policy mechanisms to implement this vision at the state, regional and federal level:

1. Increase long-term sequestration in the forest and land use sector.

- *Create national and regional offset markets to fund sequestration activities*
- *Provide supplemental funding for sequestration through cap and trade programs*
- *Reduce forest loss from development through land use policy*
- *Expand existing programs*
- *Measure and monitor U.S. forest carbon so that we better understand gains and losses*

2. Utilize wood and wood residue for high efficiency renewable power generation to replace fossil fuels and ensure that net carbon benefits, sustainable forest management, air quality and ecological health are protected.

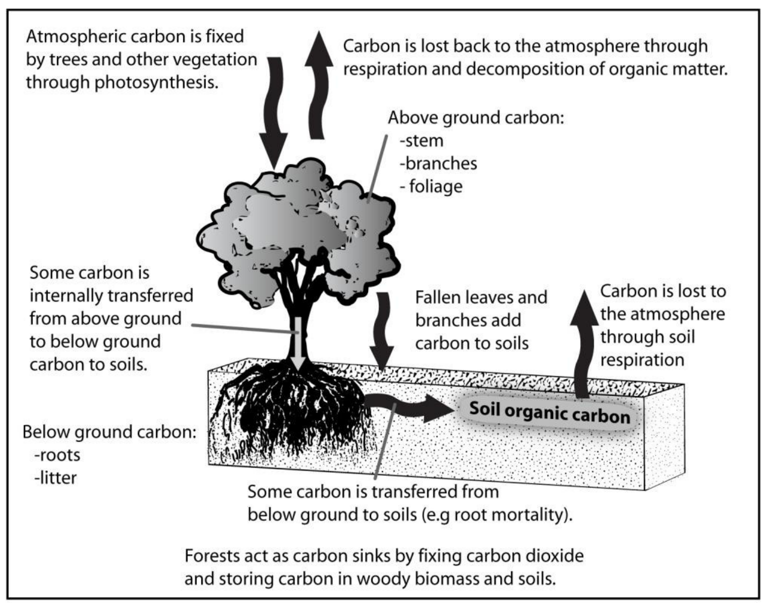
- *Renewable portfolio standards*
- *Incentives in cap and trade programs*
- *National or regional low carbon fuel standards (LCFS)*

Forests and Carbon

North American forests are critical components of the global carbon cycle, exchanging large amounts of carbon dioxide (CO_2) and other gases with the atmosphere and oceans. —The First State of the Carbon Cycle Report (2007): The North American Carbon Budget and Implications for the Global Carbon Cycle

Forests play a key role in the carbon cycle because trees use photosynthesis to convert atmospheric carbon dioxide (CO_2) to oxygen and store carbon in their leaves, trunks, roots, and branches. Forest soils also store considerable amounts of carbon. As forests soak up CO_2 from the atmosphere, they act as a vast carbon bank, taking in carbon deposits on a regular basis. Forests are also dynamic systems that release carbon through natural decay, storm damage, infestation, forest fires, and management activities such as harvesting, burning, and clearing for cropland or development. Forests are a carbon "sink" when they absorb more carbon than they release, and a carbon "source" if they release more CO_2. The net carbon benefit of our forests depends on forest age, health and management decisions. Although at one time old forests were thought to stop sequestering new carbon at a certain age, new science suggests that older forests can continue to sequester significant carbon. (See e.g., Luyssaert, et al. 2008, Foster et al. 2010)

Figure 1: The Forest Carbon Cycle



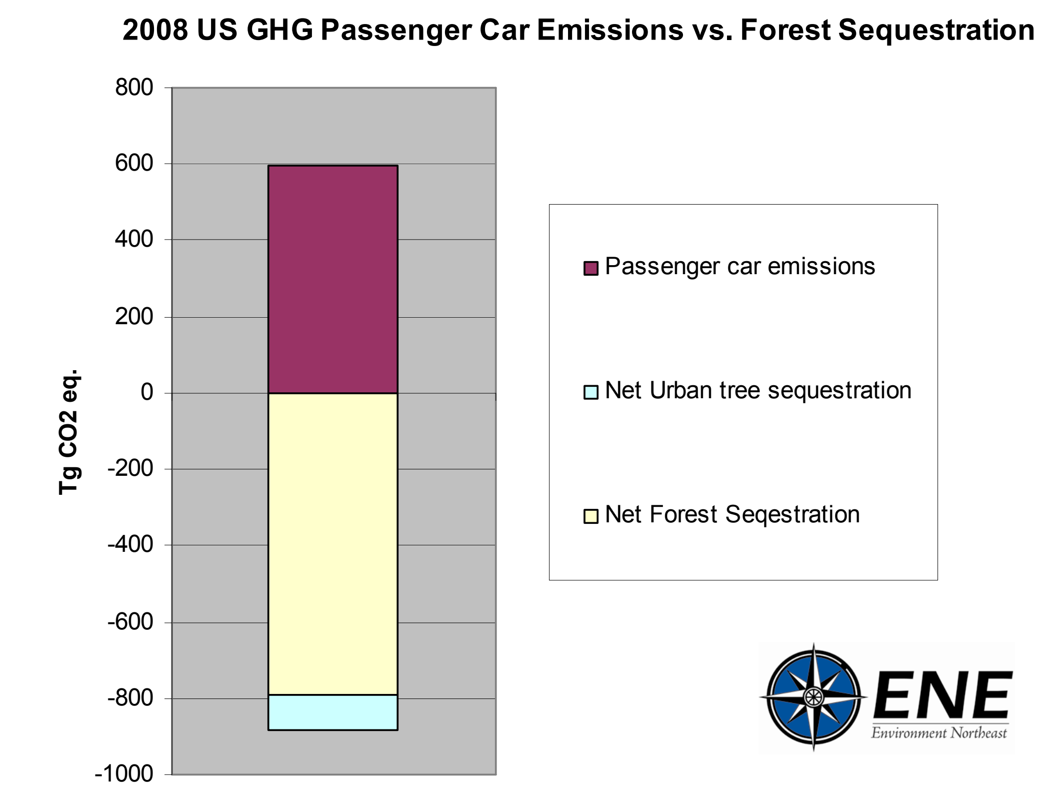
Source: Minnesota Board of Soil and Water Resources

Because forests store close to 90 percent of Earth's terrestrial vegetation biomass, they are critical components in the global carbon cycle. According to the Intergovernmental Panel on Climate Change (IPCC), the total carbon stored globally in forests in 2005 was 638 Gigatons (Gt), more than the amount of carbon in the entire atmosphere. However, scientists also estimate that tropical deforestation contributed up to 20 percent of annual carbon emissions during the 1990s. (Gullison et al. 2007) Draft U.S. climate change legislation has thus sought to address rainforest deforestation through significant proposed funding for international conservation efforts.

It is vital to recognize that forests also play a significant climate role in the United States, both as a major carbon sink and a rising source of emissions. The most recent U.S. Greenhouse Gas Inventory (1990-2008) estimates that sequestration from the nation's grasslands, cropland and forests currently offsets 13.5% of our annual GHG emissions, and that forests alone are responsible for sequestering 11.4% of U.S. emissions each year. (U.S. Environmental Protection Agency 2010)

In other words, **every year forests in the United States sequester more carbon than U.S. passenger cars emit**. (*See* Fig. 2) In addition, U.S. forested ecosystems and soils currently contain an amount of carbon equivalent to over 165 billion metric tons of CO_2, —approximately 27 years' worth of our current annual CO_2 emissions from fossil fuels and other sources. (2010 USDA Forest Service Sustainability Report)

Figure 2: U.S. Forest carbon sequestration compared to passenger car emissions

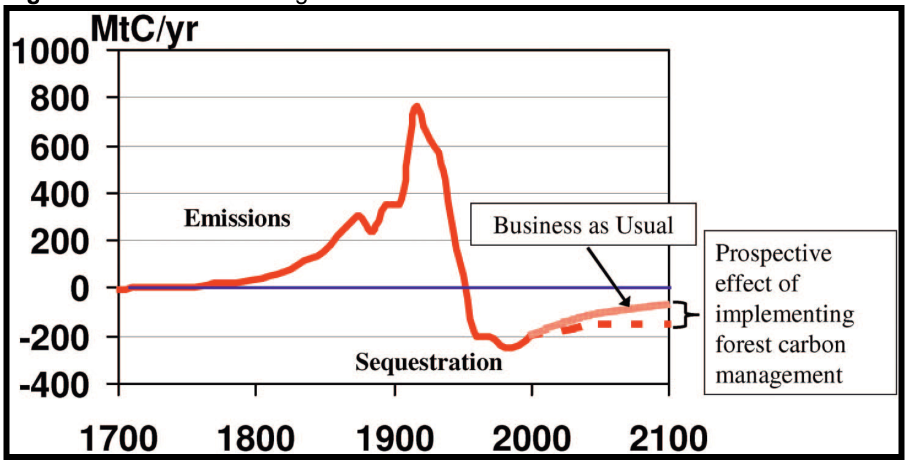


Source: U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007

U.S. Forest Service researchers project that forest carbon sequestration could *double* through additional forest conservation and improved management practices (Birdsey et al. 2006), such as reforestation, longer harvest rotations that retain older trees in the forest, better protection of riparian areas, thinning, restocking of under-stocked lands, as well as reduced deforestation. But the current rate of sequestration is projected to decline unless actions are taken to reverse this trend. (*See* Fig. 3)

The U.S. Forest Service estimates that over one million acres of U.S. forest were lost each year through the 1990's, and that 50 million more acres will be converted to other uses in the next 50 years – the equivalent of losing an area the size of New England ten times over. (USDA Forest Service 2007) Actual forest and forest carbon loss could in reality be far greater, given the lack of up-to-date land use data, incomplete information on forest carbon stocks and sequestration rates, rising land prices, demographic trends, and lack of a coherent U.S. forest carbon policy. According to the annual U.S. greenhouse gas inventories, the rate of net sequestration in the country has been declining in the last few years.

Figure 3: The Carbon Budget of the U.S. forest sector 1700-2100



Source: Birdsey, R., K Pregitzer, and A. Lucier. 2006. Forest Carbon Management in the United States: 1600-2100. *Journal of Environmental Quality* 35: 1461-1469.

One of the greatest challenges to forest carbon conservation is that more than half of all U.S. forestland (423 million acres) is in private ownership, much of it in small parcels, making implementation of a broad program complex. (Butler 2008)

The potential to use forests as a key climate mitigation strategy is extraordinary. Carbon protection can be dovetailed with additional forest objectives to protect biodiversity and watersheds, improve habitat connectivity and forest health, and create forests that are more resilient and adaptable in the face of escalating climate change. Moreover, increased forest carbon sequestration and conservation ranks as one of the more cost-effective and readily available climate mitigation strategies, and it can play an important role in creating an affordable cap and trade emissions reduction program. (Congressional Budget Office 2009) Overall, it is clear that protection and enhancement of valuable forest carbon resources must be a central component of any climate strategy and that new initiatives should be implemented at the state, regional and federal levels to achieve this important goal.

A Regional Case Study –
The New England Forest Carbon Resource

The forests that blanket this region are… storing globally important amounts of carbon and thereby thwarting global climate change. Protecting these forests and managing them to produce and store additional carbon will bring immense benefits to local communities and the world. —David Foster and William Labich of the Harvard Forest

By the end of the 19th century, much of New England's forests had been cleared for extensive agricultural cultivation, but economic times changed. In the past 100 years New England forests have been regenerating on those abandoned farm fields. Today this six-state region is approximately 80% forested. (Smith et al 2007, RPA Reassessment) Maine, New Hampshire and Vermont are three of the four most heavily forested states in the country. A recent report to the New England Governors noted that, "New England's forests are recognized as a resource of increasing national and international significance. They represent the largest intact temperate broadleaf forest in the country, including almost 9 million acres in contiguous blocks of at least 2,000 acres in size." (New England Governors' Conference Report 2009)

These forests also represent a sizeable climate mitigation opportunity for the region. It has been estimated that in the early 2000s, New England forests sequestered 25 – 48MMT CO_2e every year. (*See* Table 1) removing the equivalent of 23-43% of regional electricity and heating emissions over the same time period.

Table 1: Annual New England emissions and sequestration from forests

State	Annual emissions: MMTCO2e/yr Range of estimates[1]
Connecticut	(1.05) to 0.98
Maine	4.74 to (17.55)
Massachusetts	(3.89) to (13.46)
New Hampshire	(9.01) to (10.63)
Rhode Island	(0.12) to (1.31)
Vermont	(16.17) to (5.81)
Total	**(25.50) to (47.78)**

The hundred years of regional forest regrowth peaked in approximately 1960, and since that time competing land uses have progressively reversed this trend. (Foster et al. 2010) Although the maturing forests continue to increase total forest carbon sequestration, the region is no longer adding net forestland, and there are significant indications that a new era of major deforestation may be underway. According to U.S. Forest Service data, the region lost a net of 347,000 forested acres in the past decade. (*See* Table 2) This masks a much greater area of gross deforestation, some of which was balanced out by reforestation of other acres. The USGS Lands Cover Trends Project has recently confirmed that this trend is occurring across the eastern U.S. Between 1973 and 2000, the region experienced a 4.1 percent decline in forest cover – losing more than 7 million acres. (Drummond et al. 2010)

[1] Figures in the left column come from USDA 2003, Figures in the right column come from Sampson and Kamp 2007. Negative numbers reflect net sequestration instead of net emissions.

Northeastern forests are in increasing jeopardy primarily because of (1) the high percentage of private land ownership, which leaves forests vulnerable to changes in land use and management; (2) population density; (3) escalating rate and scale of development; and (4) the changing economics of the forest products industry.

The Northeast is the most densely populated region in the country, and development pressure continues to replace natural habitats with pavement at an increasing rate, particularly given that 86% of the region's forestland is in private landownership. (*See* Table 2) Between 1980 and 2000, the population of the Northeast increased by more than 10%, (Sampson and Kamp 2007) putting increasing pressure on our forest resources. U.S. Forest Service researchers have estimated that by 2050, 70 percent of Rhode Island and 61 percent of both Connecticut and Massachusetts could be urbanized. (Nowack et al. 2005) A Massachusetts Audubon Society analysis found that the Commonwealth lost 22 acres of land to development *every day* between 1999 and 2005. Of the 40,000 acres developed in that time, 30,000 acres had been forestland. (DeNormandie et al. 2009)

Table 2: Forestland in New England, 2007

State Source: 2007 RPA Reassessment	Total land	Total forest land	Change in Forest land 1997-2007	Forests on private land	Number of private forestland owners (Sampling error 13%-30%)
	Thousands of acres				
CT	3,101	1,794	-69	1,383	108,000
ME	19,752	17,673	-38	16,575	252,000
MA	5,018	3,171	-93	2,179	293,000
NH	5,740	4,850	-105	3,646	128,000
RI	669	356	-53	303	38,000
VT	5,920	4,618	11	3,864	88,000
Total	40,200	32,462	-347	27,950	907,000
Total % of land base		80.75%			
Total % of forest land				86%	

The three northern New England states also face escalating development and land conversion pressure. A national analysis by the U.S. Forest Service found that three of Maine's southern watersheds are in the top 15 nationwide for largest projected increase in housing density. (Stein et al. 2005) A study of Maine, New Hampshire and Vermont forest loss from 1992 to 2001 estimated that about 271,816 acres of forests were newly developed from other land-cover types, and about 766,000 acres of forests were converted to other cover types in the same period, resulting in an approximate net loss of 495,000 acres of forest.[2] While the three states sequestered a net of 473 million metric tons of CO_2 (MMTCO2e) due to forest growth and reforestation, forest land converted to non-forest land area change resulted in a loss of 96 million metric tons of CO_2. (Zheng et al. 2009)

[2] This estimate differs slightly from the numbers in Table 1 because it relied on satellite imagery as opposed to field sampling.

A notable trend affecting the future of the forests in northern New England is the changing economics of the forest products industry. Once held in large ownership by large industrial companies focused primarily on paper production, two thirds of the Northern Forest region of northern New England and New York exchanged hands in the last two decades (New England Governors Report 2009) as the economics of the forest products industry changed dramatically. Parcelization and development are an increasingly familiar component of these new transactions, with timberland investment companies moving into the region and looking for return on investment on shorter timelines.

As land becomes far more valuable for development than timber, more private owners and timber investors are unable to resist the market trends and financial benefits of selling, dividing, or converting some or all of their forestland for development. This trend was clearly documented in a 2006 survey of New England forestland owners that revealed that 43,000 landowners owning 1.75 million acres planned to sell some or all of their land in the next five years, and that 28,000 owners owning 500,000 acres planned to subdivide their land over the same period. (Butler 2008) Importantly, the "soft" deforestation of the last century for agriculture was reversible, while today's "hard" deforestation for roads, parking and subdivisions is permanent. (Foster et al. 2010)

Photograph courtesy of the Orton Family Foundation

Issues and Policy Solutions at the Federal, Regional and State Level

"Protecting the world's forests is not a luxury – it is a necessity…. It is imperative that we sustain our forests everywhere so that they, in turn, can sustain us." —U.S. Agriculture Secretary and former Governor of Iowa Tom Vilsack

The two main strategies that will optimize the benefit our forest carbon resource can be implemented with key policies at the federal, state, regional and local levels.

1. Increase long-term sequestration in the forest and land use sector.

U.S. forests currently sequester nearly 12% of annual emissions. In order to maintain or increase this amount, several strategies must be implemented across the country. These include: 1) maintaining or increasing total forest cover by afforestation of non-forest land and preventing the conversion of forest land to other land uses; and 2) changing forest management practices to maintain or increase total carbon per acre stored on existing forest land. Such practices include longer harvest rotations that retain older trees in the forest, better protection of riparian areas, thinning, and restocking of under-stocked lands. (Sohngen et al. 2007)

These goals can be accomplished through the following policy solutions:

Create national and regional offset markets to fund sequestration activities

Federal climate policy could, through a carbon trading program or other means, create "offsets" - opportunities for industries regulated under cap and trade emissions reduction programs to meet required emissions reductions in part through approved alternatives. Under an approved offset program, an emitter could pay a forestland owner for forest management and conservation that provided additional and permanent forest carbon improvements equivalent to the emissions reductions required at the source.

Offsets provide flexibility and cost-effective choices for polluters to reduce emissions. The Congressional Budget Office and the U.S. EPA have both documented in detail how forest offsets will be cost effective, readily available and an important component of cap and trade cost-containment, particularly in the early years of the program.[3] Recent climate policies considered in both the House and the Senate included offset programs that would allow for both agricultural and forest offsets. However, offset standards must be rigorous in order to ensure that they produce real and permanent emissions reductions, beyond business as usual and equivalent to what is required at the stack, or emission targets will not be achieved.

If designed correctly, a strong offset market will also create landowner support for a cap and trade system, and spur innovation in technologies and methodologies to quantify the carbon benefit of forests and changes in management practices. The knowledge gained from quantifying the net

[3] See, e.g., CBO Economic and Budget Issue Brief, "The Use of Offsets to Reduce Greenhouse Gases," August 3, 2009: "The cost savings to the economy generated by offsets could be substantial. CBO estimates that between 2012 and 2050 average annual savings from offsets could be about 70 percent under ACESA. Of course, the intended environmental benefit would be fully realized only if the offsets provided the full reduction in GHGs for which they were credited."

climate impact of interventions in the forest sector can be used to inform other forest policy decisions.

Any forest activity whose climate benefit can be accurately quantified and verified could theoretically be eligible as an offset. In existing and proposed offset programs, the categories most often referred to are afforestation (planting trees on non-forested land), avoided deforestation (preventing forest conversion), improved forest management, and urban forestry.

At the international level, in negotiations for a successor treaty, discussions have focused on how developed countries could fund reduced deforestation (Reduced Emissions from Deforestation and Degradation, or REDD), either through the carbon market or through a voluntary fund.

At the regional level, ten Northeast and mid-Atlantic states implemented the first mandatory cap and trade program in the country in January 2009, known as the Regional Greenhouse Gas Initiative (RGGI). In its first year, RGGI had six successful allowance auctions and returned $494 million to the states for energy efficiency investment and other climate mitigation programs. The RGGI program also established a very rigorous set of standards for offsets that remains the best model for a federal cap and trade program. In order to meet RGGI standards, new offset types must demonstrate how they meet a rigorous "five-part test" to ensure that the projects truly increase carbon reductions: offsets must be *real, surplus (additional), verifiable, permanent and enforceable.*

Federal offsets should meet the strict five-part test established for RGGI offsets ("RSVP-E"):

Real: able to quantify an actual and measurable reduction in emissions.

Surplus (additional): additional or surplus to reductions in emissions that would occur under business as usual activities, above and beyond what would have occurred absent any funding for the offset project.

Verifiable: sufficient measurement and documentation to allow independent auditors to assess and confirm project eligibility and performance.

Permanent: be lasting, ensuring that a reduction in emissions is not capable of being reversed at some future point in time.

Enforceable: able to enforce compliance or require a return of the offset credit if other requirements are not met.

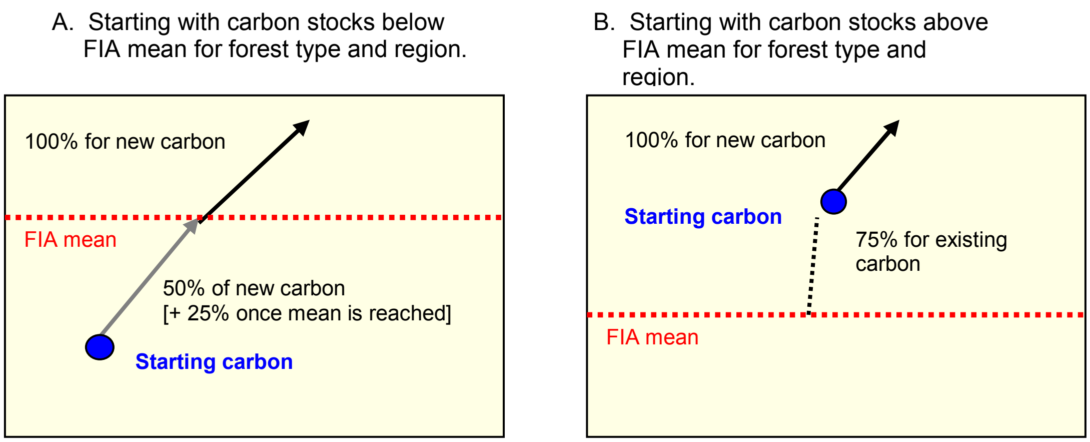
For example, in regards to *permanence*, the sequestration gains a project has been credited for could be reversed through natural occurrences (fire, pest infestations, hurricanes) or human actions (breaking a project contract by harvesting or developing land). Offset protocols must specify both what length of time the sequestered carbon must remain out of the atmosphere in order to be considered equivalent to a permanent emissions reduction, and what insurance or other replacement mechanisms need to be in place to ensure that any reversals are compensated for.

The RGGI offset program currently permits a small number of project types, including afforestation. However, RGGI allows for the addition of other offset types, and the Memorandum of Understanding between participating states specifically recognizes forest management as an initial category to consider.

The opportunity to increase carbon sequestration through afforestation is important but limited in the Northeast and in other areas with large forest cover. Additional ways to reduce emissions and increase carbon storage the region include sustainably managing forests to increase carbon storage, permanently conserving forests threatened with development, and urban forestry.

ENE worked for two years with the Maine Forest Service, Maine Department of Environmental Protection and the Manomet Center for Conservation Sciences to develop a detailed, peer-reviewed set of recommendations for adding these three new forest offset categories to the RGGI offset program, *A Policy Framework For Including Avoided Deforestation And Forest Management Practices As Forest Offset Types In The Regional Greenhouse Gas Initiative.* ENE et al. submitted this forest offsets proposal to RGGI in the summer of 2009 and the recommendations are currently under review.

Figure 4: Recommendations to RGGI on Forest Management Baselines



The RGGI recommendations set out a lower carbon credit for projects that start (A) **below** the FIA mean carbon stocking level for the forest type and region, and a higher credit for projects (B) **above** the FIA mean.

The RGGI forest offset proposal sets out a credible and effective approach for forest offsets in RGGI and also provides a valuable precedent for federal policy. Proposed climate legislation passed by the U.S. House of Representatives (the *American Clean Energy and Security Act* or ACES) and other legislation that has been considered in the U.S. Senate provides for an extensive amount of offsets, both national and international, to meet carbon emission reduction levels. Real emissions reductions will only occur if the offsets program is rigorously crafted along the lines of the RGGI five-part test and the ENE et al. RGGI forest offset protocol recommendations.

An important state precedent for an offset program is in California. The Climate Action Reserve (CAR) is a voluntary program for registering offsets. It was originally tied to the voluntary emissions registry, which has now been transitioned to the national Climate Registry. Existing CAR forest offset projects may be eligible for credit under the mandatory state cap and trade program that is being developed (AB 32). The registry includes protocols for forest management, avoided deforestation and urban forestry, and the California Air Resources Board is considering approving use of these protocols for future projects under the AB 32 program as well.

Provide supplemental funding for sequestration

The economics of the offset market, which will likely include many non-forest offsets from many geographic regions, and will compete with direct emissions reductions, means that there is no guarantee that offset funding will be sufficient to meet national and regional forest carbon goals. Furthermore, a forest offsets program will be rigorous and complex. Millions of small landowners across the country who could protect their forestlands through permanent easements or benefit from incentives to improve management practices will not be able to join an offset program due to cost, scale or program rigor. Therefore, **federal climate policy** should include adequate funding for carefully structured carbon contracts (of 20-25 years in length) and, particularly, permanent conservation easements to help protect more forestland in perpetuity from poor management and escalating development pressures. Such a program could be funded directly through the appropriations process, or allocated a certain percentage of revenue generated by auctioning emissions allowances in a cap and trade program.

This policy would allow small landowners to receive welcome new revenues; permanently protect forestland and associated ecosystem values; and help combat global warming. Funding for permanent forest conservation easements is pivotal for areas of the country with a high percentage of private ownership of forestland in small parcels. In the six New England states, for example, 86% of the forested land is privately owned, much of it in small parcels, by approximately 900,000 different landowners. Forestland conversion will continue to escalate unless programs provide incentives to landowners to conserve these forestlands and invest in long-term management plans.

Reduce forest loss from development through land use policy

Forest carbon conservation and enhancement should be included as a focused set of strategies to meet greenhouse gas reduction targets and adopted in **state policies**, regulations and tax incentives. Forest loss can be minimized through several innovative policy approaches: 1) minimizing sprawl by focusing growth within designated corridors; 2) transfer of development rights from forested, rural areas to areas designated as growth zones; 3) mitigating forest loss through reforestation and conservation offsite; and 4) modifying subdivision designs to cluster housing, thus reducing land clearing associated with new housing units. Some of these policies, such as transfer of development rights and clustered zoning, would require coordination with **municipalities**, who have jurisdiction over land use planning in many regions of the country.

While many agencies are beginning to consider long-term climate change in their permitting and planning, they need to do so consistently and systematically, as land use changes that happen today may have impacts that last 50 years or more. Ignoring the reasonably foreseeable, long-term climate impacts of these decisions affects the states' ability to make progress toward their greenhouse gas emission reduction goals. It is essential that the region move toward "carbon-efficient" planning that minimizes energy use, transportation impacts, and loss of forest carbon. States should work to achieve a "no net loss of forest carbon" standard, measure and monitor forest carbon trends, and implement an array of strategies to protect this valuable climate mitigation resource that provides so many other community and societal benefits. For example, ENE is working with policy makers and colleagues to help move states towards more climate-friendly development, including high energy efficiency standards and minimization of forest carbon loss. Important policy precedents across the country have applicability in many states and regions. In Sonoma County, California, an ordinance requires that every acre of timberland which is converted must be mitigated on a 2:1 basis. Maryland also requires 2:1 mitigation for forest loss if developers clear more than the 25% conservation threshold.

Loss of Carbon from Development – A Case Study from Plum Creek
Maine loses up to 10,000 acres annually to road clearing and development. At a loss of 100-150 tons of CO_2 per acre (the approximate range used in the existing literature) land clearing in Maine releases a total of approximately 1 to 1.5 million tons of CO_2 per year - the equivalent of the emissions from over 200,000 cars every year (in addition to the future annual sequestration that is lost). Because Maine has 1.2 million registered vehicles, achieving a carbon neutral development policy would be the same as removing 20% of a state's annual vehicle emissions.

In 1998 the Plum Creek Timber Company purchased 900,000 acres of Maine woods from a major paper company in the Moosewood Lake region of northwestern Maine. Six years later, Plum Creek submitted plans for the largest subdivision in Maine's history. The Moosehead Lake region is part of the largest expanse of undeveloped woodland east of the Mississippi. The Plum Creek development proposal envisioned up to 975 residential units, 1050 resort units (a mixture of single-family units, townhouse and apartment style units), 2 resort lodges, 190 employee housing units and 100 affordable housing units

ENE's assessment, filed as testimony in proceedings at the Maine Land Use Regulation Commission (LURC), found that between 387,378 and 501,081 metric tons of CO_2 would be lost through the Plum Creek development, of which roughly half is emitted to the atmosphere immediately (during development) and the other half through lost carbon storage potential over 50 years.

However, in the Plum Creek Project Plan, a 41% reduction in total area cleared for the 975 residential units through the use of clustered housing design would result in emissions savings of between 102,510 to 132,461 metric tons of CO_2 —a more than 25% emissions reduction.

Expand existing programs

In addition to creating new policy mechanisms to increase and preserve forest carbon storage, existing state and federal programs focused on forest stewardship and conservation should be expanded and supported. At the federal level, these include Forest Stewardship and Forest Legacy programs. At the state level, this could include conservation programs funded through bonds or real estate development taxes, as well as current use tax programs that reduce property taxes for forest land with long-term management plans that include conservation/enhancement of forest carbon storage and sequestration.

Measure and monitor the U.S. forest carbon so that we better understand gains and losses and can move toward a "no net loss" of forest carbon at both the state and federal levels.

Increased funding for forest carbon measuring and monitoring is necessary in order to develop meaningful national and state baselines for forest carbon stocks and to help states maintain and exceed that baseline for the long-term. An increased focus on monitoring funding as part of the federal climate bill must be a key component of the U.S. forest carbon strategy. While much is understood about the aggregate impact of forests and land use at the state, regional and national levels, more in-depth monitoring and research will help clarify specific trends in forest management, reforestation, and deforestation – and give policy makers increasing confidence that forest carbon strategies can reliably be a key component of the U.S. climate response. More comprehensive measuring and monitoring will: 1) create a better understanding of short-term and long-term trends, and help formulate policy and funding priorities; 2) develop more refined data to serve as baselines and performance standards for the offset market; and 3) develop more refined data to quantify the impacts of offset and non-offset programs.

> "Decisions concerning carbon storage in North American forests and their management as carbon sources and sinks will be significantly improved by (1) filling gaps in inventories of carbon pools and fluxes, (2) a better understanding of how management practices affect carbon in forests, (3) a better estimate of potential changes in forest carbon under climate change and other factors, and (4) the increased availability of decision support tools for carbon management in forests." (Birdsey et al. 2007)

In particular, this should include funding to:

- *Expand the Forest Inventory and Analysis program to increase sample sizes and intensify measurements of lesser understood carbon pools*
- *Allow states to update growth and yield data to improve future projections of forest carbon*
- *Research the impacts of harvesting regimes on forest floor and soil carbon*
- *Improve land use change estimates from the U.S. Geological Survey (USGS) National Land Cover Dataset (NLCD) and other databases to develop statewide trends on forest conversion and reversions.*

Currently there are wide discrepancies in the estimates of land use change from satellite imagery and field sampling that should be resolved. This program funding is essential in order for the states and the U.S. as a whole to develop the knowledge base, framework, and tools to protect and enhance our forest carbon resources over time.

2. Utilize wood and wood residue for high efficiency renewable power generation to replace fossil fuels and ensure that net carbon benefits, sustainable forest management, air quality and ecological health are protected.

Biomass, derived from plants or other organic matter, can be converted into fuel for electricity, heating, or transportation. While wood has been burned for heating and cooking for thousands of years, more advanced technologies are being developed to take advantage of biomass as a source of domestic energy. Recent investment and interest in biomass generation has been spurred for three main reasons. First, many states have adopted Renewable Portfolio Standards (RPS) that require an increasing percentage of electricity to be generated from renewable sources; biomass is a qualifying renewable energy source in these states, with varying restrictions on the types of eligible technologies, emissions limits and fuel sources that plants must use in order to receive Renewable Energy Credits. Second, there is interest in energy independence, energy security and diversifying fuel mixes so there is less dependence on oil and natural gas. Third, biomass markets are seen as an important economic opportunity for traditional forest based communities, particularly as a new market for low-grade wood. Federal climate legislation may provide additional biomass incentives. Overall, there is an escalating push to incentivize and build biomass facilities as part of the new clean energy economy.

However, burning biomass for electricity presents environmental concerns. Older biomass technologies in particular can have higher emissions of CO_2 and traditional pollutants such as nitrous oxides (NOx) and particulate matter (PM) than some fossil fuel fired power plants. For example, in the Northeast, the average CO_2 emissions rate for biomass is 2630 lbs/MWh compared to 2071 lbs/MWh for existing coal boilers.

CO_2 emissions can theoretically be recaptured through regrowth of forests if the carbon sequestered in regrowth is equivalent to the emissions from the power plant. For this reason, these fuels are sometimes referred to as "carbon neutral," compared to fossil fuels that burn carbon that has been stored over millions of years and is not renewable on any sort of human-scale timeframe. However, if biomass is harvested at unsustainable levels in the region, stack emissions will not be offset by an equivalent amount of sequestered CO_2, and the biomass plants will contribute to the accumulation of CO_2 in the atmosphere. Only biomass projects that rely on energy from waste or that are committed to acquiring source material from sustainably-harvested virgin wood can approach carbon neutrality when considered on a lifecycle basis.

If biomass is to play a positive role in climate mitigation, it is vital that biomass incentives and regulations are designed to ensure net greenhouse gas reductions and to avoid or minimize pollution and adverse ecosystem impacts. The use of wood energy should be carefully considered in the following state, regional and federal policies:

Renewable portfolio standards

It is essential that biomass meet the highest standards possible in four areas in order to receive RPS renewable energy credits at the **state** or **federal** level:

Best Available Control Technologies (BACT): Biomass plants must meet the strictest BACT standards possible (such as the Massachusetts standards) and not unduly increase air pollution or threaten human or ecosystem health.

Net Carbon Benefit: Biomass energy should not receive subsidies through the RPS unless it can demonstrate a net carbon benefit. Sustainable sourcing should be demonstrated using verifiable and enforceable criteria. Wood waste (from mills, powerline clearing, etc.) should be a priority feedstock. In order to minimize carbon emissions from biomass and create net carbon benefit compared to fossil fuels, forest sources must be managed to ensure that more carbon is taken up by the forest than is harvested each year.

Ecosystem Protection and Sustainability: Biomass facilities should only be permitted and incentivized if there are provisions and complementary policies in place that protect the full range of forest functions and values, carbon storage, native habitats, native biodiversity, forest nutrients, and water quality.

Highest Practicable Efficiency: Biomass facilities must meet the highest standard possible for efficiency in order to maximize the use of limited resources. Biomass plants built for commercial electricity generation can have efficiency as low as 21%, although this varies according to the type of conversion technology used. In comparison, combined heat and power (CHP) facilities generally have efficiency levels of 60-75%, while thermal applications are generally 50-75% efficient.[4] RPS regulations should specify a minimum level of efficiency and states should expand alternative energy programs to provide incentives for high efficiency approaches such as combined heat and power (CHP) and thermal applications.

[4] For residential thermal applications, EPA wood stoves must be at least 75% efficient, and pellet stoves can be closer to 90% efficient, but the above figures are for industrial and institutional applications.

States should aim for a consistent **regional approach** to standards, given that RPS incentives in one state often drive construction of new facilities in neighboring states, and wood supply is also inherently regional in nature.

Incentives in climate and renewable energy programs

The ten-state Regional Greenhouse Gas Initiative and proposed federal cap and trade legislation provide additional incentives for new biomass generation by excluding biomass emissions from the cap because of presumed net climate benefits. However, biomass emissions must be counted under a cap and trade program unless a facility can positively demonstrate carbon neutrality through sustainable wood sourcing. Drafts of federal legislation to date, for example, have included some very weak definitions of "renewable biomass" that could allow high CO_2 emissions and undermine the cap, and RGGI states have yet to define regulatory requirements for renewable biomass exemptions. Biomass policy at the regional and federal levels should include full accounting of lifecycle carbon impacts, and incorporate additional ecosystem protections to safeguard against adverse impacts.

National and regional low carbon fuel standards

A **low carbon fuel standard (LCFS)** is a market-based policy tool to reduce the carbon intensity of fuels over time. This promising policy approach promotes the introduction of low and no carbon fuels such as electricity, hydrogen, CNG, and cellulosic ethanol, while discouraging the use of higher carbon fuels such as refined products from tar sands. California adopted an LCFS in 2009, and officials in 11 mid-Atlantic and northeast states have committed to pursue a similar **regional program**.

While low carbon biofuels could play a significant role in any LCFS program, recent scientific studies have cast doubt on the ability of certain liquid biofuels, such as corn ethanol, to reduce greenhouse gas emissions when compared to fossil fuels. Devoting large areas of land to biofuels production can displace crop production and raise food prices. This may lead to either the clearing of forest and grassland for crops, or increased cultivation of marginal agricultural lands that would otherwise have been allowed to revert back to forest or grasslands. Because forest and grasslands store more carbon than cleared or cultivated land, these conversions result in large releases of greenhouse gases and reduce the future carbon sequestration potential of those lands.

Research shows that cellulosic ethanol could reduce greenhouse gas emissions as much as 88% compared to a gallon of gasoline; by contrast, conventional production of corn ethanol that results in the conversion of forests and grasslands to new cropland can increase net greenhouse gas emissions because of these *indirect land use change (ILUC) impacts*. Thus, careful accounting for the carbon intensity of biofuels that takes into account these indirect emissions will be essential to ensuring that low carbon fuel programs deliver meaningful climate benefits.

Conclusion

Forests provide unrivaled environmental, economic and recreational value.   Forest carbon conservation can provide new revenue streams for landowners and hard hit rural communities dependent on the forest products industry while advancing biodiversity and watershed protection goals, improving habitat connectivity and forest health, and creating forests that are more resilient and adaptable in the face of escalating climate change.

Forest carbon policy involves all levels of government – federal, state and local – and is well suited to regional coordination. Through a concerted commitment to the five strategies outlined in this report, we can move forward and use our vast and valuable forests as a major tool to combat global warming.

References

Amano, M. and R. A. Sedjo. 2006. *Forest sequestration: performance in selected countries in the Kyoto period and the potential role of sequestration in post-Kyoto agreements*. Washington, D.C.: Resources for the Future.

Birdsey, R., K Pregitzer, and A. Lucier. 2006. Forest Carbon Management in the United States: 1600-2100. *Journal of Environmental Quality* 35: 1461-1469.

Birdsey, R. A., J. C. Jenkins, M. Johnston, E. Huber-Sannwald. 2007. *North American Forests,* in The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle. U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Synthesis and Assessment Product 2.2. Asheville, NC.: National Oceanic and Atmospheric Administration, National Climatic Data Center.

Bosworth, D, R. Birdsey, L. Joyce, C. Millar. 2008 Climate Change and the Nation's Forests: Challenges and Opportunities; *Journal of Forestry* 106(4): 214-221.

Butler, B. J. 2008. *Family Forest Owners of the United States, 2006, a Technical Document Supporting the Forest Service 2010 RPA Assessment.* Washington, D.C., U.S. Forest Service.

Congressional Budget Office. 2007. *The Potential for Carbon Sequestration in the United States*. Washington, D.C.: The U.S. Congress.

DeNormandie, J, C. Corcoran, and J. J. Clarke. 2009. *Losing Ground: Beyond the Footprint.* Lincoln, MA: Massachusetts Audubon Society.

Drummond, M.A. and T. R. Loveland. 2010. Land Use Pressure and A Transition to Forest-cover Loss in the Eastern United States. *Bioscience*, April 2010, Vol. 60 No. 4.

Foster, D.R. and W. Labich. 2008. A Wildland and Woodland Vision for the New England Landscape: Local Conservation, Biodiversity and the Global Environment. Pp 155-175. In R.A. Askins et al. (eds.), Saving Biological Diversity. Springer.

Foster, D.R., B. M. Donahue, D. B. Kittredge, K. F. Lambert, M. L. Hunter, B. R. Hall, L. C. Irland, R. J. Lilieholm, D. A. Orwig, A. W. D'Amato, E. A. Colburn, J. R. Thompson, J. N. Levitt, A. M. Ellison, W. S. Keeton, J. D. Aber, C. V. Cogbill, C. T. Driscoll, T. J. Fahey, C. M. Hart. 2010. *Wildlands and Woodlands: A Visions for the New England Landscape.* Petersham, MA: Harvard Forest, Harvard University. *Available at* http://www.wildlandsandwoodlands.org/sites/default/files/Wildlands%20and%20Woodlands%20New%20England.pdf

Gullison, R. E., P. C. Frumhoff, J. G. Canadell, C. B. Field, D. C. Nepstad, K. Hayhoe, R. Avissar, L. M. Curran, P. Friedlingstein, C. D. Jones, and C. Nobre. Tropical Forests and Climate Policy. Published online May 10 2007; 10.1126/science.1136163 (*Science Express Policy Forum*)

Luyssaert, S, E. D. Schulze, A. Börner, A. Knohl, D. Hessenmöller, B. E. Law, P. Ciais, and J. Grace. 2008. Old-growth Forests as Global Carbon Sinks, *Nature* 455, 213-215.

Minnesota Board of Water and Soil Resources. *Carbon Sequestration: Forests*. *Available at* http://www.bwsr.state.mn.us/practices/carbon_sequestration-forests.pdf

New England Governors Conference, Inc. 2009. *Report of the Blue Ribbon Commission on Land Conservation. Available at* http://www.negc.org

Nowack, D. J. and J.T. Walton. 2005. Projected Urban Growth (2000 – 2050) and Its Estimated Impact on the US Forest Resource, *Journal of Forestry,* Dec. 2005.

Sampson, R. N. and M. H. Kamp. 2007. *Part 1: Characterization of the Northeast Region,* in Terrestrial Carbon Sequestration in the Northeast: Quantities and Costs. Winrock International, The Nature Conservancy, and the Sampson Group. Report to: US DOE-NETL Cooperative Agreement DE-FC26-01NT41151.

Sampson, R. N. and M. H. Kamp. 2007. *Part 2: Recent Trends in Sinks and Sources of Carbon,* in Terrestrial Carbon Sequestration in the Northeast: Quantities and Costs. Winrock International, The Nature Conservancy, and the Sampson Group. Report to: US DOE-NETL Cooperative Agreement DE-FC26-01NT41151.

Smith, W. B., P. D. Miles, C. H. Perry, S. A. Pugh. 2009. *Forest Resources of the United States, 2007.* Gen. Tech. Rep. WO-78. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office.

Sohngen, B., S. Walker, S. Grimland and S. Brown. 2007. *Part 4: Opportunities for Improving Carbon Storage and Management on Forest Lands*, in Terrestrial Carbon Sequestration in the Northeast: Quantities and Costs. Winrock International, The Nature Conservancy, and the Sampson Group. Report to: US DOE-NETL Cooperative Agreement DE-FC26-01NT41151.

Stavins, R. N., and K. R. Richards. 2005. *The Cost of U.S. Forest-based Carbon Sequestration,* Arlington, VA: Pew Center on Global Climate Change.

Stein, Susan M.; McRoberts, Ronald E.; Alig, Ralph J.; Nelson, Mark D.; Theobald, David M.; Eley, Mike; Dechter, Mike; Carr, Mary. 2005. *Forests on the edge: housing development on America's private forests.* Gen. Tech. Rep. PNW-GTR-636. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Stoddard, M. D. D. Sosland, D and D.Murrow. 2006. *Climate Change Roadmap for New England and Eastern Canada.* Rockport, ME: Environment Northeast.

USDA Forest Service. 2007. *Interim Update of the 2000 Renewable Resources Planning Act Assessment.* FS-874. Washington, D.C.

U.S. Environmental Protection Agency. 2010. *Inventory of Greenhouse Gas Emissions and Sinks 1990-2008.* Washington D.C.

Walker, S.M, S Grimland, N Sampson, B. Sohngen, J. Winsten, J. and S. Brown, "Comparison of Terrestrial Carbon Mitigation Options in the Northeast United States," in Terrestrial Carbon Sequestration in the Northeast: Quantities and Costs. Winrock International, The Nature Conservancy, and the Sampson Group. Report to: US DOE-NETL Cooperative Agreement DE-FC26-01NT41151.

Woodbury, P. B., J. E. Smith, L. S. Heath. 2007. Carbon Sequestration in the U.S. Carbon Sector from 1990 to 2010. *Forest Ecology and Management.* 241 (2007) 14-27.

Zheng, D, L. S. Heath, M. J. Ducey, and J. E. Smith. 2009. A preliminary investigation of forest carbon changes associated with land-use change in northern New England. 2009. In: McWilliams, W., G. Moisen, and R. Czaplewski, comps. 2009. 2008 Forest Inventory and Analysis (FIA) Symposium; October 21-23, 2008; Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Zhou, G., S. Liu, Z. Li, D. Zhang, X. Tang, C. Zhou, J. Yan, and J. Mo. 2006. Old-Growth Forests Can Accumulate Carbon in Soils. *Science,* v. 314: 1417.

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