Forests in United States Climate Policy: A Comprehensive Approach

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Abstract

The comprehensive inclusion of domestic forests in national climate policy is essential to achieving United States goals to stabilize and reduce net emissions reductions in carbon dioxide (CO_2), the primary global warming gas. U.S. forests, conserved and properly managed for resilience to a changing climate, can double their current sequestration of CO_2 while contributing the majority of projected renewable energy supplies in the next 50 years at costs equal to or below other emissions reductions efforts. However, if present trends continue, the U.S. will lose 75 million acres of forestlands over 50 years, emitting almost 20 Pg (billion metric tons) CO_2 from deforestation *not counting* loss of future sequestration.

Three key actions can stem this loss and enable the net increase of carbon stocks: reducing forest loss; restoring existing forests' carbon stocks; and reforesting former forests. Including forests comprehensively within a cap and trade system will directly address and reverse the main source of human-caused forest CO_2 emissions: forest loss and depletion.

About the Author

Laurie A. Wayburn is the co-founder and president of the Pacific Forest Trust. Considered a preeminent authority on U.S. forests and their climate benefits, Wayburn is a leader of regional, state and national efforts to enact policies that unite conservation and management with market-based incentives to reduce carbon dioxide emissions as well as conserve and sustain forests. A graduate of Harvard University, she is the co-author of *America's Private Forests: Status and Stewardship, Forest Carbon in the United States: Opportunities and Options for Private Lands, Conservation Capital in the Americas* (in press) as well as many other publications.

Wayburn is a recipient of the 2009 U.S. EPA Climate Protection Award, the 2008 James Irvine Foundation Leadership Award, the Land Trust Alliance and Lincoln Institute for Land Policy's 2008 Kingsbury Browne Conservation Leadership Award and the 2007 Forest Leadership Award, all highly prestigious honors bestowed for her leadership advancing forests and their climate benefits. She lives with her family in the San Francisco area.

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I. Summary

Forests play a dual role in global climate change, both sequestering vast quantities of carbon dioxide (CO_2) as they grow and releasing it when disturbed by harvest, conversion, or natural phenomena. Despite the great potential of forests to sequester this greenhouse gas pollution, it is estimated that more than 40% of anthropogenic (human caused) CO_2 in the atmosphere today is derived from forest loss and degradation.[1] Therefore, an urgent concern in climate policy is how to address the role of forests in affecting atmospheric carbon balances. This question involves both the tropical forests of emerging economies and the temperate forests of the United States.

Currently, some 20% of annual CO_2 emissions globally are derived from forest loss and degradation. Due to the cycling time, the period required to reabsorb emitted CO_2 from the atmosphere, of carbon, which extends into the tens of thousands of years, loss and depletion of the great temperate forests in the United States is a major contributor to this excess CO_2. The clearing of our virgin forests—and their subsequent conversion and harvest—have released more than 25 billion tons of CO_2.[2] Over 30% of U.S. forests have been lost to conversion, and some 1.5 million acres of U.S. forests continue to be cleared for development annually.[3] This causes both the emission of the biological carbon stored, and prevents future sequestration options for these lands. Should this continue over the next 50 years, the United States will have lost another 50-75 million acres of forest, and a major tool for fighting global climate change. Watersheds and habitats essential for drinking water and species survival also will be lost.

While some carbon emissions from forest loss and depletion have been reabsorbed, domestic forest carbon stocks remain far below their historic potential, and are only at 10-50% of their pre-European levels.[4] Restoring forest carbon stocks through land conservation, stewardship forestry, reforestation, reducing forest loss, and sustainable use of wood for energy could contribute an additional 1-1.5 billion tons of annual CO_2 emissions reduction for the U.S. carbon budget. These gains could be accomplished

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[1] Fisher, B.S., Nakicenovic, N., Alfsen, K., Corfee Morlot, J., de la Chesnaye, F., Hourcade, J., Jiang, K., Kainuma, M., La Rovere, E., Matysek, A., Rana, A., Riahi, K., Richels, R., Rose, S., van Vuuren, D., & Warren, R. (2007). Issues related to mitigation in the long-term context, In *Climate Change 2007: Mitigation. Contributing of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R., Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA.

[2] Houghton, R.A., Hackler, J.L., & Lawrence, K.T. (1999). The U.S. Carbon Budget: Contributions from Land-Use Change. *Science* 285, 574-578.

[3] USDA Forest Service. (2007). *Interim Update of the 2000 Renewable Resources Planning Act Assessment*. FS-874. Washington, DC. 113 p.

[4] Rhemtulla, J.M., Mladenoff, D.J., & Clayton, M.K. (2009). Historical forest baselines reveal potential for continued carbon sequestration. *Proceedings of the National Academy of Sciences,* 106:15, 6082-6087.

Whitney, G.G. (1996). *From Coastal Wilderness to Fruited Plain: A History of Environmental Change in Temperate North America from 1500 to the Present.* Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA.

through the launch of a domestic forest sector counterpart to tropical "REDD" (Reducing Deforestation and Degradation) programs designed for use in developing countries by parties to the Kyoto Protocol and its successor agreement to address global climate change.

This U.S. program would establish a minimum national baseline for forest climate benefits and integrate actions in the forest sector with those under a national cap and trade program. By setting that minimum baseline, efforts to create increases through carbon emissions reduction projects would have a clearly positive impact for the atmosphere, and create integrity throughout the system of emissions reductions efforts in forests. Overall, this would also increase beneficial services of forests in other aspects of climate change, such as in restoring and conserving watersheds, as it would entail significant new conservation of forest across the United States.

II. Introduction

Forests are critically important in the global carbon cycle. Acting as either sources of emissions of carbon dioxide (CO_2), or as "sinks" that absorb excess CO_2 and store it as carbon (C) in woody tissue and soils for millennia, forests are a significant part of both the solutions sought in addressing climate change, and the causes thereof.

This has been recognized globally since the development of the Kyoto Protocol. Forest loss and degradation is the second largest source of excess CO_2 emissions after fossil fuels. The importance of maintaining and restoring forests as carbon "sinks" was highlighted as the first identified recommendation of the Protocol. Article 2 reads:

> "1. Each Party . . . in achieving its quantified emission limitation and reduction commitments . . . in order to promote sustainable development shall: . . . (a) Implement and/or further elaborate policies and measures . . . such as [the]. . . (ii) Protection and enhancement of sinks and reservoirs of greenhouse gases not controlled by the Montreal Protocol, taking into account its commitments under relevant international environmental agreements; [and the] promotion of sustainable forest management practices, afforestation and reforestation."

However, global action on this recommendation has been stymied for lack of an agreement on how to approach the issue broadly even as there has been widely increasing acknowledgment of the need to act, especially to address tropical forest loss and degradation. A lack of legal, economic and social infrastructure in many countries, as well as, in some cases, sufficient scientific data, has hampered concerted action to halt global forest loss

As the United States is poised to reenter international negotiations on climate change, it has a unique opportunity to set an example, addressing its own deforestation and forest depletion. By instituting a model approach to reducing forest loss and degradation, the U.S. may indeed restore much of its once vast forest carbon "banks" by addressing these issues in a comprehensive and practical fashion domestically. A comprehensive approach that includes the forest sector overall and integrates the accounting of carbon in the forest sector with other sectors of the U.S. economy is essential, especially as the use of woody biomass from forests has emerged both domestically and globally as a key potential source of sustainable, renewable energy and transportation fuel.

Such an approach is being pioneered at the state level with a prototype in California under its economy-wide cap on greenhouse gases mandated by AB 32 (2006), the Global Warming Solutions Act. Implementation of this Act outlines a policy for the forest sector, which calls for the maintenance of *at least* current levels of sequestration from forests, and establishes a set of incentives and standards for increasing net forest carbon such that emissions reductions in the forest sector will be equivalent to and fungible with those from fossil fuels.

III. United States Forests: Status, Trends and Potential Carbon Impacts

Forests currently occupy roughly one-third of U.S. territory, or 749 million acres.[5] This represents a one-third reduction from their original extent at the time of European settlement. (Global forest loss also is approximately one-third, paralleling the U.S. experience) These vast temperate forests contain some of the most productive and largest carbon sinks globally.[6] Their harvest and conversion has been the cause of CO_2 emissions in excess of 25 billion tons between 1700 and 1990.[7] According to the Intergovernmental Panel on Climate Change, it takes over 35,000 years for forests to reabsorb fully a ton CO_2 released to the atmosphere, a process known as "cycling time." Therefore, much of this CO_2 released from the clearing and harvest of U.S. forests remains in the atmosphere today. Despite composing less than 8% of the global forestland base, the loss of U.S. forests is responsible for nearly 20% of all global emissions from deforestation annually—including the estimated 1.6 billion tons emitted from tropical deforestation each year.[8] On this basis alone—not counting the historic U.S. forest emissions still in the atmosphere—including domestic forests in U.S. climate policy is significant to the national carbon budget. They have been, and are part of the problem, as well as part of the solution.

A key feature of forest carbon emissions and the re-absorption, or re-sequestration, of those emissions is the time lag that occurs between these events. The emissions are

[5] Smith, B.W., Miles, P.D., Vissage, J.S., & Pugh, S.A. (2003). *Forest Resources of the United States, 2002: A Technical Document Supporting the USDA Forest Service 2005 Update of the RPA Assessment.* GTR-NC-241. St. Paul, MN: USDA, Forest Service, North Central Research Station. 137 p.
[6] Dixon, R.K., Brown, S., Houghton, R.A., Solomon, A.M., Trexler, M.C., & Wisniewski, J. (1994). Carbon pools and flux of global forest ecosystems. *Science,* 263, 185-190.
[7] *Id.* at ii.
[8] Denman, K.L., Brasseur, G., Chidthaisong, A., Ciais, P. Cox, P.M., Dickinson, R.E., Hauglustaine, D., Heinze, C. Holland, E., Jacob, D., Lohmann, U., Ramachandran, S., da Silva Dias, P.L., Wofsy, S.C. & Zhang, X. (2007). Observations: Surface and Atmospheric Climate Change. *In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA.

immediate in their impact in the atmosphere, whereas re-absorption of those emissions may take hundreds and thousands of years. It requires at least the same time period to re-absorb emissions from a forest, assuming the same extent and type of forest, as the number of years in the age of that forest upon harvest.

Restoration of U.S. forest carbon sinks, which began in parts of New England earlier in the last century even as virgin forests in the northwest were being converted, will thus be a dynamic process extending over a significant time scale. It will also require that the forestland base of the country is largely maintained. Equivalently, reducing deforestation has an immediate impact that will endure. There is thus a significant time lag between remedial actions taken to restore forests and their atmospheric impact.

IV. Harnessing the Climate Benefits of Forests

A suite of actions will yield climate benefits from domestic forests over time, with some being more immediate in their impact, and others more in the medium- and long- term. These can be categorized as follows:

- Reducing forest conversion and securing the forestland base, which has immediate benefits of preventing emissions and long-term benefits of continuing sequestration;

- Managing existing forests to restore depleted carbon banks, which has near-, medium- and long-term benefits;

- Replanting former forests, which has medium- and long-term benefits; and

- Managing forests and wood waste sustainably to provide sustainable, renewable biomass energy, which will have near-, medium- and long-term benefits.

Overall, changing how we manage and sustain forests, as well as how we utilize currently non-commercial forest products for energy over the next 100 years can result in net emissions reductions of 100-150 billion tons of CO_2.

While often thought of as complex, accounting for forest carbon is relatively simpler than for many other emissions sectors. It is based on three key factors: the amount of land in forest, the number of trees on that land and knowledge of the “growth and yield” (growth of the trees and yield of timber product from them). In the United States, these factors—amount of land in forest, amount of forest on that land and the biology of the commercially managed, as well as most non-commercial, tree species—are well documented. Multi-billion dollar forest industries are based on knowing just these facts articulated in volume of wood on land and in products. These are essential data required for doing business.

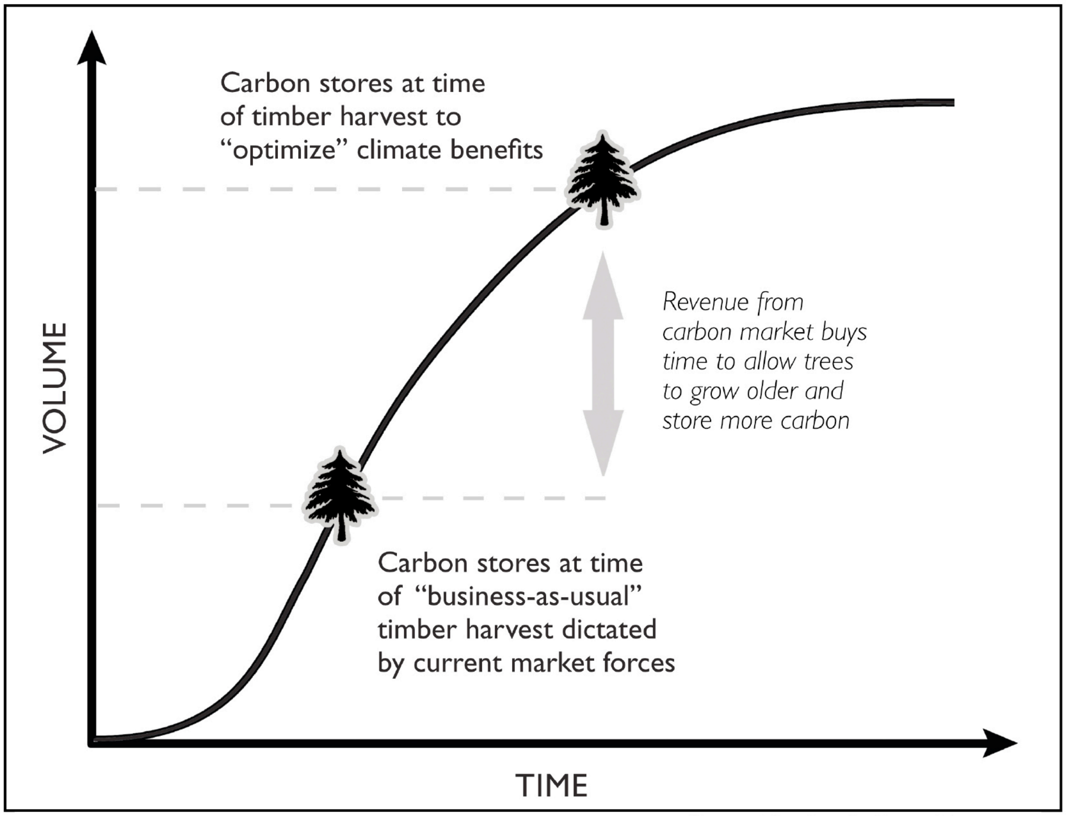
The scientific basis for projecting tree growth and converting that wood volume to carbon is well known, with more than 100 years of scientific study and publication on the topic.[9] Ownership of forestland in the U.S. also is well documented and tracked, as is development, through a variety of county, state and federal programs. Hence, monitoring forest carbon change in the U.S. is quite feasible, based on existing data, legal, economic and social systems.

Currently, U.S. forests hold, on average, substantially less carbon stock than they did 150 to 200 years ago.[10] Old growth forests held, on average, twice to tenfold the carbon that today's forests hold. These forests were also, on average, at least twice and sometimes even ten times the average age of today's forests. Forest age and amount of total carbon stock are highly correlated, with older forests (and trees) holding and annually accumulating more carbon than younger forests. Forest management today largely focuses on shorter rotations and more intensive management of forests, part of a global trend resulting in increased carbon emissions from, and decreased carbon stocks in, forests.

This poses a significant opportunity to increase the average stock of carbon through management to restore many characteristics of older forests, simply by increasing their average age over time through gradual decreases in the percentage of inventory harvested. As illustrated in the graphic below, this will increase not only the net carbon stored in the forest, but also the amount of timber product inventory removed over time.

[9] Smith, J.E., Heath, L.S., Skog, K.E., & Birdsey, R.A. (2006). *Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States*. GTR-NE-343. Newtown Square, PA: USDA, Forest Service, Northeastern Research Station. 216 p.
[10] *Id.* at iv.

Forest Carbon Stores Over Time (Generalized)

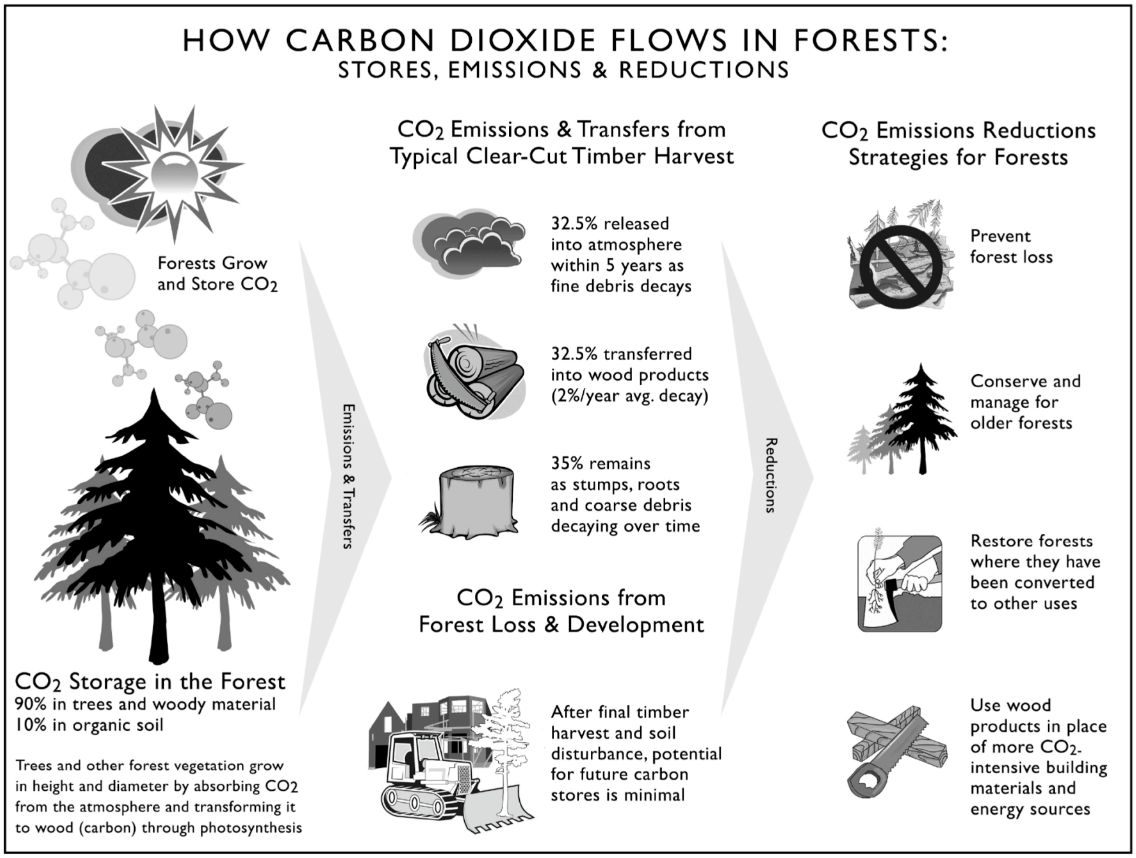


Source: The Pacific Forest Trust

Figure 1: Allowing forest to grow older will increase net stock of carbon and yield of forest products.

Forests also impact carbon flows in a number of other "emissions sectors" for carbon dioxide that are fossil fuel-based, most notably energy, manufacturing (i.e. paper and other forest products) landfills, and transportation. Carbon harvested from forests is used in biomass energy plants where it is combusted and released to the atmosphere. It is incorporated in myriad products disposed of in landfills, where it becomes methane, a gas with 67 times the global warming impact of CO_2.

Wood also is key in construction, where it decays at various rates, depending upon its specific use. Overall, there are sufficient tracking systems to establish rates of decay, or emission from forest product to establish its fate over time within a national accounting system.



Source: The Pacific Forest Trust

Figure 2: Forests are our national carbon bank accounts. There is one deposit system: photosynthesis, but many withdrawals. Managing the nation's forest carbon banks for net increases will prevent "bankruptcy" (conversion and deforestation); open more accounts (reforestation) and grow current accounts (restoration) while spending returns (forest products) more efficiently and effectively (substitution).

1. Conserving the forest land base/preventing deforestation and conversion

The United States loses 1.56 million acres a year to conversion.[11] If this trend continues, in 50 years, another 75 million acres will have been converted. Though varying by region and forest type, a typical U.S. forest stores approximately 72 metric tons of carbon (264.25 Mg CO_2) per acre on average.[12] Extrapolated over the 75 million acres expected lost to conversion in the next half century, this spells a loss of carbon from our forests of approximately 5.4 billion tons of carbon (19.8 Pg CO_2). This does not include the additional and vast quantities of future sequestration that will also be sacrificed.

[11] USDA Forest Service. (2007). *Interim Update of the 2000 Renewable Resources Planning Act Assessment*. FS-874. Washington, DC. 113 p.
[12] Birdsey, R.A. (1992). *Carbon storage and accumulation in United States forest ecosystems.* General Technical Report WO-GTR-59, USDA Forest Service.

It is well recognized that efforts to reduce fossil fuel consumption and their emissions will take time to accomplish as we continue to evolve new technologies to produce energy and increase efficiency. At the same time, globally emissions are rising, especially from China, India, Russia and Brazil as these economies rise. Thus, over the next several decades, emissions reductions from forests are perhaps particularly valuable to serve as a counter balance to increasing emissions from other sectors. This also will provide the US with a substantial emissions reductions market potential from domestic forests within the growing global carbon market. That market transacted over $60 billion in 2008, greater than the global wheat market. However, if we continue current rates of forest loss, we stand to we will be adding to net emissions at precisely the time that forests are most needed to reduce emissions, in the near and medium term, and we will lost that market potential, as well

As with all efforts to reduce CO_2 emissions, there would be a cost to reducing emissions from avoiding deforestation and conserving forestland. It is, however, a cost well within the ranges of projected costs for other emissions sectors. A common legal tool used to reduce or prevent development and dedicate land to productive, natural conditions is a conservation easement (CE). Were (CEs) to be purchased preventing development, and with a modicum of provisions to ensure some forest cover, vast amounts of forest carbon could be protected safely and at minimal cost. Assuming an easement cost of $500-1000 per acre and using a discount rate of 3%, conserving these forests would protect over 5.4 billion tons of carbon at a cost of $4-8 a ton in 2009 dollars. When the enormous additional future sequestration potential of these forests is included in the calculus, the economic value of conserving these lands becomes even greater. In addition, conserving and stewarding large-scale private forests for their net carbon storage offers the co-benefits of preserving vital watersheds and biodiversity while preparing these lands for adaptation to a warming climate.

2. Restoration of former forest

Over one third of U.S. forests have been converted out of forest since European settlement, with some reforestation in now abandoned farmlands in the New England and Mid West, as well as in-growth from fire suppression in many western states. However, there is substantial former forest acreage that remains out of forest, with more than 300 million acres of historic forestland converted since 1630.[13] While much of this land is in productive agriculture, or is unavailable as it is under cities, suburbs and roads, material acreages could be reforested without a negative impact on food production, especially through focusing on reforesting of riparian areas along key watersheds. It is estimated that an acre of hardwood bottomland reforested in the lower Mississippi floodplain sequesters an average of 100 and up to more than 300 tons of carbon dioxide over the next 100 years—meaning that the reforestation of riparian areas along the Mississippi and

[13] Smith, B.W., Miles, P.D., Vissage, J.S., & Pugh, S.A. (2003). *Forest Resources of the United States, 2002: A Technical Document Supporting the USDA Forest Service 2005 Update of the RPA Assessment.* GTR-NC-241. St. Paul, MN: USDA, Forest Service, North Central Research Station. 137 p.

Missouri Rivers could provide substantial carbon benefits. [14] One such project, on the Tensas River National Wildlife Refuge in Tallulah, Louisiana, is estimated to sequester up to 600,000 tons of carbon dioxide over the next 50 years. [15] In addition to these substantial climate benefits, riparian forests also offer major benefits for water quality, lessening nitrogen and sediment loads, and providing key wildlife habitat. With only 20% of the 22 million acres in the Lower Mississippi Alluvial Valley supporting their original bottomland hardwood habitat, the scale of carbon benefits achieved in these efforts may be quite material considerable over time.[16]

3. Increasing average age of forests

As illustrated in numerous studies, including by Houghton (2008) in Rocky Mountain forests, Harmon (1992, 2007) and Law (2008) in northwestern forests, and Rhemtulla et al. (2009) in mid-western forests, U.S. forests are far from their optimal condition or age for either stock of carbon or production of wood products.[17] This is directly correlated with the average age of these forests. Younger, more frequently managed forests store less carbon, than do older, more intact forests. In Wisconsin, Rhemtulla et al. found that both the reforestation of previously deforested lands and the continued growth of existing forests presented an immense opportunity for increasing untapped carbon storage. On average, forests in Wisconsin have only regained about 50% of their historic levels of carbon storage after 70 to 100 years of regrowth—suggesting that a considerable potential for additional carbon storage exists in these forests. By increasing the average age of existing forests, 69 million tons or more of additional carbon storage could be achievable in Wisconsin alone, and this would be a conservative estimate. [18] When the additional carbon storage potential from reforestation is included in these estimates, the potential for untapped carbon storage more than triples. California redwood forests are another compelling example, with average industrial carbon stores at 10% or less of what older, more natural forests store.[19]

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[14] Özberk, E. & McFarland, B. (2008). *Tensas River National Wildlife Refuge Afforestation Project*. Carbonfund.org.

[15] USFWS Press Release. (Sept. 28, 2004). *Louisiana Partners Use Innovative Conservation Tool to Save Threatened Habitat in Lower Mississippi River Valley.* http://www.fws.gov/news/NewsReleases/showNews.cfm?newsId=4FACA0BE-B9C3-63E3-951F15BF1D459389 (accessed June 1, 2009).

[16] *Id.* at xiv.

[17] *Id.* at iv.

[18] *Ibid*.

[19] Wayburn, L.A., Franklin, J.F., Gordon, J.C., Binkley, C.S., Mladenoff, D.J. & Christensen, Jr., N.L. (2007). *Forest Carbon in the United States: Opportunities & Options for Private Lands.* Pacific Forest Trust.

Forest Carbon Storage: Past & Present

Forest Type	Forest Location	Historic C (Mg ha^{-1})	Present C (Mg ha^{-1})	Present Capacity
Mixed Mesophytic	S. Indiana	145	56	39%
Mixed Mesophytic	E. Kentucky	107	60	56%
Beech-Sugar Maple	S. Michigan	171	49	29%
Northern Hardwoods	U.P. Michigan	147	49	33%
Northern Hardwoods	U.P. Michigan	129	49	38%
Hemlock-White Pine-N. Hardwoods	L.P. Michigan	309	49	16%
Sugar Maple-Basswood	S. Minnesota	137	36	26%
Sugar Maple-Basswood	S. Minnesota	135	36	27%
Northern Hardwoods	C. New Hampshire	118	73	62%
Hemlock-White Pine	S. New Hampshire	333	73	22%
Spruce-Fir	N. New Hampshire	112	73	65%
Oak-Hickory	New Jersey	109	65	60%
Hemlock-White Pine-N. Hardwoods	N.W. Pennsylvania	200	64	32%
Hemlock-White Pine	N.W. Pennsylvania	198	64	32%
Hemlock-Northern Hardwoods	C.Vermont	190	71	37%

Figure 3: Current levels of carbon stocks in forests across the US are far below historic levels, illustrating the potential to reabsorb and store substantial additional amounts of carbon in the next decades.[20]

4. Closed loop product substitution: woody biomass for energy

Biomass already plays a substantial role in the nation's energy supply, contributing 47% of renewable energy consumption in 2003, and more than 3% of total U.S. energy consumption, with 87% of that coming from forests.[21] Of that 87%, the vast majority is derived from forests, with culled urban trees and those harvested from tree thinning of utility and suburban communities contributing a portion as well. The Energy Information Administration projects that, with the enactment of a national renewable energy standard, the contribution of biomass will increase to more than 60% of all renewable consumption over the next two decades – or 13% of total U.S. energy consumption.[22] U.S. forests currently provide approximately 142 million tons of woody biomass annually, or enough to generate about 142 billion kilowatt-hours. (One ton of woody biomass equals

[20] *Id.* at iv, v.

[21] Perlack, R.D., Wright, L.L., Turhollow, A.F., Graham, R.L., Stokes, B.J., and Erbach, D.C. (2005). *Biomass as feedstock for a bioenergy and bioproducts industry: The technical feasibility of a billion-ton annual supply*. U.S. Department of Energy DOE/GO-102005-2135.

[22] US DOE. (2009). *Impacts of a 25-Percent Renewable Electricity Standards as Proposed in the American Clean Energy and Security Act Discussion Draft.* Energy Information Administration, Office of Integrated Analysis and Forecasting. Washington, DC. SR/OIAF/2009-04. 42 p.

1,000 kilowatts; roughly the amount one person consumes in a month). The Department of Energy estimates that the potential of U.S. forestlands to contribute woody biomass is far greater however, and could account for up to 368 million dry tons of biomass annually for energy production.[23]

If this biomass can be produced in a "closed loop" —wherein the emissions caused through the production and combustion of woody biomass are reabsorbed in the next cycle of forest growth—this results in net less CO_2 emissions over time than those created through the use of fossil fuels. This substitution of woody biomass as sustainable, renewable energy for non-renewable energy is one of the most significant positive indirect climate benefits from forests. It is predicated on having the requisite land base to produce these energy and fuel stocks. Land-use decisions and land conservation strategies that prevent conversion of these lands to other uses will be essential for production of this renewable energy solution. However, "closing the loop" on production of this biomass is essential. Older forests have significantly higher current and future carbon stocks. If they are harvested to make way for energy plantations, or demand for other wood products is simply shifted to other forests (creating emissions "leakage"), then a closed loop will take longer to achieve or may not be achieved, resulting in net greater emissions being produced overall.

5. Regional differences in climate strategies

Forestry has become an increasingly global industry in the last two decades, with many economic decisions influenced more by global trends than state or national ones. Moreover, forest management and land use are regulated at the state level in the United States. The context of decision making for landowners has been heavily influenced by global trends and state contexts more than national influences. As such, effective national policy to restore increased average carbon stocks across the landscape must leverage both global trends, which the growing carbon market provides, and also build from the distinct base in each state.

State contexts and opportunities vary considerably across the United States. Historically the nation's forested regions may be characterized by regional groupings: eastern forests of New England and mid-Atlantic; southern forests; the Lake States; northwestern forests, lands of the southwest and Alaska. For discussion purposes and given major similarities, it is useful to view these as groups that share major contexts and opportunities broadly, although they differ in regional specifics. In all cases, efforts to increase net carbon stocks, as well as reduce forest loss and increase the stability of the forestland base, must address the threats thereto. Across the board, each region's top priority is centered on conserving their land base, with emphasis on varying management changes that can restore and maintain carbon stocks closer to historic levels, adapted by region.

In New England and the mid-Atlantic region, the two greatest threats to forests and the stability of their carbon stocks are land loss and inconsistent forest management (pers.

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[23] *Id.* at xxi.

comm. D. Foster, January 2009). These have led to forest fragmentation and unsustainable trends in forests structure and stocking Here, the two most promising strategies will be 1) increased conservation and 2) stewardship programs to restore forest composition and resilience. These strategies also will yield an increased stock of low-grade wood products resulting from restoration management that can supply the increasing demand for biofuels, which may have a dual climate benefit in reduced reliance on fossil fuels.

These three foci—land conservation, restoration and biomass production for fuel substitution (although from managed plantations)—also apply to many southern forests (pers. comm. N. Christensen, January 2009). Forest restoration through reforesting historic forests may also be an important tool, with benefits yielded over the longer term (Ibid.) In the Pacific Northwest, restoring some portion of the immense stocks of forest carbon that these highly productive forests held will yield substantial net increases in sequestration (pers. comm. M. Harmon, J. Franklin, January 2009) as well as conserve the land base increasingly threatened by urbanization. Harvest of this region's virgin forests in the 1800-mid 1900s led to the emission of billions of tons of CO_2.[24] Harvest and conversion remain significant sources of CO_2 emissions in Washington State today.[25] It is estimated that doubling the average age of these forests would double, or more, standing stocks of carbon while still keeping these lands in timber production. In the Lake States, the focus on restoration management will increase the resilience of the region's forests substantially as well as potentially double standing stocks of carbon. A biomass fuel substitution focus in this region, as in others, will need to be carefully assessed to ensure that, indeed, net gains are being made in reductions of atmospheric carbon.

In the intermountain forests extending from the Rockies to the "east side" forests of the Sierra in California and the Cascades of Oregon and Washington, which are dominated by federal ownership, a different strategy might yield the best results. Here, increased management to restore a more natural forest composition and structure will be key to long-term restoration of carbon stocks, though in the near- to mid- term they may have increased emissions from harvest. This area, with appropriate infrastructure development of small-scale facilities, could contribute substantially to biomass energy, as well. Alaska, with its remaining virgin forests, has very similar issues as those faced in tropical countries with intact native forests.

Avoiding deforestation of these forests, which estimated carbon stocks of more than 13.9 Pg, is the single most effective strategy from a climate perspective. Clearly, ensuring that these substantial forest carbon stocks are not released through harvest is critical.[26] Thus,

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[24] Harmon, M.E. Ferrell, W.E. and Franklin, J.F. (1990). Effects on carbon storage of conversion of old-growth forests to young forests. *Science* 247, 699-702.

[25] Washington Climate Advisory Team. (2008) *Leading the Way: A Comprehensive Approach to Reducing Greenhouse Gases in Washington State.* Recommendations of the Washington Climate Advisory Team. http://www.ecy.wa.gov/climatechange/reports.htm <http://www.ecy.wa.gov/climatechange/reports.htm> (accessed June 24, 2009).

[26] Birdsey, R.A. (1992). *Carbon storage and accumulation in United States forest ecosystems.* General Technical Report WO-GTR-59, USDA Forest Service.

while each region varies in its strategic approach, all have a significant opportunity to increase or stabilize carbon stocks.

IV. Integrating Forests in Climate Policy: Accounting, Monitoring and Markets

Accounting for flows of biological carbon emissions and sequestration in the forest sector, and across into other emissions sectors, can and must be consistent and fungible with accounting for other emissions sectors based on fossil fuels. However, ecosystem carbon differs significantly in one aspect: this carbon is embedded in a dynamic, living system that cycles. Carbon cannot be effectively separated from the ecosystem, whereas emissions from fossil fuels have a linear path. The stability, resilience and adaptability of the ecosystem are a key factor in ensuring the stability and reliability of forest carbon. If the landscape that is storing carbon is unstable and degraded, then the carbon within it is also at risk. As such, any system that seeks to increase carbon stocks in and prevent carbon loss from forests focus also on promoting ecosystem resilience and adaptability. With likely increased stress on ecosystems from climate change, this becomes even more important.[27]

Forests, as all natural habitats, which have more natural characteristics: species composition, more natural and complex structure, a range of naturally occurring age classes are more resilient under stress.[28] Thus, forest management which retains, promotes and restores more natural characteristics in a forest results in a forest which is more resilient and robust under the increased stresses of climate change. As national policy promotes reductions in net CO_2 emissions via forest carbon, it must therefore also incorporate a focus on restoring ecosystem resilience and adaptability through promoting natural forest management.

These more natural forests also provide a variety of other key climate benefits as we deal with climate change. Perhaps most important, forests serve as watersheds. With the increasing variability of weather patterns and a general drying predicted for much of the US under a changing climate, managing forest for this watershed function becomes more vital. There is a synergy in managing for the restoration of more natural levels of carbon stocks and the management, which will promote and protect watershed functions.

Managing for short-term gains in tons of carbon *alone,* without these considerations, could well lead to greater instability in ecosystems; whereas managing for carbon gains within the context of managing also for more stable, robust resilient ecosystems will likely have more durable results. Instituting a climate policy to increase net forest carbon consistent with reducing uncertainty and risk for ecosystems will likely have longer lasting positive impacts for climate.

While the critical issue of reducing CO_2 emissions from forest loss and degradation globally has long been recognized, the means of regulating emissions from forest loss or

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[27] Millar, C.I., Stephenson, N.L., & Stephens, S.L. (2007). Climate change and Forests of the Future: Managing in the Face of Uncertainty. *Ecological Applications* 17:8, 2145-2151.
[28] *Ibid.*

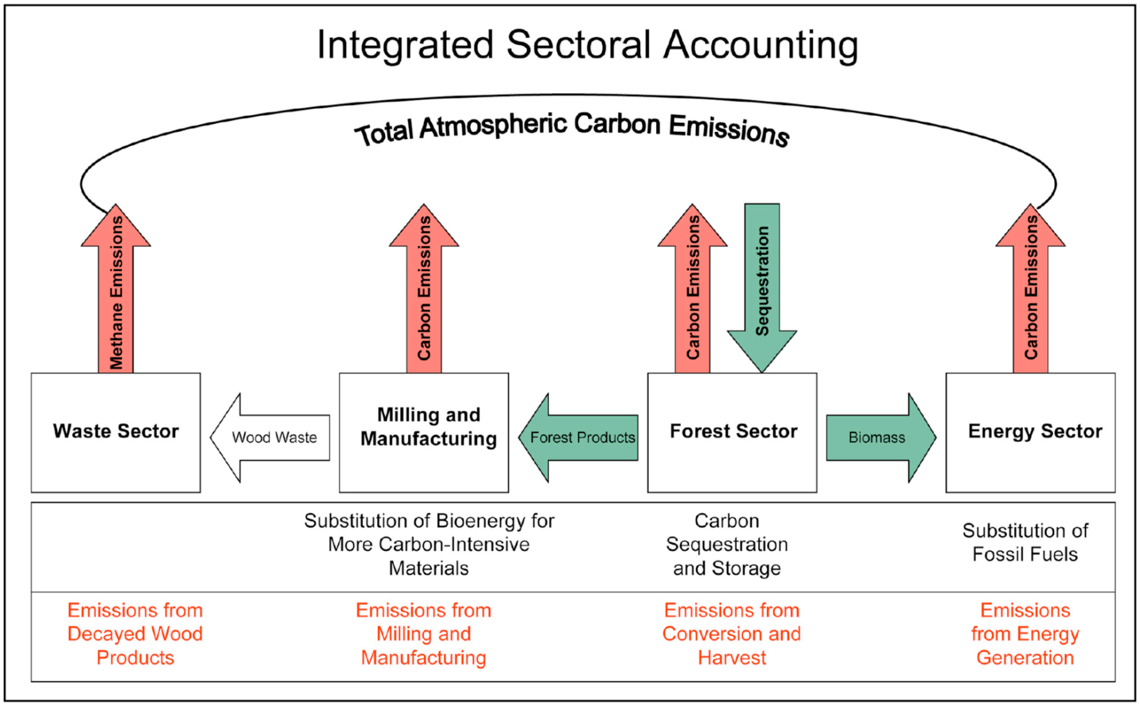
establishing targets for forest sequestration and gain has been far less well established. There has not been a widely accepted parallel treatment of limiting forest sector emissions and promoting emissions reductions in a fashion equivalent with those from other emissions sectors. Globally, forest loss and depletion was primarily seen as a developing country concern, not one of the developed economies committed under the Protocol. It was therefore not initially addressed in any direct fashion, rather as a minor mechanism for defined project level offset activities as part of the Clean Development Mechanism. (a feature of the Protocol allowing signatories from industrialized countries to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their home countries). These project level activities are inherently limited in their effectiveness for emissions reductions broadly, as they occur in the absence of a clearly defined context of limits on emissions from the sector in which they occur. In the energy sector, by contrast, individual generation facilities are given reduction mandates within a sectoral limit overall and thus the individual actions also collectively meet a clearly defined goal and are within an overall monitoring system to achieve that goal.

A further challenge for ensuring real gains out of the forest sector through project level activities alone is that the sector is inherently linked with other emissions sectors, especially energy and manufacturing.

1. Inventory and monitoring

Wood is used in many parts of the world, including the U.S., to generate energy. Woody biomass accounts for the majority of renewable energy supplies in the US, with hydroelectric energy second. Accounting for emissions from combustion or other techniques of woody materials for energy is part of the accounting cycle for emissions derived from forests, once one includes the product cycle (see above). Thus, accounting for emissions only within a single project area misses the interactions with other emissions areas or requires very complex, cumbersome and expensive accounting and monitoring systems.

While the U.S. has long desired to include forests in its own accounting to meet potential national targets within an international framework, it did not have a similarly comprehensive treatment of forests to that for the energy or transportation sectors. Thus, the global community and international carbon markets have not embraced the inclusion of forests within the U.S. portfolio. The challenge for the U.S., then, within this global context, is to establish a comprehensive and integrated approach for the forest sector that will ensure net reductions in atmospheric CO_2 are achieved from this sector, rather than a set of individual project activities that, while in and of themselves may be beneficial, have no real impact on the sector as a whole.



Source: The Pacific Forest Trust

Figure 4: By tracking forest carbon at the sectoral level, forest carbon may be fully integrated with carbon accounting among other economic sectors, thereby eliminating concerns of leakage from forest emissions reductions.

While the U.S. has argued for the comprehensive accounting of CO_2 emissions from tropical forests, the infrastructure to do so is not yet in place. However, the fundamental elements and infrastructure of a comprehensive accounting system are already in place in the U.S. These exist in systems at the federal, state and county jurisdiction. While these may have varying levels of accuracy, taken as a whole they comprise the basis on which solid data can be derived and a comprehensive monitoring system built.

Any monitoring system needs to be established and implemented in a practical fashion to capture both the quantity and quality of data required to determine significant changes, trends, and causes of those and be cost-effective. Building from existing data where it is of usable quality is therefore a practical approach. Data is gathered by a variety of sources in the forest sector.

At the federal level, the FIA, or Forest Inventory Analysis, is the most appropriate data set. Although it was designed for other purposes than monitoring CO_2 emissions and sequestration, it can be extrapolated from to assess changes in forest carbon stocks. The FIA is currently used to estimate national emissions and sequestration from all U.S. forests for purposes of reporting to the UNFCCC. The FIA has an excellent distribution of data plots on federal forests. On private lands, however, significant investment will be needed to bring an equivalent level of robustness to the data derived. However, other data sources exist that can be used while improvements are made to the FIA that have a fine grain of resolution. These are at the county level, where development and forest conversions are tracked, and at the larger ownership levels where forest management is practiced regularly. In these ownerships, timber inventory records are maintained at high levels of accuracy, usually at a 90% confidence level.

Monitoring of forest carbon stocks also needs to be designed to focus on the key aspects of material change: deforestation and forest depletion, in order to stem the loss of forest carbon. It can therefore be initially directed to focus on lands where the material changes occur: lands under conversion, where data from county level permits is available, and ownerships of significant scale where harvest occurs regularly, causing changes in carbon stocks. This county level data on parcel conversion can be translated to its carbon impact by using aerial images (i.e. such as are available on Google Earth) and standard interpretation for forest types and associated carbon stocks.

There are an estimated 11,000 ownerships in the U.S. of private forests of 5,000 acres and above, and these owners control an estimated 25% of forests.[29] Owners of 1,000 acres and above control nearly 36%, and number fewer than 39,000.[30] This means that less than 0.09% of all forest owners control more than a quarter of all forest land, and while less than 0.35% control more than a third of all private forest land. Further, almost 90% of these owners, 32,000, are either publicly traded industrial ownerships, Timber Investment Management Organizations (TIMOs) or Real Estate investment Trusts (REITs), which typically maintain annual updates of their inventories in order to determine their financial value.[31] These ownerships therefore have data readily available on their inventories of timber.

Initially focusing on either of these ownership levels for reporting of annual changes in forest stocks would maximize monitoring coverage on private forestland while minimizing reporting burden. This will enable detection of trends in depletion over time.

Monitoring forests that are not managed regularly will require significant investment, but it is not essential as a first order priority in a comprehensive monitoring system because these lands are not changing significantly on an annual basis. Rather, they are steadily accumulating greater carbon stocks. These trends can be adequately inferred from the existing FIA.

With these foci, use of country permit data for conversions and deforestation, use of ownership level, fine grained data from private ownerships at 1000 or 5000 acres; and FIA data for federal and non managed lands, a manageable number of entities can be monitored, and reports developed from existing data systems.

Forests in the U.S. are divided into two main sets of ownership: 43% public, 57% private. Within the public ownership, the predominant form is federal, 77%, state 21% and local

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[29] Butler, B.J. (2008). *Family Forest Owners of the United States, 2006.* GTR-NRS-27. Newtown Square, PA. USDA, Forest Service, Northern Research Station. 72 p.
[30] *Ibid.*
[31] *Ibid.*

1%.[32] From a climate perspective, management choices on the federal lands are most significant, as these are the largest holdings and the least fragmented, therefore holding the largest carbon stocks currently and most potential for increases both in net stocks and robustness of those stocks. These stocks, overall, are the stocks that have been increasing over the past two decades and are not threatened by conversion to development. They are also governed through common national policy mechanisms, rather than the fragmented patchwork of state policies, and they are less affected by trends globally in terms of management choices. They are governed by national legislative mandate and direction from the executive branch. As such, they are ideally suited to have national objectives established for them in addressing climate change.

2. Public lands and public mandates

Federal, and most public, forests are far less affected by market forces than privately owned forests. With their public trust mandates, and with their positive role in serving as the bulwark of carbon sinks in the United States, it makes sense to dedicate these forests to serving as the anchor for forest sequestration nationally. This carbon storage will help meet national commitments. It also makes sense to exclude public forests from market forces that may derive from a cap and trade system, as their management is not centrally responsive to these.

Given the significant emerging threats to watershed and habitat health and function from climate change, these federal forests can serve as key cornerstones for landscape level management strategies to promote forest resilience. This approach to management of federal forests, which is consonant with their existing mandates, yields double benefits for climate: both for increased resilience and adaptability to climate change, and increases in long-term carbon stores. Financing of these measures must be added, though to the federal budget as the existing management on federal forests is not adequate to respond to the increasing threats of climate change that have combined with historic conditions to pose unprecedented levels of "natural " risk from fires, pests, weather stress and invasive species.

3. Private lands and a market framework a market

Privately owned forests face some of the same "natural" threats to the stability of their carbon stores as federal forests in portions of the country, but, as noted above, also face threats that are market oriented in nature: higher competing values from development, or alternative uses of the land for agriculture, or for short-term, intensive forestry with lower overall yields of carbon. These threats to private forests, then, are susceptible to market forces, and are thus appropriate to include within a cap and trade system, with appropriate rules to regulate this market.

Key tools that could be utilized in this regard are the Clean Air Act and the National Environmental Policy Act, and at the state level, their state counterparts in Environmental Quality, Review and/or Protection Acts. Sixteen states, as well as Puerto Rico and the

[32] *Ibid.*

District of Columbia, have such legislation and regulation, and the Clean Air Act affects all states. These legislative acts require that emissions from the loss of biological carbon, such as the conversion of forests, be assessed, and several states are also considering and/or developing mechanisms to mitigate for these losses, notably California, Washington, Massachusetts, Maine and New York. Both Maine and California have already (as of May 2009) introduced legislation to this effect.

In 2007, suit was brought against the U.S. Environmental Protection Agency (EPA) for neglecting to regulate carbon dioxide as a pollutant under the Clean Air Act (CAA). In *Massachusetts v. EPA* (2007), the Supreme Court held that carbon dioxide qualifies as a pollutant under the Clean Air Act, and as a result, the EPA is obligated to consider its effect on the public health and welfare.[33] In response to the decision in *Massachusetts v. EPA*, the EPA is in the final process of an endangerment finding for CO_2 emissions under the CAA. Because the suit was filed under §202(a) of the CAA, which applies to mobile sources, the initial endangerment finding only will address CO_2 emissions from vehicles. Despite this fact, the EPA is clear in the proposed endangerment finding that, while a substantial emitter of carbon dioxide, mobile sources are only the second largest contributor to domestic greenhouse gas emissions behind stationary sources. Accordingly, the EPA states that it will address other CO_2 sources, such as stationary sources, including biological emissions from anthropogenic changes in land use, in later actions.[34] This will enable the EPA to set in motion assessment, monitoring and mitigation systems as needed to reduce net emissions effectively.

The complexities of dealing with climate change and its manifold causes and solutions are as evident in the land-use sector as they are in other sectors. Any such system implemented under the Clean Air Act authority would likely entail inter-agency collaboration with the Energy, Transportation Interior and Agriculture Departments, as each have some authority or impact over the forest resource. The potential of forests to significantly increase renewable energy, as provide transportation fuel is a key part of the life cycle impact of forest contributions to addressing climate. The engagement of these agencies to ensure the robustness and viability of the resource production capacity is a key to their success. This also brings more resources for solutions into consideration, as, historically, more financial resources have been dedicated to energy and transportation issues–maintaining our built infrastructure, over the past 50 years than to maintain our natural infrastructure through restoration management.

A potential of 1.5 billion tons of emissions reductions annually is equated with the restoration and dependability of forest carbon stocks. While the vast value of the ecosystem services provided by these forests may be difficult to calculate in economic terms, the considerable monetary value of their climate potential becomes clearer when compared to recent investments in domestic emissions reductions. For instance, in the American Recovery & Reinvestment Plan, energy efficiency provisions costing more than $23.1 billion are expected to achieve emissions reductions of up to 50 million metric

[33] *Massachusetts et al. v. EPA*, 549 U.S. 497 (2007).
[34] US EPA. (2009). *Proposed Endangerment and Cause of Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act*. EPA-HQ-OAR-2009-0171.

tons of carbon annually—only about 3% of that available from forests each year.[35] To contrast this with the costs of avoiding deforestation, as noted earlier, forest carbon emissions reductions are achieved at a fraction of this cost to promote energy efficiency reductions.

There are a number of existing legal and regulatory authorities and programs under the relevant departments which regulate forests at the federal and state levels whose use would enable the integration of forests with legislative efforts to establish a market as a key part of an overall limit, or "cap and trade," system to reduce CO_2 emissions. The following charts illustrate existing legislative means available to implement a monitoring, mitigation and incentive program based on existing activities and programs under the Farm, Energy and Transportation bills.

[35] American Recovery & Reinvestment Act, H.R. 1. (2009).

ICF International. (2009). *Summary Report: Climate Impact of the Economic Stimulus Package: Prelminary Report prepared for Greenpeace USA*. http://www.greenpeace.org/usa/press-center/reports4/ghg-impact-of-the-economic-sti. (accessed June 19, 2009).

Existing Policy Implementation Mechanisms

Tracking Emissions from Forest Conversion
NEPA & State Environmental Quality Acts Requires the preparation of an impact statement for actions significantly affecting environmental quality. Can be used to monitor the loss of climate benefits from forest conversion and to trigger mitigation.
Maintaining Forest Carbon Stocks
Food Security Act *Swampbuster Program* Requires landowners to comply with wetland conservation guidelines to be eligible for government farm benefits. Can be extended to forestland conservation.
Clean Air Act Authorizes EPA to withhold Title 23 transportation funding from non-attaining states. Can be used to compel states to assess and monitor forest CO2 emissions or face reduced federal funding.
Monitoring Forest Carbon
Farm Bill *Statewide Forest Assessments* Provides funding and technical assistance for the development and implementation of statewide forest resource assessments. Can be used to assess forest carbon sequestration and storage at national scale. *Environmental Quality Incentives Program* Requires forestlands to have an approved forest management plan. Can be used to conserve and restore forest climate benefits.
Incentivizing Forest Conservation
Food Security Act *Debt Forgiveness for Conservation* Authorizes farm program participants to qualify for cancellation of indebtedness in exchange for conservation easements on farms and uplands. Can be increased for forestland conservation.
Endangered Species Act *Conservation Grants* Authorizes federal agencies to provide grants for projects that have direct conservation or recovery benefits for threatened and endangered species. Can be leveraged to finance adaptive forestland conservation.
Farm Bill *Rural Energy for America Program* Provides grants and loan guarantees for energy efficiency improvements and renewable energy systems. Can be used to incentivize forest conservation for the production of sustainable biomass. *Forest Legacy Program* Protects forestlands with grants used to purchase permanent conservation easements on forests threatened by conversion. Can be used to protect forests from the loss of climate benefits.
Stimulus Bill *Tax Incentives* Extends Investment Tax Credit (ITC) to biomass and renews Production Tax Credit (PTC). Can be used to incentivize forest conservation for the production of sustainable biomass energy feedstocks.

Figure 5: Existing authorities and programs at the state and federal level provide the foundation for a robust accounting, monitoring and implement system to include forests in a national cap and trade system.

Critical to acceptance of the forest sector's inclusion in a cap and trade scenario is a *minimum threshold,* or "baseline," below which climate benefits from forests will not fall, in order that market forces can effectively raise the net level of carbon through a trading system. This is an effective equivalent in the forest sector to setting a limit for emissions from other sectors, and then using market forces, via trading, to reward those entities that reduce net emissions at the greatest amount and fastest rate. It is likely that any other effort to mandate or require gains in sequestration would be met with significant resistance and poor implementation based on prior comparable efforts.

Incentives have a long precedence as an effective means, however, for achieving such outcomes.[36]

However, a trading system will require that emissions reductions from the forest sector will be of equivalent quality to those from others sectors if they are to be used to meet capped entity obligations. This means they must meet compliance requirements. This will require high degrees of accuracy and commitment, such as those undertaken via the Climate Action Reserve under California's Global Warming Solutions Act (AB 32).[37]

4. Risk reduction and the role of conservation easements

A key concern in climate policy is ensuring that we reduce net emissions to the atmosphere permanently, which is effectively defined by the Kyoto Protocol as being actions that endure at least 100 years. There are few legal means to require actions that endure at least 100 years. Indeed, there is a legal construct known as the "Law Against Perpetuities" which normally prohibits contracts of greater than 99 years.

Conservation easements however, are one of these few legal means of ensuring undertaking perpetual legal commitments.[38] CEs are commonly defined as "negative servitudes in gross", and they effectively strip out of a property ownership the right to develop land (convert it from its relatively natural state to a developed one, for example). As such they make an ideal market and incentive based tool to prevent deforestation and thus to ensure that lands remain in forest.

While not the only tool for ensuring long-term emissions reductions from forests, these legal tools provide added assurance to other contracts, which underpin such projects. They also carry a significant financial benefit for landowners, adding to the revenues derived from such a market. In the pre-compliance carbon markets in California, sales of emissions reductions have added over $2,000/acre in net present value. Conservation easements on working forests are typically valued at over 50% of fee title, adding substantially to revenues from productive forests.

Conservation easements can and do allow and guide forest management to achieve certain objectives and thus can protect working forests, enabling key management goals to be met, such as are need for maintaining and restoring carbon stocks in forests. Other key standards in conservation easements, notably the principle that these protect and be

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[36] K. Brouhle, C. Griffiths and A. Wolverton. (2005). The use of voluntary approaches for environmental policymaking in the U.S. In: E. Croci, Editor, *The Handbook of Environmental Voluntary Agreements: Design, Implementation and Evaluation Issues*, Springer, The Netherlands.
[37] The California Global Warming Solutions Act of 2006 (AB 32).

California Air Resources Board. (2008). *Proposed Scoping Plan: A framework for change.*

Climate Action Reserve. (2009). *Updated Forest Project Protocol.* http://www.arb.ca.gov/cc/forestry/forestry_protocols/forestry_protocols.htm. (accessed June 1, 2009).
[38] Byers, E., & Ponte, K.M. (2005) *The Conservation Easement Handbook.* The Land Trust Alliance and The Trust for Public Lands 555 p.

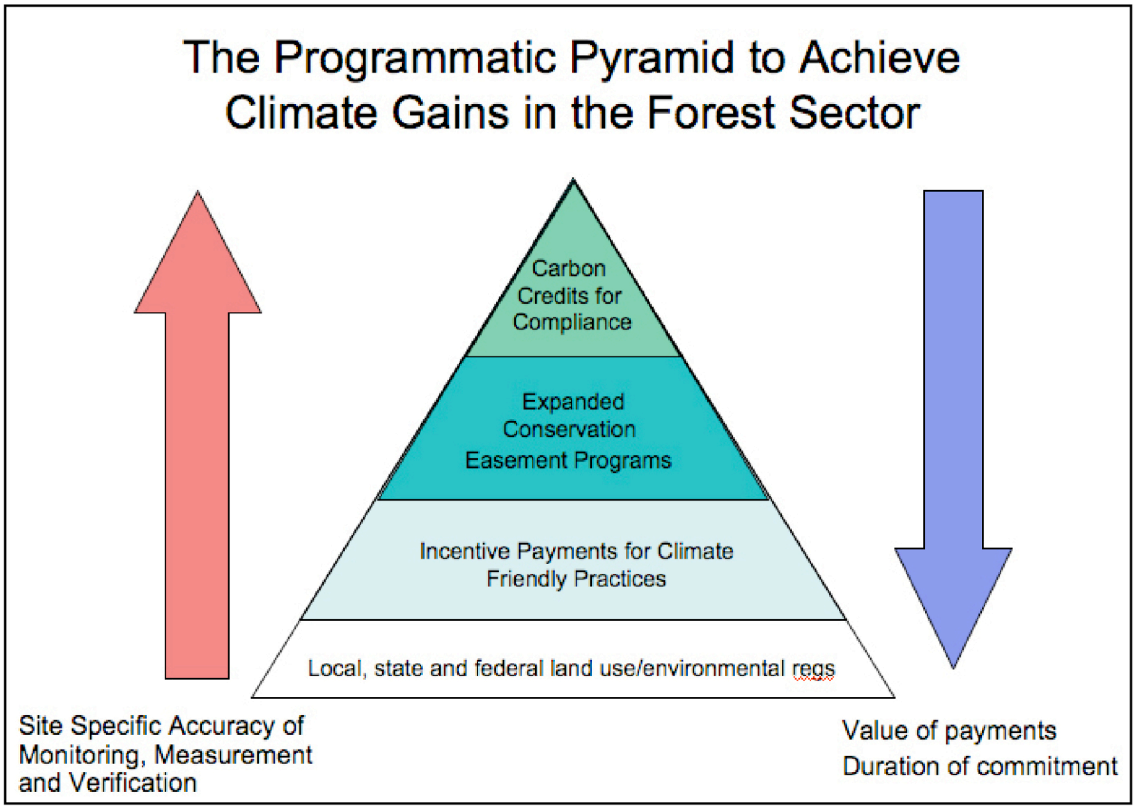
consistent with maintaining relatively natural habitat and help ensure that adaptation goals are met. The more natural a forest, the more resistant and resilient it is in response to stress. Thus, use of easements naturally reinforces both the underlying legal durability and permanence of actions undertaken to benefit climate, and their natural durability and resilience.

A further benefit is that, in the developing compliance systems at the state level, in both California and the new England states participating in the Regional Greenhouse Gas Initiative (RGGI), the pre-compliance and compliance market has demonstrated a marked preference for forest emissions reductions that are undertaken on lands protected by conservation easements. The additional rigor, quality and legal permanence, with the "third party" enforcement nature of easements over projects that provide the carbon gains have proven appealing to buyers of forest carbon emissions reductions. It creates an additional layer of reliability to actual purchase and sale contracts for emissions reductions, as well as adding to public credibility that there are additional environmental co-benefits to the carbon gains of the project. Easements are thus a key supplemental tool to be used in implementing plans to reduce emissions from forests; indeed in the first actions approved in California under its early action measures to achieve the goals of AB 32, and under the RGGI rules for forest emissions reductions easements are a requirement to secure project areas. They remain a preferred tool as these actions are ramped up to greater scale.

Additional gains may be obtained on private forests with efforts that are unlikely to meet any compliance obligation requirements under a cap and trade system. Such measures would include providing public subsidies for reforestation and habitat improvements that benefit climate. These benefits would not be required to be maintained or inventoried to the same levels as those for capped entities, but may well add substantially to overall net sequestration. For instance, afforestation programs alone have the potential to contribute up to 50 million additional tons of carbon storage over the next 20 to 30 years.[39]

Programs such as EQIP, the federal Environmental Quality Improvement Program, are ideal "delivery systems" for such efforts, as they are landowner friendly, very popular, and focus on habitat restoration, but do not require long-term commitments by landowners.

[39] Birdsey, R., Alig, R. and Adams, D. 2000. Chapter 8: Mitigation activities in the forest sector to reduce emissions and enhance sinks of greenhouse gases *in* Joyce, L.A. and Birdsey, R. (eds.) 2000. The impact of climate change on America's forests: a technical document supporting the 2000 USDA Forest Service RPA Assessment. General Technical Report RMRS-GTR-59, USDA Forest Service Rocky Mountain Research Station.



Source: The Pacific Forest Trust

Figure 6: A variety of tools, approaches and programs can be used to achieve carbon and climate benefits from forests. These range form the highest quality actions which can be used within a cap and trade system and require high standards of accounting permanence and verification, to those achieved through more temporal, less rigorous planning efforts, to those required by other legal and regulatory commitments such as best management practices.

VI. Conclusion

Conservation and restoration of higher levels of carbon stocks in U.S. forests is a key component of any comprehensive approach to achieving the contemplated goals of U.S. climate policy. Sustaining these vast and vital lands also will spur increased investment in U.S. forests, directly addressing and reversing the threats leading to forest loss and depletion. The longer-term resilience and robustness of these forests also is key, as the dependability of these stocks relies on the resilience of the forest ecosystems in which the carbon is embedded. Climate adaptation benefits must also be integrated with achieving these goals, protecting and restoring watershed and providing for wildlife and fisheries habitat and refugia. The benefits of integrating forests into climate policy also include provision of some significant complement to the nation's renewable energy supplies. Conservation easements are emerging as a key tool for land-use and climate planning, offering essential incentives for private landowners to participate in national efforts to increase the climate benefits of forests.