Forest Carbon Solutions for Mitigating Climate Change

A Toolkit for State Governments
created by the Forest Climate Working Group

DECEMBER 2015

Endorsing Organizations

American Bird Conservancy
American Forest Foundation
American Forests
California Forestry Association
CarbonVerde, LLC
Forest Stewards Guild
Forest Trends
Green Diamond
Hancock Natural Resource Group
Hardwood Federation
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Sustainable Forestry Initiative
The Trust for Public Land

State governments have a unique opportunity to use forests and forest products as a climate mitigation strategy while also advancing other environmental and economic December 2015 goals in their states.

The Forest Climate Working Group (FCWG), a diverse group of forest interests including landowners, industry, conservationists, academia, and carbon market interests, has worked together for over seven years to advocate for state and federal policies that ensure that the full potential of U.S. forests and forest products is realized to provide climate solutions. The FCWG believes that federal and state governments should recognize the critical role that forests play in absorbing carbon emissions from industrial sources and enable U.S. forests and forest products to further capture carbon emissions and enhance the environment and the economy.

This document serves as a "toolkit" for States that are looking for opportunities to reduce greenhouse gases, stimulate rural economies, and provide for environmental benefits, particularly those States that face significant carbon reduction targets under the federal Environmental Protection Agency's (EPA) Clean Power Plan.

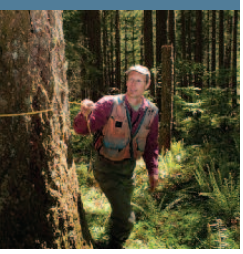
U.S. Forests and Climate Mitigation—Current and Potential Carbon Solutions

Background

Forests, trees and forest products offer tremendous forest carbon services as "natural scrubber systems" that capture carbon dioxide from sources of greenhouse gas emissions, such as the power, industrial and transportation sectors. Forests play a key role in meeting carbon emission reduction goals by capturing and storing carbon immediately, rapidly, in great quantity, and for long periods of time.

Forest products (consumer and building products made from wood) similarly store carbon and, especially when used in place of more fossil-fuel intensive products in building construction and consumer products, offer a significantly lower carbon footprint while providing the same or better shelter and performance.

Forests and forest products are the largest yet most underused tool the U.S. currently has to address federal or state emission reduction goals. Currently, U.S. forests and forest products recapture and reduce annual U.S. greenhouse gas emissions by approximately 13%[1].



Forest landowners provide this "baseline" carbon capture and other environmental and economic benefits essentially for free. But, according to science-based assessments[2] of the forest resource, without additional strategies and incentives to increase forest management and conservation, these forests face heavy threats and pressures that could undermine their ability to continue to provide these services.

Each year, the equivalent of about 41% of the U.S. power sector's greenhouse gas emissions are removed from the atmosphere and stored by U.S. forests in rural and urban areas and in forest products[3]. Using a conservative estimate of $10 per ton of CO_2, these environmental benefits of about 860 million metric tons a year are worth $8.6 billion a year[4]. With the right incentive policies and programs in place, forests and forest products sequestration could be increased to offset an additional 5-7% of the country's fossil fuel emissions.[5]

The U.S. Forest Service predicts that this existing forest emission capture and storage (known as an emissions sink) will face increasing pressures in the coming decades from natural disturbances such as wildfires, drought, insects, and diseases. Additionally, the U.S. Forest Service estimates that we could see loss of as much as 34 million acres of now privately owned forests taken out of forest use due to development pressures.[6]

Official projections indicate that the rate of conversion from agricultural land to forests over the last few decades — which has helped reduce the impact of forest loss elsewhere (resulting in an overall net gain of forest land in the United States in recent decades) — will slow dramatically. Reversion of farmland to forest and creation of new forests through planting could be overtaken by losses of forestland to development. The forest carbon sink (net annual carbon sequestration) we take for granted now could see as much as 30% decline by 2030 and 90% by 2060[7], which is equivalent to the loss of 2% a year in emissions buffering capacity that would have to be made up with additional emissions reductions in power, transportation, and other sectors.

Urban forests, which include all publically and privately owned trees within an urban area, also offer significant carbon benefits. Urban forests cover about 103 million acres of the continental U.S. comprising about 5% of the total tree cover, and averaging about 35% tree canopy cover within urban areas[8].

In addition to the extensive climate mitigation benefits of forests, strategies to increase forest carbon services can also improve forest resilience in the face of climate change. Unlike most climate mitigation strategies, forest carbon strategies by and large have the effect of addressing both mitigation and adaptation.

The Role of Private and Family-owned Working Forests

More than half of America's forests (approximately 57%) are owned by private landowners: companies, families, and individuals. In fact, the largest forest ownership group in the U.S. is families and most of these forests — roughly 110 million acres — are in small tracts of less than 100 acres (Box 1).

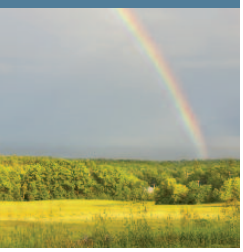
The Solution

This toolkit suggests policies that States can adopt to support forest carbon services. These suggestions assume that the EPA's Clean Power Plan will be implemented, but regardless of the political or legal outcome of this EPA rulemaking, States should consider adopting forest carbon strategies as part of their own carbon mitigation, clean energy and rural economic development efforts.

Federal action is also underway. The federal government, primarily the U.S. Department of Agriculture, has taken a number of steps in the past several years to both maintain and enhance forest carbon services, and the FCWG is working at the federal level to support and enhance these initiatives. Federal actions maintained and boosted through the President's Climate Action Plan[9] include expanded investments in fire and forest health management, science and data to better track the status of contributions by forests and forest products to greenhouse gas reduction, incentives and support for building with wood, support for land acquisition for forest lands at risk of conversion to development and for better management of private lands, support of voluntary-incentive based cost-share and other programs for working forest and agricultural lands, and special programs to encourage tree planting and care in urban areas. In addition, some States have included forest carbon in allowance funded programs.

BOX 1:

Role of private and family-owned working forests: To maintain and enhance U.S. forest carbon services, private forests must be a central focus, thus the FCWG recommendations included here focus primarily on private, working forests. These families and private owners grow and manage trees on their land, provide carbon storage and sequestration benefits, and forego the opportunity to use the land for other purposes, such as annual cropping or development. Growing trees is not always as economically viable as the alternatives. Economic incentives, like emissions markets, tax incentives, and cost-share programs can supplement traditional forest markets making it economically viable for these owners to keep growing trees, invest in good management, and provide all the private and public benefits of working forests, including wildlife habitat, clean water, and recreation, in addition to the carbon benefits.



How States Can Promote Forest Carbon Services in the Context of Current Policy Environment

The FCWG believes there is an opportunity for States to take action to better enhance forest carbon services in their states, and in turn, help to address carbon emissions reductions goals as well as improve the environment and economy of their State's forested areas.

Some early mover States have pursued cap-and-trade systems that give credit to forest carbon under a traditional "offsets" program; examples are California's Air Resources Board rules and the northeastern states' Regional Greenhouse Gas Initiative (RGGI). However, at this point in time, barring any legal challenges by States to reverse this position, the EPA has banned the use of "traditional" offsets in the Clean Power Plan rule.[a] At the same time, the EPA has recognized in the Clean Power Plan rule and its draft Federal Implementation Plan that U.S. forests and forest products play a vital and positive role in addressing climate change.

Forest carbon capture should not be thought of as an "offset," which is traditionally defined as an emissions reduction from "outside the cap" that offsets emissions "inside the cap." Rather, forest carbon is a natural scrubber technology that directly captures carbon dioxide emitted from power plant smokestacks, in the same way that sulfur or ash emissions are captured by scrubbers located at the power plant. The only difference is that forests are located outside the fence line of the power plant, but the scientific and physical connection of the power plant smokestack with the forest's carbon-absorbing services is just as direct. Moreover, because forests are serving power plants in this way, forests can be thought of as part of the electrical power grid in the same way that energy efficiency programs are assumed to be "connected" to the grid.

The FCWG believes there are a variety of ways, not mutually exclusive, that a State could recognize, incentivize, and support forest carbon as part of a State's overall climate strategy.

Ideally, States could seek EPA recognition of forest carbon strategies as "complementary measures to facilitate compliance", which EPA has generally recognized are within the States' legal authority to propose under the Clean Power Plan as qualified compliance measures to meet State carbon dioxide reduction targets. Although, as noted, EPA seems to have excluded forest carbon in the rule, EPA failed to explain why forest carbon could not qualify as a complementary compliance measure, given that the federal Clean Air Act gives States exclusive legal rights to identify and implement those compliance strategies that make the most sense for a particular State or group of States.

[a] States could urge EPA to recognize forest carbon strategies as compliance mechanisms in their State Implementation Plan (SIP) submissions. While EPA appears to have prohibited forest carbon as a direct compliance measure, arguably EPA lacks legal authority to restrict a State's flexibility and options for achieving compliance with power plant emissions targets. Accordingly, interested States should consider options to convince EPA that recognition of forest carbon capture is within the Agency's authority.

Alternatively, States could consider proposing a State Implementation Plan (SIP) that promotes forest carbon reductions as "contingency" or "backup" measures. Under the state implementation plan process, historically States have been allowed to propose contingency measures, to be used if and only if the primary compliance strategies fall short. Forest carbon could serve as cost-effective insurance to help States ensure that their 2030 reduction goals are met without economic disruption should power plants be unable to find adequate emissions reductions from conventional "grid-based" strategies. Regardless of EPA's rules in the Clean Power Plan, States could also incentivize forest carbon as "supplemental emissions reductions," to be used as emissions reductions beyond the power sector and counted toward other policy goals.

With any of these approaches, States have a unique opportunity under the Clean Power Plan to incentivize forest carbon by drawing on the power sector, which directly benefits from the emissions scrubbing services that forests

provide. States can incentivize forest carbon by using revenue from allowance auctions, establishing allowance set-asides for forest owners, or using allowances to support other revenue sources or tax expenditure strategies. These options are discussed later in this toolkit. There are numerous reasons that States should pursue a forest carbon strategy, including:

- Forest carbon protection and management, benefits all the other sectors, and not just the power sector. The loss of carbon sequestration by forests represents billions of dollars other sectors would have to spend to hold down the emissions to even lower levels.

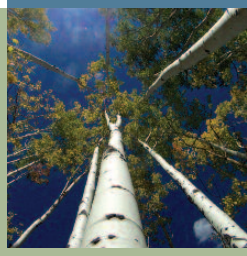
- Investments in forest carbon strategies don't just benefit the climate — there are multiple benefits from investing in forest carbon strategies such as clean air and clean water, and wildlife, and recreational benefits that may actually help States address other issues like as threatened and endangered species, wildfire mitigation, or watershed and water supply improvements.

- Investments in forest carbon strategies will drive economic opportunities in rural communities. Whether a state pursues a policy to reward landowners for managing their forests or incentivize sustainable wood materials, or some other approach, these investments will multiply rural America jobs and economic growth. Extension Forestry faculty could play an important role in the dissemination of information related to this program as they have established contacts with the private forest landowners in each state and are well trained in how to reach clientele with new programs.

- Even though EPA appears to have ruled out forest carbon at this point as a direct compliance strategy, EPA might recognize forest carbon reductions as a contingency strategy for compliance purposes if proposed by States in SIP submissions, particularly if States are struggling with meeting reduction targets later in the 2022-2030 compliance period.

- Data from the U.S. Forest Service (USFS) predicts that if no action is taken, the emission reductions achieved by the Clean Power Plan in some States could be strongly counteracted by losses in carbon benefits in the forest sector, largely due to forest conversion, wildfires, and other threats. With this in mind, States that take proactive, voluntary approaches to addressing this impending problem will get ahead of this issue and possibly avoid deeper cuts in power plant emissions that may otherwise be required after 2030.

- Other federal strategies, like USDA's Climate Smart Agriculture and Forestry building blocks for farms and forests, can be combined with state investments, thereby providing States with leverage and synergy with federal programs and resources to better address forest carbon issues and potentials.



The Five Essential Strategies for Forest Carbon Services from Private, Urban, and Family-owned Working Forests:

There are five essential strategies to get the most out of forest carbon services on U.S. forests. They address the biggest drivers of the expected loss in these services, namely forest land conversion, forest health and growth decline, and the competing use of fossil-intensive materials (non-wood) for building.

These strategies include:

(1) Keep forests as forests;

(2) Create new forests through afforestation and replace them quickly – reforest them after fire, wind, insect attack, and other disturbance;

(3) Manage forests, periodic tending, harvest and reforestation, to keep them healthy and resilient;

(4) Protect urban forests and increase the extent and diversity of tree cover; and

(5) Increase the use of forest products especially to extend carbon storage and replace other, more fossil fuel intensive products.

Keep Forests as Forests: For forests to continue to be part of the climate solution, we need to keep existing forests as forests. According to the USFS, we could lose as many as 34 million acres of private forests by the year 2060. Preventing this loss would retain carbon storage benefits on the scale of greenhouse emissions of 8.14 billion tons of carbon dioxide[10] that would otherwise be taken out of storage through land use conversion, and maintain the capacity of these lands to provide more than 100 million tons per year in future carbon benefits. To put this in perspective, these at-risk lands store the equivalent of 5 years' worth of all U.S. coal power plant carbon emissions[11]. In the context of the EPA's Clean Power Plan, this erosion of the forest sink capacity would negate between 80-100% of the emissions reductions gained under the Clean Power Plan.

Increase Forests Through Afforestation: Growing new forests on marginal agricultural land, in ways that don't displace food and fuel sources, is another way to increase forest carbon services. There are more than 100 million acres of marginal agricultural land that could be planted in trees, which would result in

more than 500 million tons of additional carbon sequestration capacity each year, along with all the other benefits that forests provide like clean water, wildlife habitat, and wood products[12].

In addition to rural afforestation, urban tree planting can also provide multiple carbon benefits. First, the carbon sequestered and stored in the trees captures emissions from power plants. In addition, energy efficiency benefits from the cooling effects of trees in urban environments can result in savings of up to 20% of air conditioning energy costs in home and business.

Manage Forests to Keep them Healthy and Resilient: In addition to maintaining forests to keep existing sequestration and storage capacity in place, our forests have the potential to do more with improved management.

A range of forest practices such as rapid reforestation, thinning wildfire-prone forests, extending forest rotations, and removing diseased trees can increase the survival of trees that sequester the most carbon. Its is estimated that these range of practices protect current sequestration and forestall the expected decline in forest sequestration.

Protect Urban Forests: Urban forests play an important role in the forest-climate solution. Carbon storage by urban trees is about 10.2% nationally of the combined total carbon stored in U.S. forestlands and urban forests[13]. In addition to the carbon storage capacity, significant energy-conserving co-benefits are provided by urban trees. Transpiration cooling and changes in albedo from trees alters urban microclimates, reducing carbon emissions from urban buildings[14].

Use More Forest Products: Forest products from well-managed forests, such as wood products used in building construction, not only continue holding the carbon stored in the forest but also reduce emissions when used in place of other more fossil-fuel intensive products. Currently, forest products comprise 9% of our annual sequestration and storage. We estimate the relative importance of wood products will increase by more than half as wood products storage remains stable and forest growth and land use contributions slow in the future. Additionally, we estimate that increased use of wood in buildings could yield an additional 32.7 mmt of CO_2 equivalent per year in the U.S. This is the equivalent of permanently shuttering 8.6 coal fired power plants[15].

Three Policy Models that Support These Essential Strategies

The FCWG recommends three policy models that States could pursue in support of these four essential strategies (retaining forests, increasing forest acreage, managing forests for increased carbon, and increasing the use of forest products). A description of each model is provided below.

- **Strategic Carbon: Working Forest Carbon Incentives Model**
- **Maintaining and Enhancing State Forest Tax Incentives**
- **Expanding the Use of Wood In Building Construction**

Strategic Carbon: Working Forest Carbon Incentives Model

While the EPA's Clean Power Plan requires States to adopt plans to cut CO_2 emissions in the electric power sector, States can consider a broader, more comprehensive strategic approach by leveraging emissions allowances in the power sector to establish new pathways for investing in forest-based climate solutions. Leadership by States to drive forest activities with local and global benefit could serve as a catalyst that fosters broader investment in climate-beneficial forest practices.

"Strategic Carbon", put simply, is an approach where funding is used to reward landowners, through cost-sharing or other mechanisms, for practices that provide forest carbon services. While this "Strategic Carbon" approach would be distinct from the focus and function of existing incentive programs, such as USDA's Conservation Reserve Program or existing carbon market programs such as California's cap-and-trade program, a Strategic Carbon approach as described here is intended to complement and learn from these programs.

The Strategic Carbon policy option described herein establishes a structure that can break through the impediments that existing forest carbon programs have struggled with, such as high transaction costs and impractically long restrictions on land use, which have stymied widespread participation by forest landowners in voluntary and mandatory carbon markets to date.

The advantages of a strategic forest carbon incentive model include:

- Forest carbon benefits generated from this policy option could be quantified using affordable procedures applying research-based values over a 15-year contract period, eliminating the need for highly precise and accurate, and regular forest inventories.

- Any perceived need for retaining forest carbon stocks in an attempt to achieve "permanence" is eliminated. Because the mitigation achieved is in addition to the State's mandated CO_2 reduction. Reversals can be replaced with a forest buffer account without compromising the Clean Power Plan mandate or broader state level emissions targets.

- The evidence is strong that there can be very good public return on investment for States that proceed to implement a sensible, low-cost, high impact program to incentivize forestry practices. This policy option provides a leverage opportunity where investments in non-electricity sector CO_2 mitigation solutions generate 2-3 times the amount of mitigation per dollar invested, therefore providing an opportunity that complements market carbon in trading systems, and indirect carbon programs such as those operated by USDA[16].

- This policy option offers States a flexible carbon investment program focused on climate-beneficial forest practices that also address key local challenges and goals, such as water quality and quantity problems or wildlife habitat as well as create climate resiliency.

DETAILED DESCRIPTION OF POLICY OPTION

Under a "Strategic Carbon" approach, a State would designate revenues from power plant allowance auctions, a set-aside of allowances, or other funding sources, toward a strategic carbon investment program to offer incentives to landowners for targeted forestry practices that sequester carbon or avoid carbon emissions while generating local benefits. A State may choose to include other lands such as public lands, tribal lands, or urban lands, in addition to private lands in this program, based on an analysis of the State's carbon portfolio.The program should include the following elements:

1. Establish program administration for a set-aside fund using allowance auction revenues or allowances distributions, or using general funds that are backfilled by Clean Power Plan allowances or other revenues. The FCWG suggests this program should be administered by the state forestry experts under the auspices of the office of the State Forester and other relevant environmental, energy and natural resources agencies. The program administrators would establish program rules and processes for landowners to apply, participate, verify, and receive incentive payments.

2. Define the forestry practices that would be included in the program based on consideration of a State's Forest Action Plan as well as an evaluation of the most significant forest carbon drivers in the State. The suggested range of forestry practices should include afforestation, reforestation, improved forest management, and avoided conversion (Box 2).

3. Identify the carbon benefits for each practice, based on existing forest inventory data and research, with the data stratified, as appropriate, by region, forest type, site index, soil type, or other criteria. Determine how much each amount should be discounted, if at all, to provide conservative estimates to assure that, across the many sites involved in the program, the program's reported results are highly credible. The FCWG will assist in developing these scientific resources as needed.

BOX 2:

Forest Practices to Incentivize

- **Afforestation** – planting trees on land that has not been in forests for many years, this could include windbreaks and shelterbelts as well as urban lands.

- **Reforestation** – planting trees where forests have been lost and are not coming back naturally.

- **Improved forest management with best practices to enhance carbon storage** –
  - Improving regeneration after harvest
  - Planting in under-stocked forests
  - Reducing competition from slow-growing species
  - Thinning to remove defective trees and improve productivity
  - Wildfire management including thinning or prescribed burning to reduce wildfire risk
  - Changing rotations to increase carbon storage
  - Improving harvest efficiency and wood utilization
  - Fertilization

- **Avoided conversion** – incentives to maintain forests as forests and avoid the loss of forest to development.

a. For forest practices such as afforestation, reforestation, or improved forest management, the incentive payment should be based on the projected annual increase in carbon sequestration that will result from implementing the specified forest practice for a particular forest type and geography.

b. For avoided conversion projects, incentives should be based on an evaluation of the current carbon stocks on the property that would otherwise be lost if the property were converted. Various other considerations could be included to refine projected carbon gains, such as an evaluation of the risk of conversion or an assessment of the allowable footprint of conversion under local land use laws.

4. Establish payment rates for each adopted practice, as well as rules for verifying that practices have been adopted and maintained in a technically credible manner. This might include reverse auctions as the means for optimizing the public's value as well as a mechanism for leveraging the public's investment in these practices[17].

5. Establish rules for calculating carbon stocks based on an aggregate statistical effect of best practices across all enrolled acreage, thus avoiding any need to quantify carbon on an acre-by-acre basis, which will substantially reduce transaction costs and burdens on landowners.

6. Establish rules for contract length. Contract length should be structured so that it is not a barrier to forest owner participation, but also achieves meaningful reductions. We recommend renewable 15-year contracts for forest practices. For avoided conversion projects, we recommend the use of conservation easements or other legal mechanisms that assure that the forest will remain as forest in perpetuity.

7. Establish rules for treatment of intentional and unintentional reversals where landowners are unable to meet program rules. Generally, if the loss of reported carbon due to an intentional reversal due to the landowner's failure to maintain the practice for the contract period, the landowner will be required to repay the original incentive, perhaps with a penalty or interest clause. If the reversal was unintentional, such as a major storm or fire, the State should cover the loss with a carbon buffer pool as used in forest carbon offset market programs.

8. States should consider integrating program guidelines that also incentivize landowners to pursue additional co-benefits for climate change preparedness and resilience. These potential benefits include but are not limited to:

   a. Protection of waterways that will likely be impacted by future climate variations.

   b. Forest health and adaptive management actions that lessen future threats from wildfire, disease, and pest infestations.

   c. Buffering or creating habitat for species that will face habitat loss as a result of climate change.

   States could identify a suite of relevant co-benefits for landowners to consider as they develop proposed activities for carbon incentives. This might even include guidance, such as information from the state wildlife agency about relevant habitat considerations. States could then develop a mechanism within their incentive programs to encourage landowners to pursue these additional co-benefits in designing their forest activities. Potential mechanisms for recognizing these additional co-benefits might include:

   a. Bonus ranking points for applicants to the State's strategic carbon program.

   b. Increase in per-acre payments.

   c. Matching cost-share or technical assistance from other state programs relevant to that co-benefit.

Maintaining and Enhancing State Forest Tax Incentives

This option could include utilizing existing tax incentives in the U.S. or designing new tax incentives to encourage forest retention and management, thereby enhancing climate change mitigation[18].

Tax incentives could prove to be a powerful tool for encouraging forest management activities that would increase forestland retention, increase carbon storage on existing forests, as well as encourage afforestation efforts to increase sequestration potential through expanding the forest base. Federal and state tax policies can affect forestland values significantly, primarily through the federal income tax provisions for forest owners and current use taxation at the state level[19]. Several studies have demonstrated the utility of incentives, including tax incentives, for encouraging specific management practices. A study focused on Lake State landowner interest in carbon offset programs revealed that current payments for carbon are not enough of an incentive to participate in markets, "a majority of focus group participants expressed interest in general carbon management as a means to achieve reduced property taxes."[20] A similar study of landowners in eastern Tennessee reported similar results, with the majority of respondents indicating the preferred means of compensation for providing increased carbon storage was reduced property taxes[21].

DETAILED DESCRIPTION OF POLICY OPTIONS

1) **Enacting, maintaining and enhancing current use tax laws:** As stated above, maintaining or enacting current use valuation taxes aid primarily in reducing the cost of owning forestland, thereby encouraging owners to maintain this land use. Thirty-seven states have one or more preferential property tax programs applicable to forest land owners. Increased tax rates increase holding costs and can provide a strong incentive for converting these lands to other uses, particularly in rapidly urbanizing areas. Moreover, reduced holding costs also lessen the desire to harvest prematurely for immediate income, allowing landowners to hold their timber for extended periods and increasing the amount of carbon stored for extended periods. Both consequences, maintaining forest cover and removing pressure for premature harvests, will increase carbon storage on forests.

   Improvements or modifications to existing current use tax laws to enhance carbon benefits: While current use tax incentives currently provide a substantial carbon benefit, as noted above, modifications can be made to these programs to enhance the carbon benefits of these programs. Potential modifications could include:

- **Enhanced incentives for long-term retention of forests:** Half of the state tax programs have minimum enrollment periods and more than 80% have a withdrawal penalty. Most programs with enrollment minimums require a 10 year enrollment, some even longer, to receive the tax benefit. This enrollment provision could be extended in association with an enhanced tax benefit to enhance the likelihood of forest lands being retained in forest use[22].

- **Management plan consideration of carbon benefits:** Most current use state programs require a forest management plan for the property. Some require compliance with the management plan as it pertains to timber harvesting and sustainable yield. State current use tax programs could be modified to require consideration of carbon benefits and encourage landowners to implement strategies that optimize the carbon benefits of their forests while balancing the wildlife, wood, and other benefits.

2) **Enacting or maintaining existing or enhanced long-term forest retention tax incentives:** A number of states have current tax incentives for long-term retention of forests, in the form of conservation easement tax incentives. These incentives should be maintained and could be focused on high-carbon forests or forests that are most vulnerable to conversion in attempt to retain forest carbon benefits. States that don't currently have such tax incentives could enact these incentives and deliver clear carbon benefits.

3) **New tax Incentives for forest carbon services:** Incentives designed to increase the financial viability of forest practices and intermediate treatments (i.e., afforestation, reforestation, improved forest management) will provide similar benefits to those mentioned above for current use taxes. It's important to note that given these incentives won't likely be tied to an emissions cap, flexibility is strongly encouraged to support landowners doing short-term, carbon beneficial practices that will likely continue but are not guaranteed, after the life of the incentive.

Under this model, a landowner would be rewarded for implementing and maintaining specific carbon practices that have proven carbon benefits.

A state pursuing this model should consider the following steps:

- Establish, based on available data about forests in the state, a set of the most carbon beneficial practices for the state. Suggested practices could include: afforestation or reforestation, improved forest management (i.e. thinning, timber stand improvement), or avoided conversion. This could also include priority areas where the highest carbon benefit resides and a focus on priority practices that address the most important forest carbon drivers in the state.

- Define standard best management practices for each practice, based on forest type, to maximize carbon benefits in the establishment and maintenance of the practice. (An example of this is afforestation of abandoned agriculture land use of certain best management practices for both establishment and maintenance that includes active management and harvested wood products).

- Establish tax credit rates (preferred, but could also be a deduction) based on the most important practices to reward. For example, a state might choose that thinning wildfire prone forests is the most carbon beneficial practice for their states forests, and therefore reward landowners at $10/acre. The same state might decide that afforestation is the second most impactful activity and reward landowners at $8/acre for this practice. Tax credit rates could be correlated to carbon pricing for other sectors, to appropriately reward forest owners for the carbon benefits they are providing.

- Set provisions to allow annual tax credit for implementing or maintaining the practice. Allow landowners to receive a tax credit from their state property taxes annually, with demonstrated proof of establishing or maintaining said practice. (i.e. landowner demonstrates they afforested their abandoned agriculture land in year one, receives a $10/acre tax credit. In year 2, provided landowner can demonstrate that the land is still in forest and managed for carbon benefits via established BMPs, landowner again receives $10/acre tax credit again, etc.)

- Determine process for annually calculating the aggregate carbon value of these tax incentives for use in communicating the value of this model in the context of other emissions reductions efforts.

Expanding the Use of Wood In Building Construction

U.S. and global populations continue to increase as an increasing percentage of the population moves to cities. World-wide society will need to provide housing and workspace for 3 billion people in the next twenty years in urban settings. Multifamily housing and commercial buildings in cities are constructed primarily of two materials: steel and concrete. Yet these materials are energy intensive and manufacturing them contributes significantly to global greenhouse gas emissions, with transportation and construction emissions doubling that contribution. This puts growth on a collision course with sustainability — unless we find more environmentally friendly alternatives to supplement concrete and steel for this new construction demand.

More and more well respected architects are turning to wood as part of the answer to the carbon dilemma. It is grown using solar energy, captures carbon dioxide from the air and stores its carbon for long periods of time. When harvested responsibly, wood is one of the best materials architects and engineers have for reducing greenhouse gas emissions and storing carbon in buildings. While wood is one of the oldest building materials known, new technology utilizing engineered "mass timber" panels and wood-based building systems is opening new possibilities for wood as a cost effective and sustainable alternative for building multiple story buildings in an urban environment.

The potential for incorporating this innovative new approach is enormous and is being developed in places like Australia, Europe, and Canada. Around the world there are a growing number of contemporary all-wood buildings that range from seven to 14 stories, with many more planned in Europe and Canada. A 20 story wooden building wood store approximately 3,100 tons of carbon for several times longer than it takes a forest to absorb that much from the atmosphere, accumulating more stored carbon than can be stored in the forest alone. At the same time, each ton of wood used in place of steel and concrete reduces CO_2 emissions by approximately 7.7 tons. In addition to enhancing urban growth, the use of wood also contributes to revitalization of rural communities that rely on the forest economy and provide wood markets that support continued investment in working forests and sustainable forestry.

States seeking opportunities to support climate mitigation and reduce carbon emissions should explore a range of policy approaches that encourage innovation in wood building construction. We estimate that if opportunities for wood buildings were maximized in all potential markets including low-rise, multi-family, and the 7-15 story markets, we could see as much as 33 mmt of CO_2 reductions and storage benefits annually, the equivalent of the emissions benefit of shuttering 8 coal-fired power plants each year. We also estimate a roughly $14 billion economic benefit to the U.S. from this increase in wood use.

Although little information is available regarding the effectiveness of incentives in the U.S. for encouraging the use of wood products in construction, the benefits for climate change mitigation are quite evident[23]. Peterson and Solberg (2005) provide a thorough review of the assessment of building materials, concluding that wood provides a better option for reducing greenhouse gas emissions, and also *"causing less emissions of SO_2 and…. less waste compared to the alternative materials."*[24]

The U.S. is lagging in the adoption of new mass timber construction technology. The barriers to adoption, such as antiquated building code restrictions, are often more effectively dealt with at a

more local level. Therefore the FCWG believes that states have a great opportunity to learn from policy approaches that have worked elsewhere to promote this technology. For states establishing a comprehensive carbon and climate mitigation strategy, we recommend that the use of mass timber, and other innovative technologies, be encouraged using one or more of the following policy approaches that are derived from successful approaches used on other parts of the world.

DETAILED DESCRIPTION OF POLICY OPTION(S)

Information and public awareness strategy: building awareness and information, especially amongst builders, homeowners, architects and engineers will increase the use of wood in buildings and thereby reduce emissions from alternative materials and store carbon long-term. States could invest some portion of revenues from carbon pricing or other sources to invest in education through strategies such as WoodWorks in their states. We estimate that current investments of $1 million in Woodworks, a nonprofit that provides outreach and training about modern wood technology, have extended storage and avoided emissions of 3.6 million tons of CO_2 per year. A state or group of states could expect similar impacts.

Establish a policy to prefer "carbon beneficial" building materials: states could establish a procurement policy for state owned or state funded buildings that requires, provided cost and availability criteria are met, building construction using low embodied carbon building materials, based on life cycle assessment of building material options. Implementation of such a policy could reduce carbon emissions linked to buildings constructed by about 9.5%.

Account for carbon impacts of building materials through life cycle analysis: states could establish policies for state owned or state funded buildings that reward low carbon impact buildings. In establishing such policies, states could prefer building design, construction, and use that have the lowest carbon emission profile, based on life cycle assessment. In establishing such as policy, states should recognize both the energy use of the building and the embodied energy in accounting for the carbon emissions profile.

Tax incentives for low carbon residential and commercial building construction: to encourage non-state funded entities to reduce their carbon emissions from building materials choices, a state could establish a tax credit for building owners, for using low carbon building materials in new and existing construction projects. This credit could be structured similar to credits provided for energy saving product installations like solar panels or geothermal heating and cooling systems, that are rewarded upon proof of installation. States would develop a standard listing of "low carbon" building materials that would qualify, all based on life cycle assessments of functionally equivalent building products, and offer tax credits commensurate with the carbon benefits of each product.

Endnotes

[1] U.S. Environmental Protection Agency.2015. Inventory of US Greenhouse Gas Emissions and Sinks: 1009-2013. EPA 430-R-15-004. Washington, D.C. Office of Atmospheric Programs. 564p. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

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[3] U.S. Environmental Protection Agency.2015. Inventory of US Greenhouse Gas Emissions and Sinks: 1009-2013. EPA 430-R-15-004. Washington, D.C. Office of Atmospheric Programs. 564p. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

[4] Calculated from U.S. Environmental Protection Agency.2015. Inventory of US Greenhouse Gas Emissions and Sinks: 1009-2013. EPA 430-R-15-004. Washington, D.C. Office of Atmospheric Programs. 564p. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

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Calculated from mid-range estimates of potential for afforestation and forest management compared with 850 million metric tons CO2 in 2014. Base reference: *US EPA. 2005. Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture. Office of Atmospheric Programs.* http://www2.epa.gov/nscep

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[7] USDA Forest Service, 2012. Future of America's Forests and Rangelands. Forest Service 2010 Resources Planning Act Assessment. Gen Tech. Rep. WO-87 http://www.fs.fed.us/research/rpa/assessment/. Projected reductions 2030 and 2060 estimated as a percent of the 2009 base year. Checked against newer projections in Wear and Coulston (2015) above. The CPP estimates that it will reduce annual emissions in the power sector by 81 MMT/year (2020), 265 MMT/year (2025), and 413 MMT/year (2030). http://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants#federal-plan. The 2010 RPA shows a possible reduction in sequestration in the forest sector of 205 MMT C (752 MMT CO2 Eq) by 2030, almost twice as much as the CPP estimates for its emission reduction impact.

[8] Nowak, D.J., and E.J. Greenfield (2012) *Tree and impervious cover in the United States*. Journal of Landscape and Urban Planning (107) pp. 21-30.

[9] Climate Change and President Obama's Action Plan, https://www.whitehouse.gov/climate-change

[10] US EPA. 2015. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013. Chapter 6 – Land Use, Land Use Change, and Forestry. http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport.html. Annex 3 of this report shows 65.25 metric tons as the average carbon storage per acre of forest in the U.S., a figure that takes into account all forest carbon pools. Therefore, preventing the loss of 34 million acres of private forest lands would protect about: 65.25 x 34,000,000 x 44/12 = 8.14 billion tons of carbon dioxide stores.

[11] According to the U.S. Energy Information Administration, CO2 emissions from coal electricity generation in the U.S. totaled 1,514 million metric tons in 2012. http://www.eia.gov/tools/faqs/faq.cfm?id=77&t=11

[12] *U.S. Department of Agriculture. 2004. Economic Research Service. Economics of Sequestering Carbon in the U.S. Agricultural Sector Technical Bulletin No. 1909.* http://www.ers.usda.gov/publications/tb-technical-bulletin/tb1909.aspx. Acreage and sequestration potential taken from USDA publication above. Calculations based on assumption of carbon sequestration potential from afforestation of marginal farm lands of 1.58 tons per acre per year in C (5.8 in CO2). USDA reference above estimates crop and pasture conversion could sequester an additional .8 to 2 tons per acre per year.

[13] U.S. Environmental Protection Agency.2015. Inventory of US Greenhouse Gas Emissions and Sinks: 1009-2013. EPA 430-R-15-004. Washington, D.C. Office of Atmospheric Programs. 564p. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html *U.S. Department of Agriculture. 2004. Economic Research Service. Economics of Sequestering Carbon in the U.S. Agricultural Sector Technical Bulletin No. 1909.* http://www.ers.usda.gov/publications/tb-technical-bulletin/tb1909.aspx (Acreage and sequestration potential taken from USDA publication above. Calculations based on assumption of carbon sequestration potential from afforestation of marginal farm lands of 1.58 tons per acre per year in C (5.8 in CO2). USDA reference above estimates crop and pasture conversion could sequester an additional .8 to 2 tons per acre per year.)

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[17] Ibid, Dodge, et al., *Going to Scale*. The authors suggest that reverse auctions can be effectively used to leverage investments in greenhouse gas mitigation using adopted forestry practices.

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For more information contact the Forest Climate Working Group co-chairs:

Jad Daley
The Trust for Public Land
100 M Street SE
Suite 700
Washington, DC 20003
jad.daley@tpl.org
802.223.1373 X14
www.tpl.org

Rita Hite
American Forest Foundation
2000 M Street NW
Suite 550
Washington, DC 20036
rhite@forestfoundation.org
202.765.3486
https://www.forestfoundation.org/forests-and-climate-change
twitter #FCWG

The Forest Climate Working Group is a broad and diverse coalition of forest stakeholders formed to develop consensus recommendations for U.S. forest components. The participants in the Forest Climate Working Group—landowner, industry, conservation, wildlife, carbon finance, and forestry organizations—have worked together since 2007 to advance our common interests around forests and forest products as a climate change solution.

American Forest Foundation
2000 M Street NW
Suite 550
Washington, DC 20036
P 202.765.3660
www.forestfoundation.org

The Trust for Public Land
100 M Street SE
Suite 700
Washington, DC 20003
P 202.543.7552
www.tpl.org