



NATURE'S BENEFITS: CARBON SEQUESTRATION



Carbon Sequestration: What carbon sequestration benefits do the National Forests in California create?

When the Earth is warmed by the Sun, warmth is radiated back from the surface to the atmosphere. Many gases in the atmosphere, including CO₂, absorb this heat energy and radiate it in all directions including back downward to the surface. The use of carbon based fossil fuels takes carbon sequestered in the earth as oil or gas and emits it in the form of CO₂ into the atmosphere. The more CO₂ that is released into the atmosphere, the more heat energy is radiated back to the Earth, warming our planet. Oceans, forests and other vegetation only remove about 60% of the human emitted carbon from the atmosphere through natural processes¹, so reducing the warming of our future climate depends on both reducing the human caused emissions, or “sources” of CO₂ as well as additional sequestration of CO₂ or carbon as “sinks” in the ocean and Earth’s land-based ecosystems.

The benefits to people’s everyday lives from National Forests absorbing carbon, also known as “carbon sequestration,” comes from a reduction in the effects of climate change. This is not only important for the communities and habitats of people, plants, and animals now, but for future generations. If enough carbon is sequestered, and emissions reduced, then the greenhouse effect will be reduced in the future, resulting in fewer warmer days as well as less occurrence of drought and other extreme weather cycles associated with climate change.

In California, due to the historic experience of fire on public lands, significant tree mortality where 102 million dead and dying trees have been identified since 2010, and recent 5-year drought, National Forests and the carbon they sequester are at higher risk for catastrophic fire. To ensure the longevity of forests acting as carbon sinks, prevention of catastrophic fire and an all-lands approach to restoration of the National Forests in California, partnering with federal, state, local, non-profit and private entities is critical.

Background:

Today, many forests are unhealthy, with unnaturally dense stands that lack resilience, making them more susceptible to drought, disease, insect pests, and uncharacteristically large, severe

¹ Carbon and Climate | Basic information on the major, <http://carboncycle.aos.wisc.edu/>

wildfires. In fact, there are some models that show that California's forests could become net emitters of carbon—meaning that trees cease to absorb carbon and actually begin giving off carbon—due primarily to the uncharacteristic fire and tree mortality that is occurring. These events result in massive amounts of dead trees emitting carbon for decades as they decay. Managing forests in California to be healthy, resilient net sinks of carbon is a vital part of California's climate change policy. Forested lands in the state are the largest land-based carbon sink, but recent trends and long-term evidence suggest that these lands could become a source of overall net greenhouse gas (GHG) emissions if actions are not taken to both protect these lands and enhance their potential to sequester carbon. Decades of fire exclusion, coupled with ongoing drought and the growing impacts of climate change, have dramatically increased the size and intensity of wildfires and bark beetle infestations; exposed millions of urban and rural residents to unhealthy smoke-laden air and threaten progress toward meeting the state's ambitious 2030 and 2050 targets for GHG reductions.

As a result, it is important to manage forests to sequester carbon and as healthy, resilient ecosystems that have a reduced risk of catastrophic fire. With catastrophic fire, many forest acres could be immediately emitted as carbon to the atmosphere, greatly exacerbating the greenhouse effect, contributing to global warming and climate change, as well as damaging human health in the form of smoke and air quality. Lower and mixed intensity fires will burn some trees, and thus emit some carbon, but ultimately provide conditions for a mix of tree types, to include large diameter trees that sequester more carbon than hundreds of small trees. Thus, in the long-term, to maximize carbon storage in forests, tree stocks need to be maintained at a resilient level that naturally includes fire, and avoids large catastrophic fires.

In California, climate change, greenhouse gas emissions, carbon and forest carbon are prominent issues, with California as a global leader on innovative policy and industry in these areas. The enactment of the California Global Warming Solutions Act of 2006 (Assembly Bill (AB) 32) into law, marked a watershed moment in California's history insofar as it required a sharp reduction of greenhouse gas emissions. AB 32 and the associated Climate Scoping Plan recognizes the important role forests play in meeting the state's greenhouse reduction goals, stating that actions should be taken to "[p]reserve forest sequestration and encourage the use of forest biomass for sustainable energy generation."

As part of the Climate Scoping Plan, the California Forest Carbon Plan seeks to firmly re-establish California's forests as a more resilient and reliable long-term carbon sink, rather than a GHG and carbon emission source. The following key components of the Plan offer a path for California to manage for carbon alongside wildlife habitat, watershed protection, recreational access, traditional tribal uses, public health and safety, forest products, and local and regional economic development:

1. Significantly increase the pace and scale of forest and watershed improvements on nonfederal forest lands.
2. Support Federal goals and actions to improve forest and watershed health and resiliency.
3. Prevent forest land conversions through easements and acquisitions, as well as land use planning.

4. Innovate solutions for wood products and biomass utilization to support ongoing forest management activities.
5. Support key research, data management, and accountability needs.
6. Protect and enhance the carbon sequestration potential and related co-benefits of urban forests.

It is essential to recognize the important role federally managed lands play in the achievement of the California climate goals. A majority of the forestland in California are National Forests managed by the U.S Forest Service (USFS), and these lands comprise the largest forest carbon sink under one ownership in the state. Several regulatory, policy, and financial challenges have hindered the ability of the USFS to increase the pace and scale of restoration needed. Only collaboratively, can the State of California, USFS, and other partners overcome these obstacles to achieve long-term carbon sink stability and forest health and resilience across the state.

Key Messages:

- National Forests in California sequester 620 million metric tons of carbon, over half of the State's forest carbon², or
 - The equivalent of over 480 million cars driven in one year.
 - Over 250 billion gallons of gasoline.
 - Electricity for over 335 million homes.
 - About 2.5 trillion pounds of coal burned.
- Each year, from 2001-2016, National Forests in California added a net 3.1 million metric tons of carbon annually³, or
 - The equivalent of over 2.4 million cars driven in one year.
 - Over 1.25 billion gallons of gasoline consumed.
 - Electricity for over 1.6 million homes.
 - Over 12 billion pounds of coal burned.
- The 2014 King Fire burned 97,717 acres and emitted an estimated 3,345,058 metric tons⁴ of carbon, or
 - The equivalent of over 2.5 million cars driven in 1 year.
 - Over 1.3 billion gallons of gasoline.
 - Electricity for over 1.3 million homes.
 - Over 13 billion pounds of coal burned.
- There is global interest, health, habitat, and economic benefits to mitigating climate change impacts. Future climate change impacts include increasing temperatures and increased frequency and severity of weather events like drought and floods.
 - If rising temperature are reversed or stopped in the future, negative health impacts such as heatstroke and dehydration will be reduced.
 - If periods of drought can be decreased and eased, there may be less tree mortality, bug and invasive plant infestation.

² FIA data & analysis 2017

³ FIA data & analysis 2017

⁴ Tarnay, USEPA Clean energy Calculator

- If flood events are less frequent and intense, less damage will be incurred by homes, roads, and natural habitat
 - If forest tree and vegetation density can be reduced by restoration aimed at creating healthy and resilient landscapes, combined with less drought, catastrophic wildfire may be less prevalent.
- Mitigation of climate change effects through reduced emissions and increased carbon sequestration will result in less climate related impacts to people, plants, and animals habitats
 - Forests' ability to absorb carbon can assist in reducing the intensity of climate change and ultimately provides more stability to people, plant, and animal habitats.
 - While physical impacts from climate change that people experience in the form of more warmer days and extreme weather event occurrence, can be reduced, there are also impacts to jobs and local economies and commerce
 - For example, if crop yields decrease and the demand for labor decreases or seasonal temperatures maintain a longer duration, certain types of outdoor work may not be able to be accomplished on time; soil production could go down and water availability could become less certain, impacting food chains, job growth and commerce.
 - Stabilizing efforts associated with mitigating climate change impacts will assist in ensuring stable ecosystem conditions for economic growth.
 - Additionally, with rising temperatures and precipitation variability, plant and animal habitat is impacted.
 - Plant and animal species in ecosystems are associated with particular natural ranges of variability for their habitat; snow leopards need snow. As climatic conditions change, certain species more vulnerable to those changes will find their habitats less suitable for living and be forced to migrate to other areas, or their habitats less connected in general. Some species, like red fir, will not be able to migrate, putting them at higher risk for survival.
- Land managers are managing National Forests in California to become long-term carbon sinks.
 - Forests, soils, oceans, and the atmosphere are important stores of carbon
 - A carbon sink stores carbon and absorbs more carbon than it emits.
 - Long-term carbon sequestration as part of many benefits of forest management will help reduce global warming; ultimately slowing or reversing climate change.
- The Region is focusing on Sustainable Operations at an organization operations level to reduce its carbon footprint.
 - Efforts have included installation of energy efficient appliances, solar panels to power Supervisors' Offices, xeriscaping, LED lighting replacements, vehicle right-sizing, Power-It-Down days for office computers and other office appliances, reducing organizational electricity bills etc...
- To accelerate restoration on California's National Public Lands and thereby create healthy resilient forests with large carbon sinks, the Region is seeking innovative implementation and financing collaborations with state and private partners to bring more resources to bear.

- The quicker our forests can be restored, the greater the chance that forest trees can continue to absorb carbon, be resilient against fire, and assist in reversing climate change.

Questions and Answers:

1. Why is “Carbon Sequestration” so important?

Answer: Scientists say the world’s atmospheric carbon dioxide levels are increasing by about three billion metric tons every year. As air pollution increases, so do the number of health problems for Californians. Planting trees and managing their development is a proven way to reduce the number of harmful particulates in the air⁵. Carbon sequestered, or stored, is carbon not emitted into the atmosphere. Less carbon in the atmosphere will reduce the greenhouse gas effect and lessen the impacts of climate change.

2. How much carbon can National Forests in California process?

Answer:

- National Forests in California sequester 620 million metric tons of carbon, over half of the State’s forest carbon⁶, or
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3. How is carbon emitted?

Answer: Carbon is stored in most living things. By heating carbon rich resources, a chain reaction called combustion occurs whereby hydrocarbon (meaning a compound composed of only carbon and hydrogen) reacts with oxygen in the air to produce carbon dioxide and water. These reactions release energy, often in the form of heat. Energy produced from renewable sources like biomass, wind, and solar release significantly less carbon into the atmosphere than fossil fuels like oil and gas because trees can be regrown to replace the carbon, or in the case of wind and solar, avoid the combustion process all together.

Fire will also release carbon from where it is stored in forests. However, moderate mixed severity fire, with some carbon emissions is needed to maintain healthy resilient forests to preclude catastrophic fire which emits, exponentially, more carbon to the atmosphere. Thus biomass energy, the source of which comes through thinning of overly dense forest stands, promotes both forest health and lowers the risk of catastrophic fire.

⁵ <http://www.gacarbon.org/downloads/Carbon%20Sequestration%20FAQ.pdf>

⁶ FIA 2017 Data & Analysis

⁷ FIA 2017 Data & Analysis

Note that dead trees also emit carbon as they decay, and wood harvested from forests decay at lower levels when milled for furniture or buildings.

4. Can we stop carbon from being emitted from National Forests in California?

Answer: By reducing the risk of catastrophic fire in California's forests, as well as reducing rates of tree mortality, we can stabilize the carbon sequestered in the forests in the long-term.

Example:

Disney Voluntary Carbon Sequestration Demonstration Project on the Angeles National Forest

In 2011, the National Forest Foundation established a partnership with The Walt Disney Company to support a carbon sequestration demonstration project on the Angeles National Forest. The project reforested 964 acres in an area that burned during the 2009 Station Fire, the 10th largest in modern California history, and the largest wildfire in the modern history of Los Angeles County at 160,557 acres. The goal of the project was to rapidly establish forest cover in fire affected native stands within 5 years of the burn. If action was not taken quickly, the establishment of forest cover would be delayed by decades and in some instances conversion from forested lands to shrub/hardwood type would occur with no conifer tree component present. By planting approximately 164,000 trees, the project is expected to yield an estimated carbon sequestration benefit of 137,022 metric tons CO₂e or the equivalent of⁸:

- carbon sequestered by 3,551,082 tree seedlings grown over 10 years
- carbon sequestered by 129,706 acres of U.S. forests per year
- emissions from 28,944 passenger cars driven for one year

The carbon sequestered by the Disney-sponsored reforestation units was registered with the American Carbon Registry (ACR), validated by Scientific Certification Systems (SCS), and will receive carbon offsets as the trees grow.

Given that the Station Fire burned nearly 25% of the Angeles National Forest land base, public and private infrastructure, recreational facilities, wildlife habitat, and significant forest acreage were severely affected by the fire. Los Angeles Basin residents along with 17 million residents living within one hour of the Angeles National Forest bore the brunt of the fire. Additionally, four forest watersheds that provide 33% of total water supply to municipalities located in the basin was threatened by increased sedimentation and pollution resulting from the fire along with an area already notorious for polluted air sheds.

The Disney project met the need for prompt reforestation of the Station Fire burn area on the Angeles National Forest, as an important component of mitigating air quality concerns in a heavily populated area. Insofar as it takes time for trees to mature and absorb large amounts of carbon and become carbon sinks, some of the greatest impacts to society and communities from the reforestation efforts are still to come, and will include: 1.) improved air quality, reduced air pollution related illness and lost productivity and chronic diseases caused by poor air quality; 2.) the provision of clean water to local municipalities; 3.) soil stabilization in highly erodible

⁸ EPA Calculator, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

decomposed granite protecting downstream homes and buildings; 4.) restored recreational opportunities for 17 million inhabitants living near the Angeles National Forest including camping, hiking, swimming, wildlife viewing, off-road vehicle use, hunting, fishing, and other outdoor pursuits; 5.) safe and secure public and private infrastructure (natural gas pipelines, flood control structures, transmission lines, water conveyance); 6.) increased and improved habitat for birds, reptiles and other animals, to include threatened and endangered species and a suite of rare plants endemic to Southern California; and 7.) reforested hills and mountainsides that will prevent sediment from choking waterways and limiting fisheries production, while also moderating spring runoff and reducing the potential for late-season drought or low water conditions. Steady and reliable stream flows are essential to groundwater recharge in the Los Angeles Basin aquifer, providing water for millions of residents. Additionally, prompt reforestation from a project such as this one, limits the opportunity for invasive weeds to populate the site, reducing mitigation costs and disruptions to the natural ecosystem and prevents competing shrubs and other non-tree vegetation from taking over the forest that prevent trees from growing for several decades.

The Disney sponsored carbon sequestration demonstration units will have 123 permanent monitoring plots installed for measurement of growth and survival every 10 years, out to year 100 after planting. The tree per acre (TPA) goal for all planting on the Station Fire is 75-100 trees at the end of 5 years. The TPA for the Disney project will meet that goal however 100 years is needed to sequester the targeted carbon amounts.

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