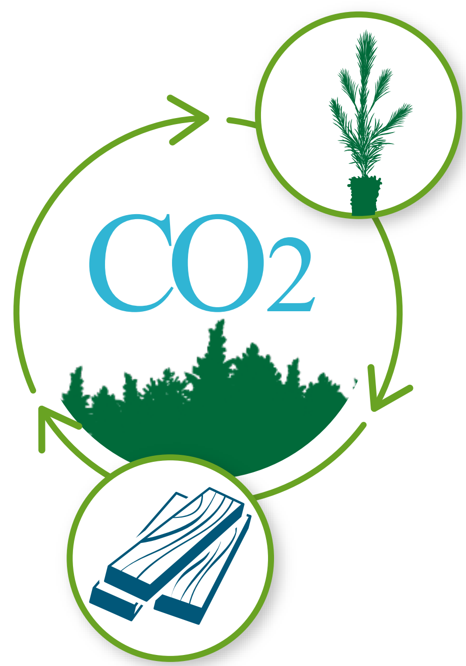
SUSTAINABILITY @ WEYERHAEUSER

HOW WE DO IT: Forest Carbon

Managed forests represent a critical element of carbon sequestration and climate change mitigation policies. It can seem counterintuitive to view harvesting as an integral part of a sustainable process, but the trees we harvest for wood products continue storing carbon for decades, and as we plant new trees to take their place — about 150 million seedlings a year — our young forests immediately begin absorbing more carbon dioxide from the atmosphere. It's a continuous cycle[1] that makes our operations carbon negative, even when considering the fossil fuels required for harvest and transportation. In fact, industrywide, research has found the life-cycle emissions[2] for wood production, transport, harvesting and manufacturing comprise only 5 to 10 percent of the total carbon sequestered in wood products and growing trees. Moreover, the emissions associated with the manufacturing and transport of fertilizer comprise less than 5 percent[3] of the additional carbon sequestered through increased tree growth.

Our managed forests provide other climate benefits, as well. They mature more quickly and are able to absorb and bank more carbon through faster, continuous rotations[4]; our harvesting methods do not disturb levels of carbon in the soil; and using wood for construction reduces emissions compared to other building materials, such as steel and concrete. That means our system of sustainable forest management already contributes meaningfully to reducing greenhouse gases and combating climate change[5].



KEY POINTS

- In the United States, forests and forest products absorb or store about 10 to 20 percent of the country's annual CO_2 emissions[6]. In Washington, the second-largest softwood lumber producer in the nation, that number is as high as 35 percent[7].
- Weyerhaeuser stores the equivalent of 9 million metric tons of CO_2 in our wood products every year[8]. That's equal to taking more than 2 million cars off the road annually.
- We reforest 100 percent of the stands we harvest — the vast majority (more than 75 percent) within a year after harvest, and more than 95 percent within two. Every harvested stand is reforested within five years.
- The carbon stored in harvested trees is replaced by growth in other trees, keeping overall forest carbon stocks even at the landscape level. Plus, portions of our forests are never harvested — such as protected areas and riparian buffers — and they continue to store carbon in perpetuity.
- Through careful species selection[9] (but not genetic modification), we cultivate seedling stocks that will be resilient under a broad range of potential climactic conditions, and we carefully select appropriate seedlings for different sites and regions.

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[1] The latest data from the U.S. Forest Service's Forest Inventory and Analysis program show that across the U.S. — and particularly in Oregon and Washington — forests are absorbing 50 percent more carbon than is harvested, or lost to fire, annually.

[2] "A flexible hybrid model of life cycle carbon balance for loblolly pine (*Pinus taeda L.*) management systems," *Forests* (2011), and "Cradle-to-gate inventory of wood production from Australia softwood plantations and native hardwood forests; Carbon sequestration and greenhouse gas emissions," *Forest Ecology and Management* (2013)

[3] "Conclusions and caveats from studies of managed forest carbon budgets," *Forest Ecology and Management* (2018)

[4] Mid-rotation stands absorb more carbon at a faster rate than more mature stands because old forests — 100-plus years old, for instance — often release the same amount of carbon as absorbed annually as they reach equilibrium (mortality plays a role, and carbon accretion more or less equals carbon loss at that point).

[5] The Intergovernmental Panel on Climate Change (IPCC) points to sustainable forest management as playing a critical role in mitigating the impact of greenhouse gas emissions.

[6] "A synthesis of current knowledge on forests and carbon storage in the United States," *Ecological Applications* (2011)

[7] "Global warming mitigating role of wood products from Washington state's private forests," *Forests* (2020)

[8] This number even takes into account the amount of carbon remaining in the product after 100 years and is based on our total production, as well as standard use and decay rates of wood products.

[9] Species selection refers to cultivating improved tree genetics through traditional tree-breeding techniques, including selecting for heartier, faster-growing and more-resilient seedlings.

KEY POINTS – *continued*

- A robust market for wood products incentivizes forest managers to prioritize growing trees over other land uses, such as development or agriculture. Switching to other land uses, rather than keeping forests in a cycle of sustainable harvesting (and thus a continual, necessary supply of wood products), contributes to deforestation, not the other way around.
- Active forest management reduces the risk of wildfire and other disturbances that cause catastrophic carbon losses, such as insect infestations and disease.[10] This benefit can't be overstated: The 2019 fires in California released = 68 million tons of CO_2, and the recent fires in British Columbia released 150 million tons. Also, from 1997 to 2015 in the U.S., the equivalent of 48 million tons of CO_2 was lost each year from insect infestations and disease[11]. Managed forests aren't immune from fire risk, but they can play an important role in reducing that risk and preventing catastrophic losses of forest carbon — especially compared to unmanaged forests.

SUPPORTING RESEARCH

- To determine the impact of our forest management practices on forest soils — which generally contain about half the total carbon in forests — we partnered with Oregon State University on a study designed to evaluate the impact of harvesting on soil carbon over a 40-year rotation[12]. During the first reassessment three years after harvest, the researchers found that harvesting operations had minimal effect on carbon levels in the forest soils. This result was especially promising given the soil is most exposed to high temperatures — and potentially higher carbon decomposition rates — during this early stage of regrowth.
- A 2019 study[13] by MIT scientists found that using lumber products instead of cement, iron and steel could significantly cut construction emissions and costs. Specifically, the study found that the CO_2 intensity — tons of CO_2 emissions per dollar of output — of lumber production is about 20 percent less than that of fabricated metal products, under 50 percent that of iron and steel, and under 25 percent that of cement.
- A long-term study from 1969 to 2016[14] found a positive carbon feedback loop with fertilization leading to larger crowns, more wood to sequester carbon, and improved water-use efficiency in the wake of climate change, among other benefits.

FREQUENTLY ASKED QUESTIONS

Does harvesting your forests contribute to deforestation?

Definitely not. Deforestation happens when forests are permanently cleared and removed. We manage our forests on a continuous cycle of harvesting, replanting and growing, and we've been doing that for more than 100 years. That said, we use a small fraction of our forests for roads and landings, and we do sell some of our land each year. Still, the vast majority of our forests stay as forests, and we intend to keep them growing for many generations to come. In the U.S. South, for instance, challenging market conditions for wood products have led to forests being converted to other uses, including development and different agricultural crops. When that land gets converted from forests, it's incredibly difficult to return it to timberlands. That's deforestation.

But if trees store carbon, shouldn't we stop harvesting them?

Our millions of acres of sustainably managed forests absorb CO_2 from the atmosphere as they grow, and much of the carbon stored in the harvested trees continues to stay captured in our long-lived wood products. By replanting our forests after harvesting, our growing trees once again absorb carbon dioxide, and the next round of wood products store more carbon yet again. That's a crucial distinction for how working forests — those managed across the landscape to produce wood products — can reduce the amount of carbon dioxide in the atmosphere[15].

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[10] "Conclusions and caveats from studies of managed forest carbon budgets," *Forest Ecology and Management* (2018)
[11] "Simulating the recent impacts of multiple biotic disturbances on forest carbon cycling across the United States," *Global Change Biology* (2018)
[12] "Soil Carbon Storage in Douglas-fir Forests in Western Oregon and Washington Before and After Modern Timber Harvesting Practices," *Soil Science Society of America Journal* (2019)
[13] "The economic and emissions benefits of engineered wood products in a low-carbon future," *Energy Economics* (2020)
[14] "Forest Fertilizer Applications in the Southeastern United States from 1969 to 2016," *Forest Science* (2018)
[15] "The global potential for carbon capture and storage from forestry," *Carbon Balance and Management* (2016)

Isn't clearcutting more disruptive to carbon storage than other practices, such as selective harvesting?

We prefer to clearcut because it's the safest and most efficient method. It reduces the need to build more forest roads (sediment reaching streams and rivers is most likely to occur through building roads), minimizes entries into the stand (thereby reducing soil compaction from machinery), and allows for higher survival and growth rates in the forests we replant after a harvest. Some species, such as Douglas-fir and Southern yellow pines, aren't as shade tolerant, so selective harvesting — which can expose regenerating trees to increased shade from mature canopies — could result in slower stand growth overall. So while a clearcut stand may look more disruptive in the short term, it ultimately leads to a faster turnaround in forest regrowth as part of a continuous cycle. Also, we've conducted studies to measure how much our harvesting practices release carbon in the forest soil and have found minimal impact on carbon levels. That's great news, as around 50 percent of all forest carbon is stored in the soil.

Doesn't cutting trees release greenhouse gases?

Even though there are some emissions associated with harvesting trees and making wood products — running machinery and transportation, for instance — those emissions are outweighed by the carbon stored and absorbed by the millions of trees we grow and harvest on a continuous cycle, and we've reduced our greenhouse gas emissions companywide by more than 50 percent over the last two decades. That means the overall process of managing forests and making wood products is a net benefit in terms of reducing greenhouse gases.

But wouldn't it just be better to let trees grow longer and absorb more carbon?

There is science to show that growing trees longer may sequester more carbon at the individual stand level, but the long-term story is far more complex. For instance, if you compared a stand planted and left untouched for 100 years with unimproved seedlings, versus a similar stand — planted at the same time but carefully managed with improved seedlings and harvested twice at 50-year rotations — the multiple rotations would end up storing about the same amount of carbon as the single longer rotation (assuming the harvested trees are used as lumber and for other solid, long-lived wood products). Then, when you factor in substitution effects and leakage (see below), as well as the increasing risk, magnitude and frequency of catastrophic carbon loss from fire, insects and disease the longer those trees grow, the more the carbon balance tilts in favor of multiple rotations, especially over time. Also, some new research — including an April 2020 study[16] in *Nature* — suggests mature forests are limited in their ability to absorb additional carbon as atmospheric carbon dioxide concentrations increase.

Are there other potential impacts from moving to longer rotations?

Yes, several. Lengthening rotation ages on a larger scale could have detrimental, unintended consequences that would cause both economic and environmental harm. Potential impacts include a higher reliance on wood products imported from other regions or countries, which often have weaker social and environmental laws and higher associated transportation emissions (known as *leakage*), and increased use of other building materials, such as steel and concrete, which generate far more carbon emissions in their manufacture and store no biogenic carbon when in use (called *substitution effects*). The combined effects of leakage and substitution effects would decrease, and potentially reverse, the climate benefits derived from increasing carbon stored in a local forest with longer rotation length. Additionally, reducing the economic incentives for forest owners to keep lands as forests could cause increased conversions of timberlands to other uses, such as development or different agricultural crops.

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[16] "The fate of carbon in a mature forest under carbon dioxide enrichment," *Nature* (April 2020)

