FORESTS, WOOD & CLIMATE

FOREST CARBON, PROTECTION & STEWARDSHIP

SIERRA CLUB

IS USING WOOD BENEFICIAL OR DETRIMENTAL IN THE FIGHT AGAINST CLIMATE CHANGE?

The timber industry routinely promotes its products as a solution to climate change, arguing that global warming can be mitigated by substituting wood for more energy-intensive materials in building construction and other applications. However, **the claimed benefit of such substitution is highly misleading when the impact of logging on forests and forest carbon is left out of the emissions equation**.

Combatting global warming requires both avoiding greenhouse gas emissions, and sequestering and storing the excess of atmospheric carbon that drives the greenhouse effect. Because of deforestation and forest degradation globally, some the world's logged forests are currently net carbon emitters, while primary (unlogged, including old growth) forests act as net carbon sinks that can sequester and store far more carbon if protected from logging. **A key question is whether forest management and wood use can result in a net increase in carbon stores. Without great advances in forest protection and stewardship, the answer is almost certainly not.**

Increased wood use that leads to significant increases in deforestation and forest degradation would only deepen our climate problems. Globally, primary forests represent immense stores of forest carbon and must be protected from logging. In addition, previously logged forests are often far below their carbon storage capacity. **This is why Sierra Club advocates for protection of public lands, to not only safeguard primary forests but also to allow younger forests degraded by past logging to recover.**

Forest stewardship is also very important. Where logging occurs, the timber industry needs to transition to climate-friendlier forest management practices that maintain or restore resilient ecosystems and substantially increase carbon stores over the levels typical of status quo industrial forestry. **This is why Sierra Club supports Forest Stewardship Council certification of private lands and other strategies to incentivize landowners to improve forest management.**

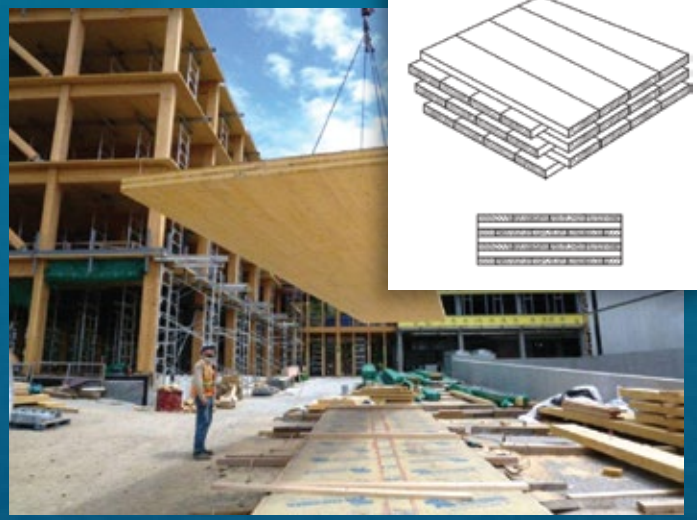
For more information: ▶ Sierra Club Forests & Climate website

Is using wood beneficial or detrimental in the fight against climate change? Unsurprisingly, many in the timber and building industries tout wood as a climate solution. A prominent example is the promotion of mid- and high-rise buildings built from wood, where mass timber products (large engineered wood products) like cross-laminated timber (CLT) can substitute for the steel and concrete traditionally used in taller building structures. The core rationale is that such substitution reduces a building's *embodied carbon*. Embodied carbon is calculated by measuring and aggregating the emissions generated from the extraction, manufacturing, transport and use of building materials -- estimated to account for roughly 10% of emissions globally[1] -- using the science of life cycle assessment (LCA). Given that a huge number of buildings are expected to be constructed in coming decades, reducing their embodied carbon is urgent, and substituting wood for non-renewable materials may seem like an obvious way to make progress. Concrete, for example, is currently the second most highly utilized substance on the planet (besides water) and its production consumes so much fossil fuel that it accounts for up to 8 percent of global CO_2 emissions[2]. The assumption (and it is questionable[3]) is that if wood is used instead of concrete and steel for buildings, the avoided emissions could be significant.

Also, wood promoters point out that, unlike iron ore and gravel, timber is a result of a biological process whereby trees use the sun's power to remove and store atmospheric carbon as they grow. Wood is about 50% carbon, and when it is used in construction that carbon is stored in the building, usually for many decades.

WHAT IS CLT?

CLT is a large wood panel made of multiple layers (three, five, or seven layers is typical) of softwood lumber stacked at right angles and glued together. It can be likened to an enormous piece of plywood, only the raw material is dimensional lumber instead of veneer. The largest CLT panels made in North America today are about 10" wide, 40' long and 12" thick. CLT panels are engineered and made to specification in the factory for a given project and shipped to the job site where the building is assembled.

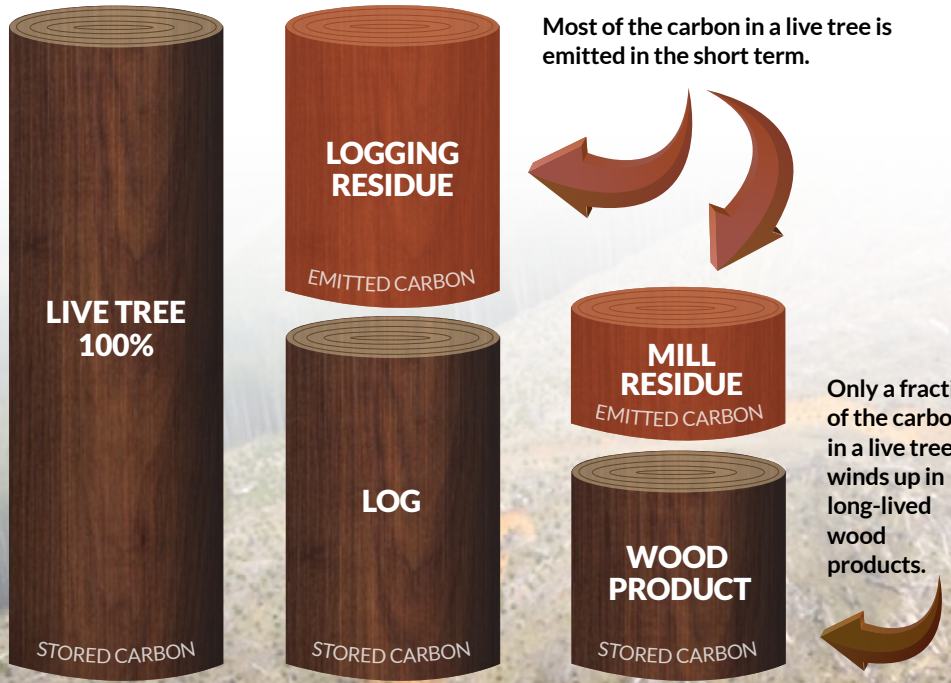


WE CAN'T FORGET FOREST CARBON

What generally gets left out of considerations of the claimed climate advantages of wood use, however, is the impact of logging on forest carbon. As the name suggests, forest carbon refers to all of the carbon stored in a forest, including what's above ground in live and dead trees and other vegetation as well as carbon stored below ground in the soil and the root mass of trees. Logging results in losses of forest carbon at all scales, from individual trees to forest stands to entire landscapes.

Tree and stand level carbon losses from logging - Logging causes the release of most of the carbon stored in trees through on-site decomposition of logging slash (branches, leaves and needles) and root wads, as well as slash burning.

Importantly, only a fraction of the carbon in an old-growth tree is actually stored if it is cut and converted to products. Estimates vary, but according to one study[4], less than a third of the original carbon in an individual tree is carried through to the end of the processing chain – the rest is downfall that rots and releases previously stored carbon into the atmosphere in the short term, or is burned in mills or "biomass" power plants as an energy source (note that incinerating wood produces even more CO_2 than burning coal, for equal energy produced[5]). Carbon embodied in products also has a much shorter "life span" than if it is left in old-growth forests, ranging from about a year for paper to decades for wood used in buildings[6].



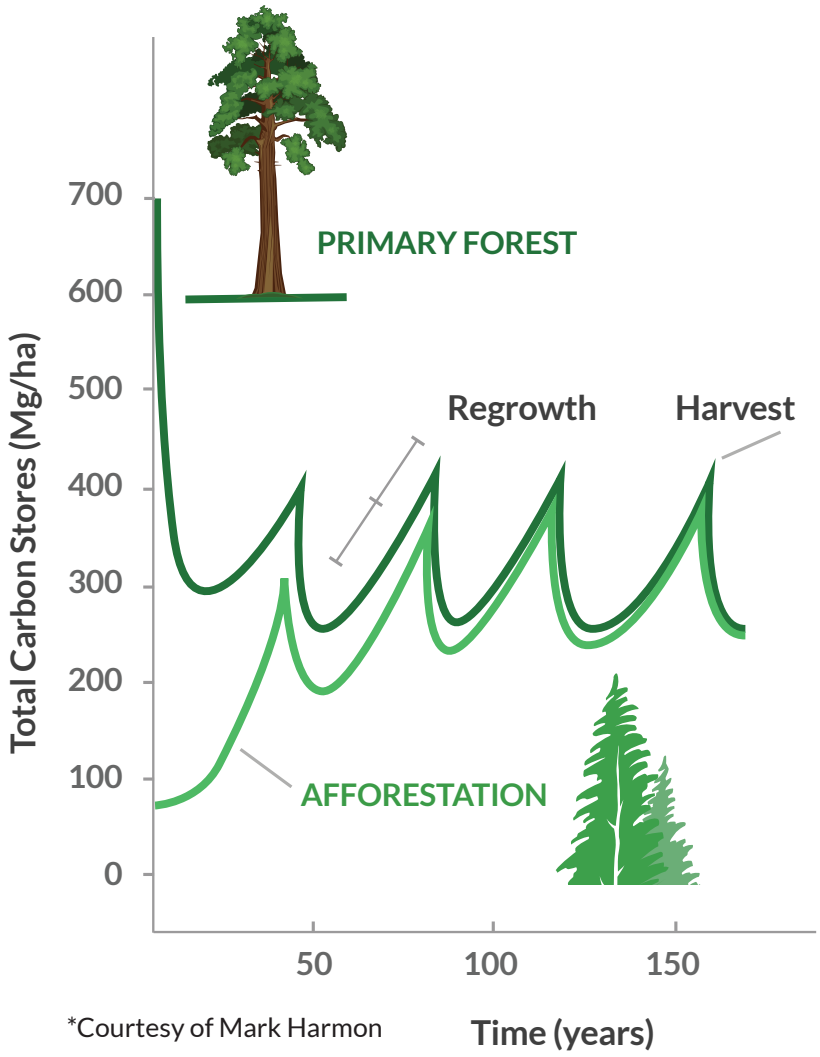
At the stand level, if the original forest was mature and subsequent logging occurs in cycles much shorter than the age of the oldest trees originally on the site, the forest will never reach its pre-logging carbon stores, creating what is know as a carbon debt[7]. For instance, replacing old-growth forest with a plantation can result in up to a 60% loss of carbon stores that will not be made up over time if, as is typical, the plantation is subsequently logged every 40 or 50 years.

Large-scale carbon emissions from landscape-level logging - Industrial logging across large areas can be a major source of CO_2 emissions, especially when it supplants primary forests with intensively-managed tree farms. In Oregon, clearcutting over millions of acres since 2000 generated 16% to 32% of total emissions from all industrial sectors, making logging one of the state's biggest carbon polluters[8].

The good news is that with increased forest protection and the widespread adoption of climate-friendlier forestry methods, the carbon debt created by past logging can be reduced. For example, scientists have estimated that by reducing logging on public lands and lengthening harvest cycles, about 15% of the carbon released by the logging of Oregon's forests in the past century could be re-absorbed over a 50-year period[9].

HOW FOREST CARBON WORKS: THE "LEAKY BUCKET" ANALOGY

It's relatively straightforward to visualize how logging impacts forest carbon at the level of an individual stand:



*Courtesy of Mark Harmon

The chart at left represents two different starting conditions: an old-growth forest (dark green line) and an agricultural field where afforestation occurs (light green line). In the former case, forest carbon starts high and drops steeply with the initial timber harvest. In the latter, carbon starts low and builds for several decades. The forest stand represented here is logged once every 40 years on a sustained-yield basis where tree growth and timber removals are in balance. The level of forest carbon drops with each harvest and then builds back up before the pattern repeats.

The picture gets more complicated at the landscape level where numerous stands are being managed simultaneously. Here's an analogy to aid in understanding how in such a scenario different approaches to forest management can impair or enhance the forest's capacity to store carbon. Visualize the managed forest as a bucket and forest carbon as the water inside it. The landscape is made up of multiple stands that have been logged at different times and are in different stages of regrowth: some are taking up carbon and some are releasing it. The challenge is to determine how all of these offsetting inputs and outputs influence what is happening to overall carbon stores – and we need to do that to figure out the differing effects of different approaches to forest management.

Carbon stores are highest in mature forests where there is little or no logging: the water level in the bucket is at or near the top. This level is never static, however. The bucket has leaks: trees and other vegetation are constantly dying and rotting, releasing some carbon into the atmosphere, but also cycling nutrients, which enhances forest productivity and carbon storage capacity But a bucket can hold water even if it has leaks as long as water is being poured into it. At the same time that carbon is escaping from the forest, new carbon is constantly being pulled from the atmosphere into the bucket. At the landscape level, it will remain fairly constant over time. **[Figure 1]**

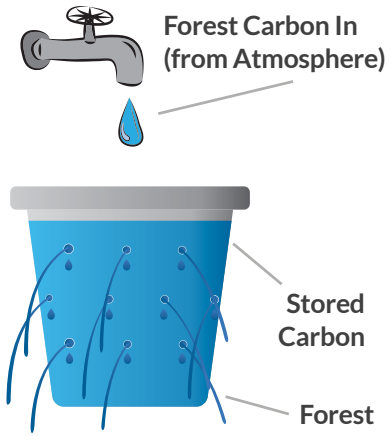


FIGURE 1

LEAKY BUCKET ANALOGY

When the forest is logged, it impacts both the amount coming into the bucket and the amount leaking out, but the larger impact is on the leakiness. The more holes you have, and the bigger they are, the leakier the bucket; and the leakier the bucket, the less carbon it will store. The number of holes is related to the frequency of logging and the size of the holes is related to its intensity or severity: the large clearcuts characteristic of conventional industrial forestry can be pictured as bigger leaks and the relatively frequent harvests (i.e. short rotations) can be pictured as more numerous leaks. **[Figure 2]**

On the other hand, less intensive, more selective logging that occurs less frequently (i.e. longer rotations) can be pictured as smaller, less numerous ones. **[Figure 3]**

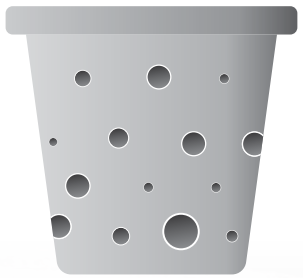


FIGURE 2

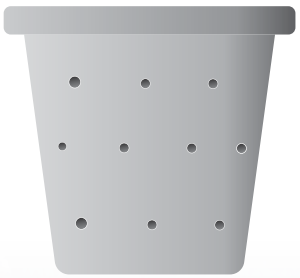


FIGURE 3

If trees are replanted or regenerate naturally in logged areas, they absorb carbon as they grow – more carbon flows in, less escapes and the level in the bucket gradually builds back up. But each time logging occurs, the bucket becomes more leaky and the carbon level falls back down – and the more intensive and frequent the logging, the farther it will fall and the lower the average level will be. **[Figure 4]**

If climate-friendlier forestry is practiced, the holes are smaller and less frequent and the bucket is less leaky. Less carbon escapes and the average level will build higher and remain so as long as the management system is continued. Forest carbon stores are significantly increased! **[Figure 5]**

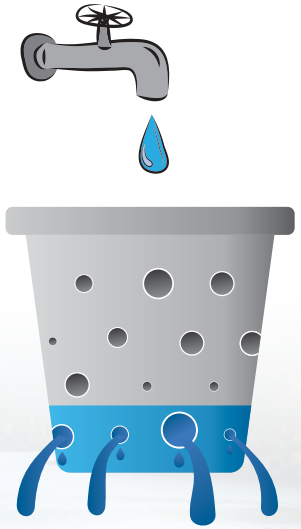


FIGURE 4

FIGURE 5

LEAKY BUCKET ANALOGY

About a third of the carbon stored in harvested trees is "carried over" in wood products and can be stored for decades in buildings and other long-lived applications. This also represents a carbon store that can increase over time, but this store is offset when logging to produce the wood results in significant reductions in levels of forest carbon over large areas. **[Figure 6]**

Increasing the extent, frequency or intensity of logging cannot lead to more forest carbon being stored. Since the goal is to combat climate change by reducing emissions and removing excess carbon from the atmosphere, what matters most is whether forest management and wood use results in net increases in carbon storage. Wood use will contribute to combatting climate change only if we protect more forest and implement climate-friendlier forestry.

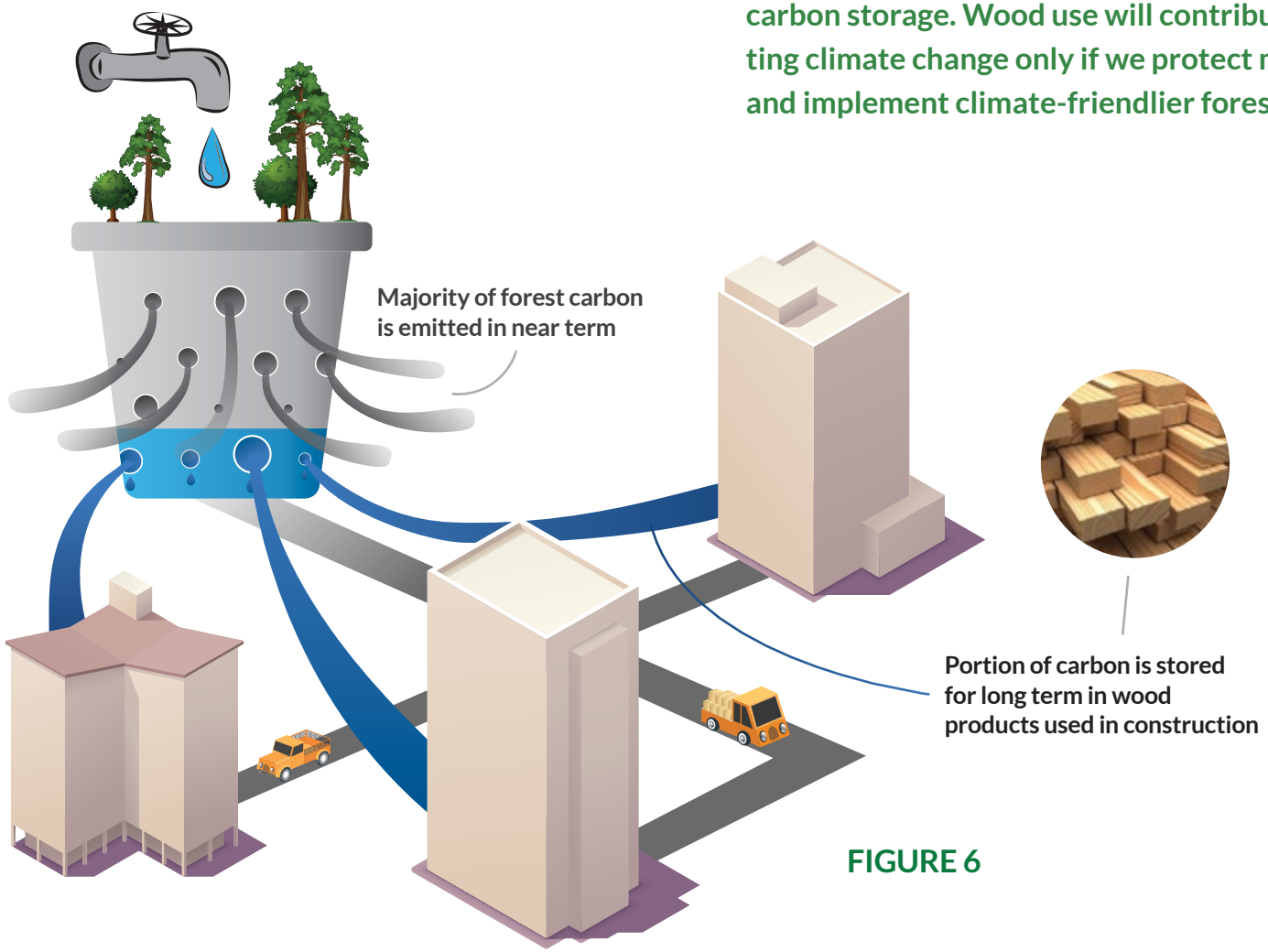


FIGURE 6

FOREST PROTECTION & STEWARDSHIP ARE KEY

Scientists increasingly recognize that a key component of efforts to mitigate the effects of climate change is to improve forest management and increase forest recovery and protection[10]. While there is no simple, one-size-fits-all answer as to how best to harvest timber to optimize carbon, in general…

- Logging of the world's remaining primary forests, as well as unroaded and other intact forest landscapes. Research indicates that forest carbon is maximized where there are the highest levels of forest protection and the least amount of logging, or no logging at all[11]. Therefore, we should permanently protect those forests that are the most carbon-rich and are mostly found on U.S. federal forestlands[12];

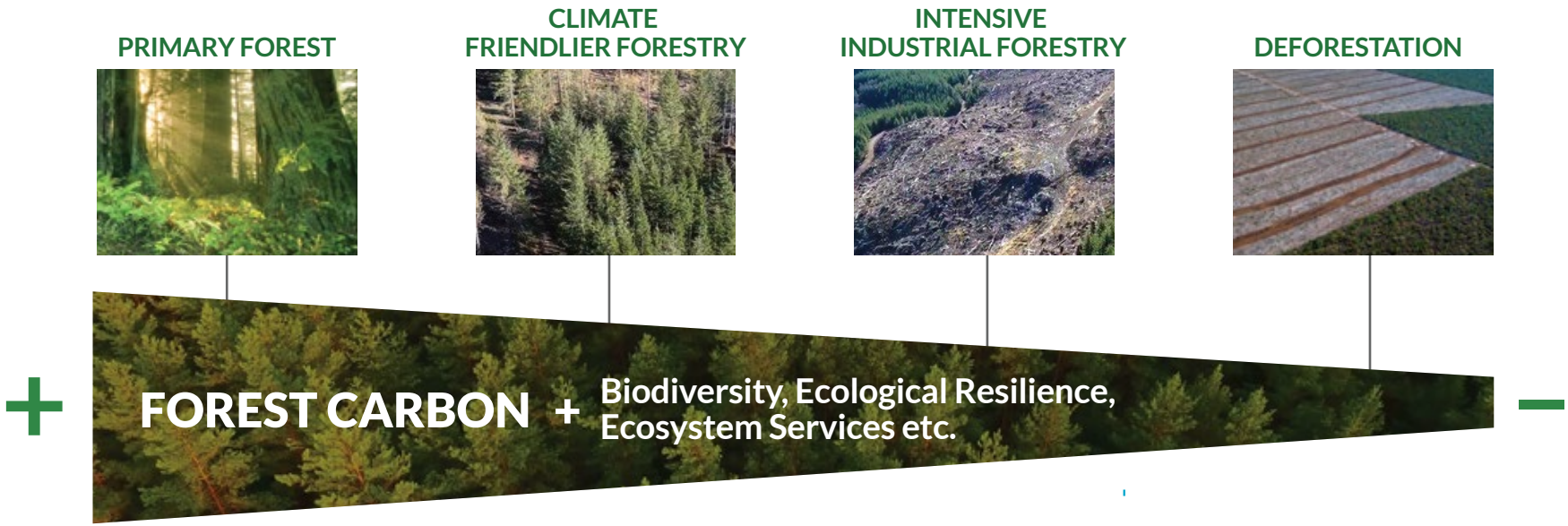
- Older forests store more carbon than younger forests, so there is a forest carbon benefit from protecting older forests on private lands and lengthening logging rotations (the time interval between harvests) on private lands[13]. Forests should be managed to optimize the amount of carbon they store regardless of ownership, and not for the quickest return on investment;

- Forest management that is less intensive (e.g. smaller clearcuts, more live-tree retention, wider riparian buffers) results in less overall emissions of forest carbon than more intensive management (e.g. industrial tree farms that rely on large, frequent clearcuts and applications of greenhouse gas-emitting fertilizers, herbicides and pesticides)[14];

- Tree plantations should not be established at the expense of natural forests and, since forests that are managed as ecosystems rather than monocultures are more resilient in the face of climate change[15] -- e.g. to pests, fire and drought -- and have higher carbon storage, many existing plantations should be restored to a more natural condition;

- Afforestation (planting trees in areas where there are none currently and it is ecologically appropriate to do so, e.g. in fallowed fields) is desirable because it brings near-term carbon benefits and will increase wood supply in the long term.

Not only would taking these actions improve the management of forest carbon, it would yield numerous other important environmental benefits including less harm to wildlife habitat, relatively higher ecological complexity and biological diversity, and reduced negative impacts on soil and water quality[16].



THREE WAYS TO PROMOTE CLIMATE-FRIENDLIER FORESTRY

Climate-friendlier forestry requires a long-term view of forest management and an appreciation for the full array of environmental and social benefits that responsibly managed forests offer. There is a trade-off between maximizing the short-term financial return on managed forests and enhancing the climate and other environmental benefits of forestry. While climate-friendlier forestry is proven to be practically viable, our financial system favors quick returns and drives short-term thinking and practice detrimental to climate, wildlife and fisheries, and water quality.

Thus, the greatest challenge facing the uptake of climate-friendlier forestry on private lands is economic in nature. There are three main ways to overcome this hurdle:

1. **Requiring climate-friendlier forestry by strengthening government regulations**

2. **Incentivizing it through policies that price carbon at a level that makes it financially attractive to forest owners, e.g. by taxing carbon emissions and using part of the proceeds to pay landowners for improving their management practices, or through carbon offset markets;**

3. **Rewarding it through premiums or preferences in the marketplace, e.g. by preferentially sourcing FSC-certified products**

CLIMATE-FRIENDLIER FORESTRY & FSC CERTIFICATION

The Forest Stewardship Council (FSC) is a voluntary program whose standards, among the available forest certification programs, best reflect and support climate-friendlier forestry. Among other things, FSC standards require the protection of High Conservation Value forests (such as primary forest), retention of more trees during logging, wider stream buffers, and smaller cut blocks than are permitted by regulation.

An environmental organization called Ecotrust completed a study[17] that compared outcomes under business-as-usual (BAU) forestry at the regulatory floor with those of FSC-certified forests in Oregon and Washington. Ecotrust found that:

- **FSC always stored more carbon. FSC stored between 25% and 60% more than BAU on average, ranging as high as 80% more carbon stored.**
- **Long rotations store more carbon than short rotations while maintaining competitive timber output.**
- **FSC requires larger stream buffers than BAU in Oregon, taking substantial areas of land out of timber production to protect streams and resulting in lower average timber yields, but higher stores of forest carbon.**

The inescapable conclusion is that wherever logging occurs, the timber industry needs to transition to climate-friendlier forestry.

FOREST STEWARDSHIP COUNCIL

A FOREST CARBON TRUST

Forests store more carbon per acre than any other terrestrial ecosystem on the planet; they need to be the nation's first line of climate change defense. What's left of carbon-dense primary forests in the U.S. are largely on federally-owned lands[18] where significant but incomplete conservation agreements have secured some protections. We need to protect them completely, and this is why Sierra Club advocates for the creation of a Forest Carbon Trust that would identify and protect carbon-dense primary forests, as well as areas suitable for old growth restoration or afforestation.

In the U.S., the Sierra Club advocates for ending commercial logging on federal public lands. This will not only safeguard remaining primary forests, but also allow previously logged areas to recover and store far more carbon. The Northwest Forest Plan offers a precedent: its implementation in the National Forests of the Pacific Northwest has succeeded in turning the region into a carbon sink by allowing for the recovery of old-growth forests[19]. This process must be allowed to continue and be extended to other regions.

Establishing a Forest Carbon Trust would facilitate a shift away from federal subsidies for logging carbon-rich, older forests, or logging of ecologically important "snag forest" habitat, to investment in needed watershed and forest protection. This would not only help natural systems adapt to climate change, it would also form the foundation of a robust green economy, providing jobs for local communities encompassing a range of skills[20].

Importantly, federal investment to protect watersheds from the impacts of logging is one of the most direct means of safeguarding clean water supplies and controlling flooding.

Another component of this approach would be the acquisition of private forestlands from willing sellers, putting them into protected public ownership to further increase the climate change mitigation potential of the Forest Carbon Trust.

This campaign could also work in conjunction with efforts to eliminate fossil fuel extraction from federal public lands—a "keep it in the forest, keep it in the ground" approach that would amplify benefits even more.

The creation of a Forest Carbon Trust would:

- result in a substantial reduction in and avoidance of carbon emissions from forest degradation and fossil fuel production,
- be integral to a broader green jobs program,
- establish a model for other nations transitioning away from fossil fuels where increased forest protection would be indispensable to any climate solution.

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ENVIRONMENTAL JUSTICE AND EQUITY

Protecting federal public lands from logging and fossil fuel extraction will advance environmental justice and equity in multiple ways:

Protected forests reduce flooding, which is increasingly impacting communities in the Southeastern U.S. and Midwest under climate change. By including a vigorous land acquisition component to the Forest Carbon Trust, we can increase federal forestlands in places where many communities lack access to nature, especially in some areas of the Southeastern U.S. Protecting federal forests from logging will also substantially curb "biomass logging" in western public forests, which is a growing threat and environmental justice concern for many lower-income communities already struggling with health effects from poor air quality (biomass facilities incinerate trees for dirty energy, emitting large amounts of particulates locally into communities, while also emitting enormous amounts of CO_2). And, by keeping carbon in our federal forests while also keeping carbon in the ground on federal lands, we can take a significant step toward mitigating climate change, which will help curb rising sea levels that are threatening many vulnerable and frontline coastal communities that do not have the financial resources to easily move inland to higher ground.

Further, by protecting federal public lands from commercial logging and fossil fuel extraction, we can redirect the hundreds of millions of dollars currently spent each year subsidizing carbon extraction from public lands to instead provide green jobs creating trails and campsites in newly-acquired federal forestlands, as well as to help the make the most vulnerable communities more fire-safe from wildland fires.

NATURAL CLIMATE SOLUTIONS

If enacted worldwide, natural climate solutions could accomplish at least 37% of the mitigation needs globally to keep the climate at a safe level[21].

In the US, some 30 million plus acres of moist forests on National Forest lands store the equivalent of 7 times U.S. annual emissions[22];

More logging occurs in U.S. forests than in any other nation in the world, making the U.S. the largest global problem in terms of carbon emissions from logging[23];

Greenhouse gas emissions from the U.S. constitute about one-quarter of the global total, and much of this is the result of fossil fuel extraction from federal public lands, including 41% of all coal extraction that occurs in the U.S.[24];

Increased forest protection globally could account for approximately half of the climate change mitigation needed to keep global temperature rise to 1.5 degrees Celsius or less[25].

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