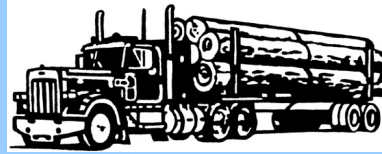


Climate Pollution from PNW Logging Kills 16,000 Per Year



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Summary

- A. Carbon dioxide and other climate pollutants released into the atmosphere kill people. New research indicates that **every 3,700 tons of carbon dioxide** (or the equivalent for other climate pollutants) released into the atmosphere **will, on average, kill one human**.
- B. In recent years, annual timber production in the Pacific Northwest (Oregon and Washington-PNW) has increased atmospheric carbon dioxide by 60 million tons: 35 million tons per year in Oregon and 25 million tons per year in Washington. **This climate pollution from logging will lead to the death of about 16,000 people.**
- C. The climate pollution from PNW logging **will kill one person for approximately every:**
- **2.4 million board feet of logs** removed from the forest.
 - **1,400 acres of land** used for industrial timber production.
 - **\$210,000 of revenues** landowners receive from log production.
- D. **The economic cost to society from this increase in human death exceeds the value of the logs by up to 60-to-1.**
- E. **Climate pollution from PNW timber production does much more than kill people.** It causes injuries, diseases, malnutrition, and starvation; destroys property and livelihoods; intensifies levels of fear and violence; degrades the quality of life; and much, much more.
- F. **It doesn't have to be this way.**
- The citizens of Oregon and Washington can demand that landowners stop killing people without accountability, impose a tax on timber production, and use the proceeds to help people become less vulnerable to heat waves and other deadly consequences of climate pollution.
 - Some landowners may decide that killing people is too high a price, cease logging on their lands, and manage their forests to remove carbon dioxide from the atmosphere.
 - If landowners opt to continue log production, they can reduce the resulting carbon pollution and number of deaths by letting trees grow longer and bigger before killing them.

I. Every 3,700 Tons of Carbon Dioxide Added to The Atmosphere Will Kill One Person

Everyday experience, common sense, and a massive amount of research all give the same message: carbon dioxide and other climate pollutants kill people. Each incremental increase in these pollutants in the atmosphere encourages changes in climate around the globe that increase the risk of death for all humans in diverse ways, including these:

- Heat waves expose human bodies to intolerable temperatures.
- New diseases emerge, existing diseases spread to new populations, and humans stressed by changes in climate become more vulnerable.
- Crop failures exacerbate hunger and starvation.
- Droughts lead to deaths from contaminated water, diseases, and dehydration.
- Flooding kills by drowning, disease, and starvation.
- Extreme weather can kill in many ways.
- Rising seas expose coastal communities to storm damage and flooding.
- Increases in deaths from violence and conflict, especially for climate-driven refugees.

For years, scientists have worked to quantify the number of deaths per unit of climate pollution. Researchers from Canada and Austria recently responded to the challenge, providing a credible estimate after reviewing more than 180 peer-reviewed scientific articles. They concluded it is reasonable to anticipate that **every 3,700 tons of carbon dioxide** (or equivalent for other pollutants) **added to the atmosphere likely will lead to the death of one person.**¹ This increased risk of death applies to everyone on Earth, but current data cannot accurately predict who will actually die.

This finding does not stand alone. Mounting evidence indicates that the risks of death likely will increase markedly unless climate pollution declines quickly. For example, the World Health Organization recently concluded it is reasonable to expect that climate-related increases in the incidence of just four maladies—undernutrition, malarial diarrhea, and heat stress—will “cause approximately 250,000 additional deaths per year” in the near future.² And another recent assessment concludes: “Unabated climate change will cause 3.4 million deaths per year by the end of the Century” with particular concern for deaths related to wildfires and high temperatures.³

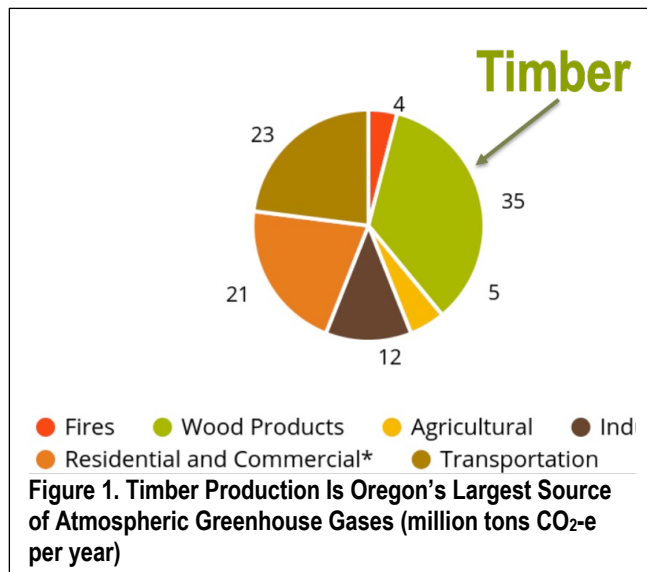
¹ Pearce, J.M., and R. Parncutt. 2023. [Quantifying Global Greenhouse Gas Emissions in Human Deaths to Guide Energy Policy](#). The researchers present evidence that supports the so-called “1000-ton rule,” according to which a person will be killed in response to climate pollution every time 1000 tons of fossil carbon are burned....” They then observe that burning 1,000 tons of fossil carbon results in and is equivalent to adding 3,700 tons of carbon dioxide to the atmosphere. Hence, the “1000-ton rule” for carbon is equivalent to a “3,700-ton rule” for carbon dioxide. The authors also acknowledge the uncertainty inherent in the 1000-ton rule: the actual number of deaths might be smaller or larger. Evidence suggests, however, that **it would be prudent to assume that the actual death rate is higher today and will become even higher in the future**. See, for example: Hansen, J., M. Sato, L. Simons, and others. 2023. [Global Warming in the Pipeline](#); British Medical Journal and others. 2023. [Time to Treat the Climate and Nature Crisis as One Indivisible Global Health Emergency](#); Newman, R., and I. Noy. 2023. [The Global Costs of Extreme Weather that Are Attributable to Climate Change](#); Lenton, T.M., and others. 2023. [The Global Tipping Points Report 2023](#); and He, H., R.J. Kramer, B.J Soden, and N. Jeevanjee. 2023. [State Dependence of CO₂ Forcing and Its Implications for Climate Sensitivity](#).

² World Health Organization. 2023. [Fact-Sheet: Climate Change](#).

³ Climate Vulnerable Forum and Lancet Countdown. 2022. [New Health Data Shows Unabated Climate Change Will Cause 3.4 Million Deaths Per year by Century End](#).

II. Climate Pollutants from Annual PNW Log Production Will Kill 16,000 People

Most of the global concern about climate-related deaths focuses on climate pollution from fossil fuels. In the PNW, however, the production and use of timber is a major source of climate pollution, primarily carbon dioxide. Indeed, the timber industry is Oregon's largest, single source of climate pollution, adding the equivalent of 35 million tons of carbon dioxide to the atmosphere per year (Figure 1).⁴ The previous section explains that each 3,700 tons of carbon dioxide will kill one person. These numbers mean that **annual timber production in Oregon will be responsible for killing about 9,500 people**. The climate pollutants materialize as the industry in Oregon produces about 4 billion board feet of logs per year, so that **each million board feet of logs will kill about 2.4 people** (Box 1).



Washington's timber industry produces about 2.8 billion board feet of logs per year.⁵ Insofar as log production is similar in the two states, it is reasonable to conclude that the climate pollution from **annual log production in Washington will be responsible for killing about 2,800 people**. **For the two states combined, the climate pollution from annual log production will be responsible for killing about 16,000 people**.

The industry-generated climate pollution increases the risk of death for everyone on Earth. It is impossible at this time to trace where exactly this risk will result in actual deaths, or who will be killed. Some might be tempted to dismiss deaths that occur outside the region as being somebody else's problem. The global climate crisis, however, means that, just as climate pollutants added to the atmosphere here will kill people living elsewhere, climate pollutants added to the atmosphere somewhere else will trigger deaths here. This reciprocal relationship means that it is reasonable, and morally imperative, to recognize that the timber industry's annual climate pollution will kill about 16,000 people and accept responsibility for the deaths, wherever they occur.

Table 1 shows the general numbers of deaths from timber production in recent years for each state and the region. Table 2 shows the log production and the resulting deaths in 2021 for different landowners.

Box 1. Deaths Per Volume of Logs

Annual log production in Oregon has been about 4 billion board feet (4,000 million board feet). These logs have generated climate pollution that will kill about 9,500 people. These numbers indicate that climate pollution from PNW log production will kill $(9,500 \div 4,000 =)$ **2.4 deaths per million board feet of logs**.

⁴ Segerstrom, C. 2018. [Timber is Oregon's Biggest Carbon Polluter](#).

⁵ Mason, Bruce & Girard. 2022. [Contribution of Working Forests to the Washington State Economy: 2021](#).

Table 1. Deaths from Annual Log Production, Oregon and Washington

Log Producer	
Oregon	
Annual Log Production (million board feet)	4,000
Atmospheric Greenhouse-Gases (tons CO ₂ -e)	35 million
Resultant Deaths, Total	9,500
Washington	
Annual Log Production (million board feet)	2,800
Atmospheric Greenhouse-Gases (tons CO ₂ -e)	24.5 million
Resultant Deaths, Total	6,700
PACIFIC NORTHWEST TOTAL	
Annual Log Production (million board feet)	6,800
Atmospheric Greenhouse-Gases (tons CO ₂ -e)	59.5 million
Resultant Deaths, Total	16,000^a

^a Rounded

Table 2. Deaths from Log Production in 2021, by Landowner

Log Producer	Log Production ^a (million board feet)	Deaths ^{b, c} (2.4 per million board feet)
Oregon		
Private & Tribal	2,898	7,000
State	484	1,200
Forest Service	282	700
BLM & Other	287	700
Total	3,950	9,500
Washington		
Industrial	1,144	2,700
Nonindustrial Private & Tribal	735	1,800
State	705	1,700
Forest Service	146	400
BLM & Other Public	16	--
Total	2,746	6,600
PACIFIC NORTHWEST TOTAL	6,696	16,000

^a Bureau of Business and Economic Research, University of Montana. 2023. [Oregon Timber Harvest](#); and [Washington Timber Harvest](#).

^b Data shown do not include workers killed while working in the timber industry, known for being especially dangerous. Nationwide, the annual death rate for logging workers is one death per 111.9 workers. [Fraser, J. 2023. [America's Most Dangerous Jobs](#).]

^c Rounded.

III. The Economic Cost to Society from Killing 16,000 People Far Exceeds the Value of the Logs

Why does the industry behave this way? Why does it continue to produce so much timber using timber-management practices that generate so much climate pollution that kills so many? Why do elected officials and other community leaders look the other way or even encourage continuation of these practices?

One answer is that landowners manage their lands to make money from the sale of logs.

How much money? **Landowners receive about \$210,000 in revenues from selling enough logs to generate enough climate pollution to kill one person** – about 2.4 million board feet (Box 2.)

This number contrasts sharply with widely accepted economic estimates of the harm from each death. Extensive research shows that, **when actions, such as logging, create a risk of killing one American, the cost to society is about \$7.5–\$12.5 million** (Box 3).⁶ So, when corporate shareholders and public forest managers decide to initiate enough logging to generate log revenues of \$210,000 the resulting increase in the risk of death from climate pollution imposes on society an economic cost of \$7.5–\$12.5 million. These numbers indicate that **the cost to society from logging that results in one climate-related death is up to 60 times greater than the revenues for landowners.**

Table 3 shows, for the different categories of landowners, that they have:

- Received **log revenues of about \$3.4 billion** by killing enough trees to produce 6.8 billion board feet of logs and generate sufficient climate pollution to kill 16,000 people.
- Forced society to cope with death-related costs that total up to (16,000 deaths X \$12.5 million =) **\$200 billion.**

Box 2. Landowner Revenue Per Death

In recent years landowners have received about \$500 per thousand board feet of logs. This price, applied to 6.8 billion board feet (the total annual harvest for the two states shown in Table 1) provides landowners with revenues of \$3.4 billion. The climate pollution from the logging results in 16,000 deaths. These numbers indicate that landowners will receive about ($\$3.4 \text{ billion} \div 16,000 =$) **\$210,000 in log revenues per death**. Conversely, this is the amount they would forgo by reducing logging to prevent a death from log-related climate pollution.

Box 3 The Economic Value of Human Life

Any increase in risk, i.e., in the probability of harm, imposes economic costs on those who bear the risk. Economists often apply the term, the economic value of human life, to the cost to society when an action will result in the death of one, unspecified person. The cost estimate represents the amount the affected population is willing to pay to avoid this increase in risk or, alternatively, the amount of compensation they require before they would be willing to accept the increase in risk. Widely accepted estimates of the **economic cost per potential death** in the US include:

- **\$7.5 million** [Federal Emergency Management Agency. 2020. [FEMA Benefit-Cost Analysis \(BCA\) Toolkit 6.0 Release Notes](#)]
- **\$10 million** [US Environmental Protection Agency. 2017. [Mortality Risk Valuation](#)]
- **\$12.5 million** [US Department of Transportation. 2021. [Departmental Guidance on Valuation of a Statistical Life in Economic Analysis](#)]

⁶ See, for example, Federal Emergency Management Agency. 2020. [FEMA Benefit-Cost Analysis \(BCA\) Toolkit 6.0 Release Notes](#); US Environmental Protection Agency. 2017. [Mortality Risk Valuation](#); and US Department of Transportation. 2021. [Departmental Guidance on Valuation of a Statistical Life in Economic Analysis](#).

Table 3. Revenues and Costs Imposed on Society from Log Production in 2021, by Landowner

Log Producer	Log Revenues ^a	Costs Imposed on Society by Climate Pollution Deaths ^{a,b}
Oregon		
Private & Tribal	\$1.4 billion	\$88 billion
State	\$0.2 billion	\$15 billion
Forest Service	\$0.1 billion	\$9 billion
BLM & Other	\$0.1 billion	\$9 billion
Total	\$2.0 billion	\$119 billion
Washington		
Industrial	\$0.6 billion	\$34 billion
Nonindustrial Private & Tribal	\$0.4 billion	\$22 billion
State	\$0.4 billion	\$21 billion
Forest Service	\$0.1 billion	\$5 billion
BLM & Other Public	--	--
Total	\$1.4 billion	\$82 billion
PACIFIC NORTHWEST TOTAL	\$3.4 billion	\$200 billion

^a Rounded

^b Deaths shown in Table 2 times value per human life = \$12.5 million.

Some landowners will share the revenues with others and, hence, also share the responsibility for the deaths and costs to society. This is especially true for Washington’s Department of Natural Resources, which bears immediate responsibility for decisions to produce 705 million board feet of logs in 2021, resulting in the death of 1,700 people and imposing on society related costs of \$21 billion. The same immediate responsibility applies to Oregon’s Board of Forestry for its decisions to produce 484 million board feet of logs in 2021, resulting in the death of 1,200 people and imposing on society costs of \$15 billion. They share some responsibility, however, with those – county commissioners, school officials, legislators, corporate managers, and others – who have encouraged them to conduct the logging out of a desire to enjoy portions of the revenues or, perhaps, political credit for same.

Additional encouragement for log production in the Pacific Northwest comes from those who assert that it is necessary to provide economic growth for rural communities and high-paying jobs for rural workers. A catalog of facts, however, points in the opposite direction. Landscapes scarred by logging can kneecap the ability of forests to generate jobs in other sectors. For decades, communities in Oregon and Washington surrounded attractive natural-resource amenities, such as clean water and salmon in streams have experienced robust economic activity and higher family incomes by attracting highly mobile entrepreneurs, investors, and skilled workers.⁷ These people typically don’t, however, move into areas surrounded by

⁷ See, for example, Rooney, B. [Oregon’s Forestry and Logging Industry: From Planting to Harvest](#); and Hjerpe, E., A. Hussain, and T. Holmes. 2020. [Amenity Migration and Public Lands: Rise of the Protected Areas](#).

Instead, clearcuts full of stumps and dense plantations that increase the risk of intense wildfire exert persistent, negative impacts on rural jobs and economic vitality. The number of manufacturing jobs per unit of logs (Figure 2) has been declining for more than two decades. The number of jobs for “loggers,” an occupational category that includes “loggers, equipment operators, truck drivers, and fallers and buckers,” hasn’t shown the same decline in recent years, but wages are low: the average wage for Oregon’s loggers is about 15 percent below the statewide average for all jobs.⁸ In the past, these workers enjoyed wages as much as 30 percent higher than the statewide average, so the current relationship indicates that timber production has brought long-term economic decline, not growth, on rural workers and communities.⁹

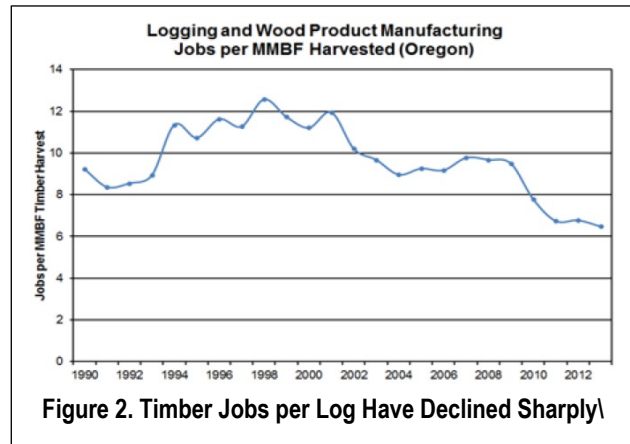


Figure 2. Timber Jobs per Log Have Declined Sharply

Whatever the number of jobs supported by logging, is it sufficient to justify killing people? Data from Oregon show that, **on average, the climate pollution from the trees killed by one “logger” (“loggers, equipment operators, truck drivers, and fallers and buckers,”) will kill more than two people** (Box 4). Those killed might include the logger’s neighbors or they might live

Box 4. Deaths Per Logger

The Oregon Employment Department in 2022 classified 4,520 employees in the state as “loggers” which includes “loggers, equipment operators, truck drivers, and fallers and buckers”. The trees they killed resulted in climate pollution that will kill 9,500 people. These numbers indicate that climate pollution from PNW timber production will kill $(9,500 \div 4,520 =) 2+$ **deaths per logger**.

elsewhere in Oregon or Washington or elsewhere in the world. Does it matter where they live? If the answer is, “Yes,” then it raises troublesome issues, such as, why is it more acceptable to kill someone living farther away than someone living more nearby?

Before leaving this section, it is important to note that climate pollutants from logging also have important non-lethal impacts. They injure many, make others ill, and intensify hunger and thirst. They destroy private property, public infrastructure, businesses, livelihoods, and communities. They lead to explosions of violence. These effects, and many more, impose costs on individuals, families, businesses, and communities. This reality was demonstrated in 2016, when the Bureau of Land Management (BLM) showed that a small subsection of the climate-related costs from additional logging on lands it manages in western Oregon would exceed the value of the logs produced by more than 4-to-1.¹⁰ Updates to a critical element of the analysis, the estimated social cost from carbon dioxide emissions, boost this ratio to **more than 20-to-1**, all else equal.¹¹ The actual ratio is much larger, because the estimate of the social cost of carbon dioxide represents just a small fraction of the total costs from climate pollution (and only one type of climate-related deaths—from heat waves).

⁸ Rooney, B. [Oregon’s Forestry and Logging Industry: From Planting to Harvest](#).

⁹ Lerner, Josh. [Oregon’s Timber History, An Update](#).

¹⁰ BLM. 2016. [Proposed Resource Management Plan/Final Environmental Impact Statement: Western Oregon](#). p. 657.

¹¹ In 2016, the social cost of carbon dioxide used by the BLM was about \$50 per ton. New analysis from EPA indicates it is reasonable to assume the value now exceeds \$350 per ton. [EPA. 2023. [EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances](#).

IV. It Doesn't Have to Be This Way

The Pacific Northwest doesn't have to produce timber with practices that kill so many people and impose such high costs on society. Better alternatives are available. Implementing them would do more than reduce the number of timber-related deaths. It also would boost economic well-being for workers, families, businesses, and communities throughout Washington and Oregon. Such an outcome will require at least these actions:

1. Require Those Who Enjoy the Benefits to Be Accountable for the Harms They Impose on Others: Reduce the Risks and Provide Compensation for Those Harmed

- Apply the Polluter-Pays-Principle: those who enjoy the benefits (profits, jobs, incomes, etc.) from climate pollution should pay the full costs of their actions. Applying the principle likely would require implementing a tax that diverts log revenues to be used to reduce vulnerability and compensate victims. Two well-tested types of tax applicable in this context are a severance (or harvest) tax based on the landowners' revenues, and a pollution tax, based on the increase in atmospheric climate pollution from logging.

2. Remove Some Lands from Logging

- Removing about 1,400 acres from the timber-producing land base would reduce logging-related climate pollution enough to avoid one death (Box 5). Doing so would reduce landowners' log revenues by about \$210,000 (Box 2) but improve economic well-being of society by perhaps \$12.5 million (Box 3).

Box 5. Timberland Acreage Per Death

Lands under corporate, industrial ownership have the greatest concentration of timber production and, hence, best illustrate the tradeoff between log production per acre and deaths per acre. In Washington, timber production occurs on 3,732,000 acres of industry-owned land. The climate pollution from annual timber production on this land will kill about 2,700 people. These numbers indicate that deaths from timber production on industrial land will occur at the rate of $(3,732,000 \div 2,700 =)$ **1,400 acres of timberland per death**. Conversely, this number represents the number of deaths that will be avoided by withdrawing this acreage from timber production.

3. Let Trees Grow Longer and Bigger

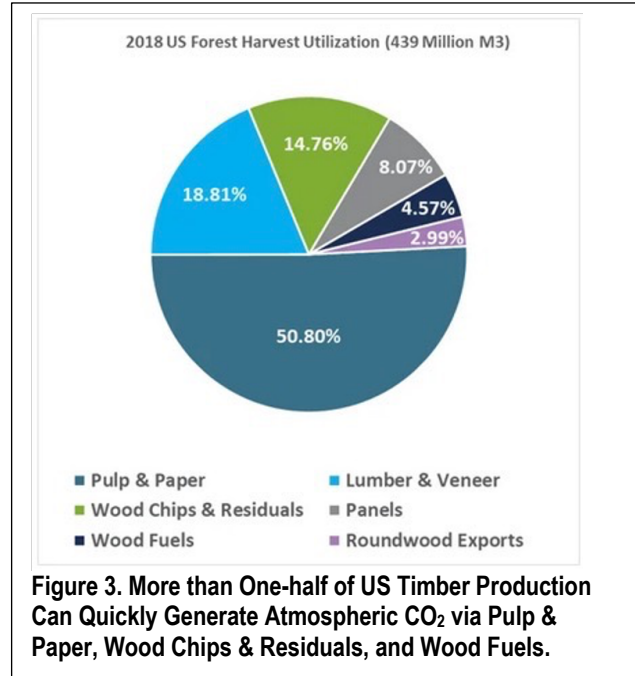
- The optimal rotation age for trees typical of western Oregon is 60-120 years, double or more than double the rotations – 30 to 45 years, or less – common in the PNW.¹²

¹² Carlisle, C., S. Fitzgerald, and H. Temesgen. 2023. [Modeling Above-Ground Carbon Dynamics under Different Silvicultural Treatments on the McDonald-Dunn Research Forest](#). Supportive research shows:

- Mature forests store substantially more carbon than young forests. Hence, allowing existing forests to continue growing is essential for limiting increases in global warming and avoiding catastrophic damage from climate change. [Wear, D.N., and M. Wibbenmeyer. 2023. [Land-Use Change, No-Net-Loss Policies, and Effects on Carbon Dioxide Removals](#).]
- Mature forests store substantially more carbon than young forests. Hence, allowing existing forests to continue growing is essential for limiting increases in global warming and avoiding catastrophic damage from climate change. [Law, B.E., L.T. Berner, and others. 2021. [Strategic Forest Reserves Can Protect Biodiversity in the Western United States and Mitigate Climate Change](#).]
- Oregon and Washington have probably the best forests in the contiguous U.S. for sequestering and storing carbon. [Williams, N.G., and M.D. Powers. 2018. [Carbon Storage Implications of Active Management in Mature *Pseudotsuga menziesii* Forests of Western Oregon](#).]
- Protecting existing intact forests and allowing young trees to grow to form new intact forests generates the greatest levels of net benefits for society and is essential for avoiding catastrophic damage from changes in climate. [Moomaw, W.R., S.A. Masino, and E.K. Faison. 2023. [Intact Forests in the United States](#):]

4. Reduce Wasteful Uses of Wood

- Today's timber industry has a linear profile: it produces a given product, often with characteristics that encourage waste, sells it into the market, and forgets about it. Consumers typically use the product once and discard it. This pattern applies both to paper and pulp products, which constitute one-half of the nation's wood products, and to others, such as wood fuels and chips (Figure 3). Experience elsewhere and in other industries indicates the industry can lower the imperative for killing trees by implementing circular production/use processes, i.e., accept responsibility for recovering a product from the initial user, restore its utility or convert it into another product, and resell the product back into the market.¹³



[Proforestation Mitigates Climate Change and Serves the Greatest Good](#); and Mo, L., Zohner, C.M., Reich, P.B., and others. 2023. [Integrated Global Assessment of the Natural Forest Carbon Potential](#)

¹³ Forster, E.J., J.R. Healey, G. Newman, and D. Styles. 2023. [Circular Wood Use Can Accelerate Decarbonisation but Requires Cross-Sectoral Coordination](#).

Ernie Niemi prepared this report for Natural Resource Economics, a consultancy in Eugene, Oregon USA, which is solely responsible for its contents. The report draws on currently available data and research findings, and on more than four decades of research on the relationships among forest ecosystems, the timber industry, and the economy of Oregon and Washington.

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