Environmental claims being made by the wood industry must be carefully evaluated.

Caveat Emptor:

Sustainability, Wood, and the Environment

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ABSTRACT

Many claims fostered by special interest wood groups do not clearly define the assumptions used to develop their environmental statements and rely on false equivalencies when comparing competing systems. This paper takes a closer look at the assumptions made and provides a framework to better consider competing claims.

The Challenge

A simple Google search of wood-related environmental impacts results in millions of possible links.

The sheer volume of often contradictory claims regarding the sustainability of wood products is overwhelming. There is more information than even the most diligent researcher could possibly pursue. But even if it were possible to read each document, it would quickly become evident that each group behind a report or study carries a distinct set of biases, ranging from those interested in simply preserving forests to those profiting from the sale of wood products.

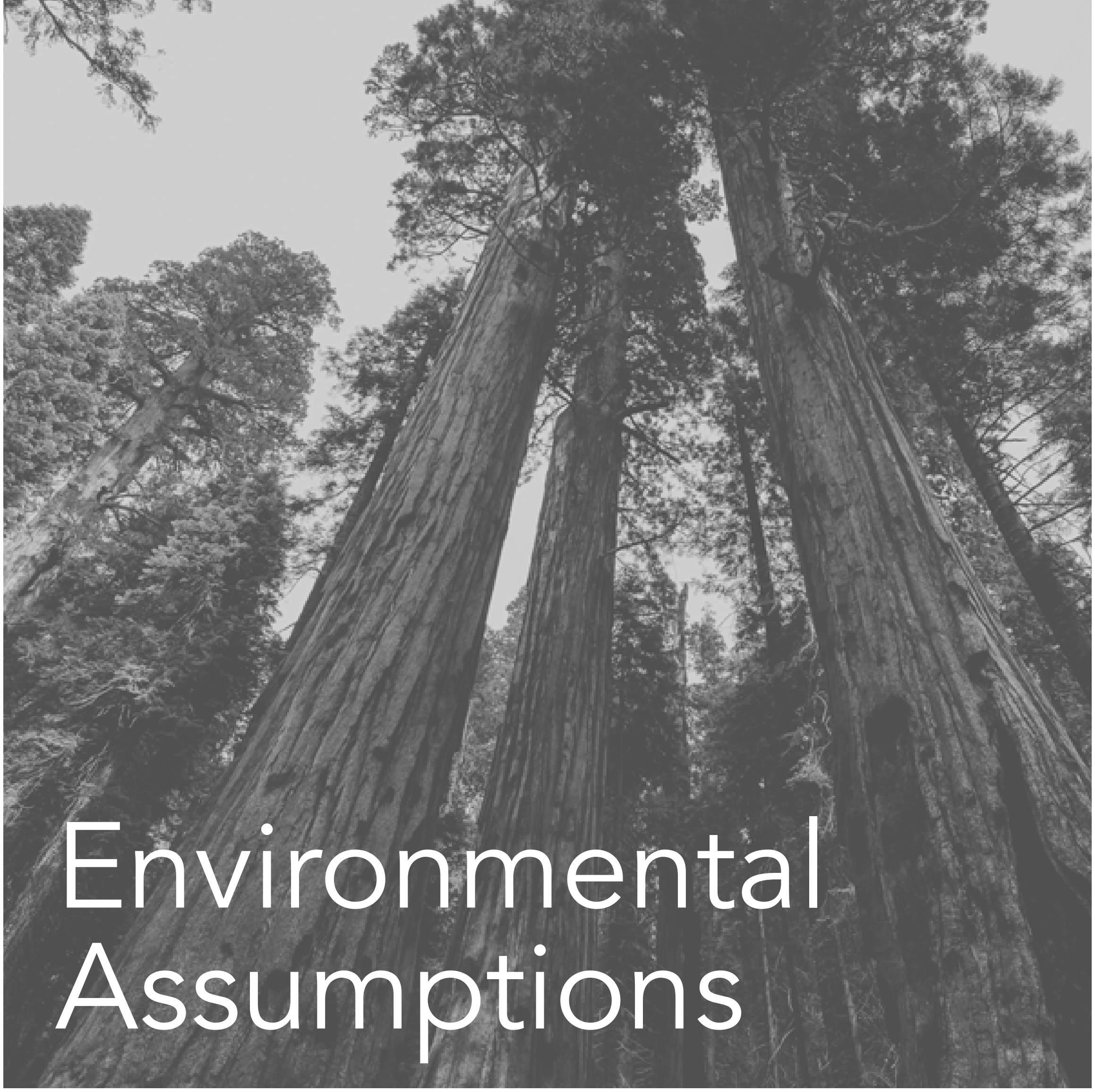
Most of these reports contain nuggets of truth, but they don't tell the whole story. They don't differentiate between different wood species, different forest management and harvesting practices, and different wood manufacturing methods. And it's very difficult to discover the actual methodologies used in a specific study, such as the basis for comparison with other materials or the underlying life cycle analysis methodology.

Buyers must beware. Many studies pick and choose between different methodologies and even between different data sets to end up with the most positive outcome to support their predetermined position. However, when arguments are examined more closely, statements such as "wood is a green material that has the least environmental impact of any material" do not stand the test of rigorous analysis.

INITIAL QUESTIONS

In any analysis of environmental impact, whether of wood or any other material, it's important to consider:

- **What assumptions are being made?**
- **What impacts are being considered?**
- **What comparisons are being made?**
- **What product boundaries are being imposed?**
- **What methodology is being used?**



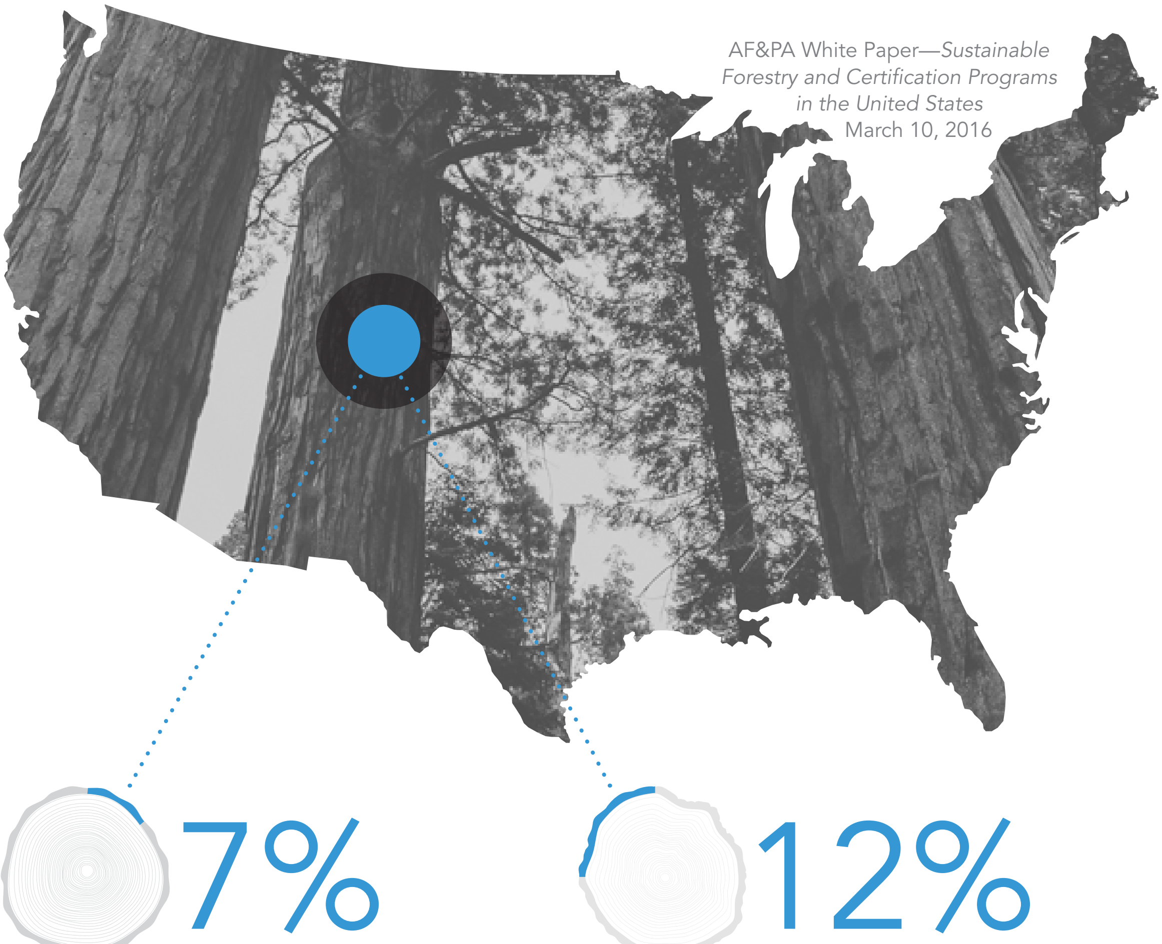
Environmental Assumptions

ASSUMPTION 1: ALL TREES ARE THE SAME.

The environmental impacts of tree species vary based on several factors.

More than 800 species of tree exist in the U.S., according to the Department of Agriculture.[1] A study performed in 2003 evaluated 87 of these species and categorized their differences. The biomass density of different species of trees varies dramatically, which means that the carbon sequestration rates may vary by as much as 400%.[2]

In addition, many published studies neglect to include non-wood elements in their results, especially when discussing manufactured wood products such as cross-laminated timber (CLT). CLT contains a significant amount of adhesives to bind the wood material together into CLT. Any analysis of the environmental impact of engineered wood products needs to include the manufacture and ultimate disposal of these chemicals, as well as their potential effects on building occupants both due to off-gassing and in fire exposure.



7%

of U.S. forests are certified as being managed sustainably (FSC)

12%

of harvesting practices are certified as being sustainably performed (SFI)[3]

Most, if not all, environmental impact studies published by the wood industry assume that the wood is sourced from sustainably managed forests and that the wood is harvested in a sustainable manner.

This assumption is critical to the wood industry's argument that an increase in wood consumption would not reduce forest acreage and new trees will be planted to replace trees that have been harvested.

However, a 2014 white paper from the American Forest and Paper Association indicated that only 7% of U.S. forests are certified as being managed sustainably (FSC) and only 12% of harvesting practices are certified as being sustainably performed (SFI).[3] Environmental claims based on the assumption of sustainable management and harvesting only apply to wood products from those forests. The majority of U.S. forests do not meet this requirement.

ASSUMPTION 2: SEEDLINGS CONSUME AS MUCH CO_2 AS MATURE TREES.

A similar assumption is that the carbon uptake in an acre of new seedlings is the same as the carbon uptake in an acre of mature forest land.

An international research group led by Nate Stephenson of the U.S. Geological Survey's Western Ecological Research Center studied more than 400 species of trees and found that for 97% of the species surveyed, the carbon sequestration rate increased substantially as the trees aged.[4] His study suggests that "large, old trees are better at absorbing carbon from the atmosphere."

Any study of wood-related environmental impacts, even in sustainably managed forests, must account for the difference in carbon dioxide (CO_2) sequestration rates between young and old trees.

ASSUMPTION 3: THERE IS LITTLE TO NO WASTE IN WOOD HARVESTING AND MILLING PROCESSES.

The wood industry often ignores the amount of biomass waste produced during harvesting and milling.

While some wood proponents claim 99% consumption of the biomass material of harvested trees, more comprehensive studies indicate that only 36% of a harvested tree ends up as a wood product when typical harvesting and milling practices are evaluated and the total mass of the tree, including the root system, is included.[5]

Why is this value so low? About 40% of a tree is left behind in the forest in the form of small branches, leaves, bark and roots. Of the 60% of the original tree that makes it to a sawmill, another 40% of the wood is lost in the lumber production process, meaning 64% of the original tree is lost in harvesting and milling.

36%

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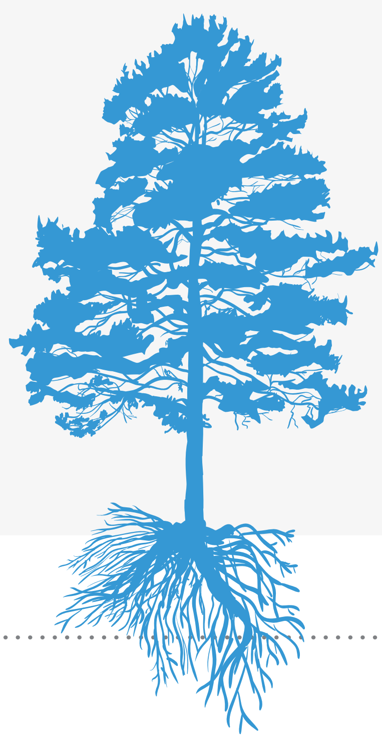

While estimates on wood waste vary, even conservative estimates put the number as higher than many people expect. "Even the most modern sawmills are hard pressed to turn half the volume of a log into lumber, creating huge quantities of waste wood," according to Jack Lutz, PhD, a forest economist at Forest Research Group and consultant to FourWinds Capital Management.[6] The Canadian wood industry cites similar numbers. "Today, a typical circular sawmill converts 50% of the log into primary product with band mill conversion at about 57%."[7]

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Waste & Emissions

What happens to the

64%

of the tree that is waste?

The portions of the tree which are left in the forest are either burned or left to decay over time. Both of these processes release CO_2 into the atmosphere. The natural decomposition of this waste releases nitrogen dioxide and methane, which are even more damaging to the environment than CO_2.

On average, typical lumber operations result in

SIX TONS OF DEBRIS PER ACRE HARVESTED.

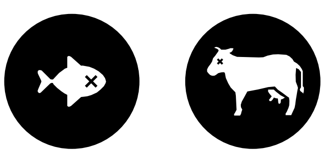
In many cases the harvested area is treated with a harmful herbicide containing the compound 2,4-D, which was a component of the infamous Agent Orange defoliant used during the Vietnam War.[8, 9]

The wood waste from the milling process is collected as chips and sawdust and either land filled, burned, pelletized or bound with adhesives to form engineered wood products.

Any analysis of the environmental impact of wood must account for emissions related to incineration as they

DO NOT REDUCE NET ENVIRONMENTAL IMPACTS.

In San Francisco, the Bay Area Air Quality Management District found that burning wood releases more particulate matter into the air than all of the vehicles and businesses in the region, and it's also the second-largest source of dioxins in the area.[10]



Carcinogenic dioxins infiltrate the water and ground, accumulating in **fish and livestock** to ultimately poison our food and water supply.[11]

The wood industry often claims a reduction in environmental impacts based on the use of pre-consumer wood waste material for energy production, including home heating. But the CO_2 production of burning wood waste is actually higher per British thermal unit (BTU) than burning coal.

What's more, the smoke produced by wood has a negative health impact, which **EFFECTIVELY NEGATES THE POSITIVE ENVIRONMENTAL IMPACTS** of wood-related products.[12]

POST-CONSUMER WOOD WASTE

Any evaluation of wood-related environmental impacts must take into account the actual levels of waste being generated on both a pre-consumer and post-consumer basis, as well as the environmental impacts related to the material's disposal.

In addition to the waste generated by harvesting and milling, it's also important to consider the waste generated by construction, demolition, and municipal solid waste collection.

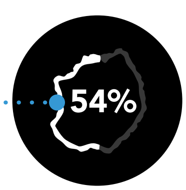
According to the U.S. Forest Service,

52.2 MILLION TONS of post-consumer wood waste was generated in 2010

15.8 million tons of MSW / **36.4** million tons of C&D

of which

28.1 MILLION TONS of that waste ended up in landfills[13].



The anaerobic decomposition process of organic materials, such as wood, takes place in landfills and is the single largest source of methane released into the atmosphere. Methane has 23 times the global warming potential of CO_2, according to the Intergovernmental Panel on Climate Change.[14]

It should be noted that the discussion does not distinguish between wood species but generally addresses the topic in terms of assumptions that must be fully defined for an analysis to take place. However, a recent study shows that different disposal methods can result in variations of as much as 2,700 kg of CO_2 equivalent per cubic meter of lumber.[15]

Product Boundaries

When discussing the environmental impact of wood, it's critical to address the definition of the boundaries of the life cycle assessment (LCA) used to calculate impacts.

LCA: LIFE CYCLE ASSESSMENT

An LCA which ignores the use, maintenance, operation, deconstruction, and waste collection/decomposition/incineration phases of wood does not provide an accurate analysis of the full environmental impact of the product.

A full view of any product should take the comprehensive life cycle of the product into consideration. A complete LCA for a wood product must therefore also account for land-clearing, habitat disruption, and planting operations. An LCA that accounts only for the harvesting and milling of lumber accurately depicts only those two stages of the product, not the comprehensive end-of-life.

Every LCA is different, and each LCA makes certain assumptions. One of the most misleading common assumptions from the wood industry is to take a credit in their LCAs based on waste-to-energy incineration of wood. However, because the emissions from burning wood are actually worse for the environment than burning either coal or oil, this benefit is at best overstated and more realistically should be considered a net negative.

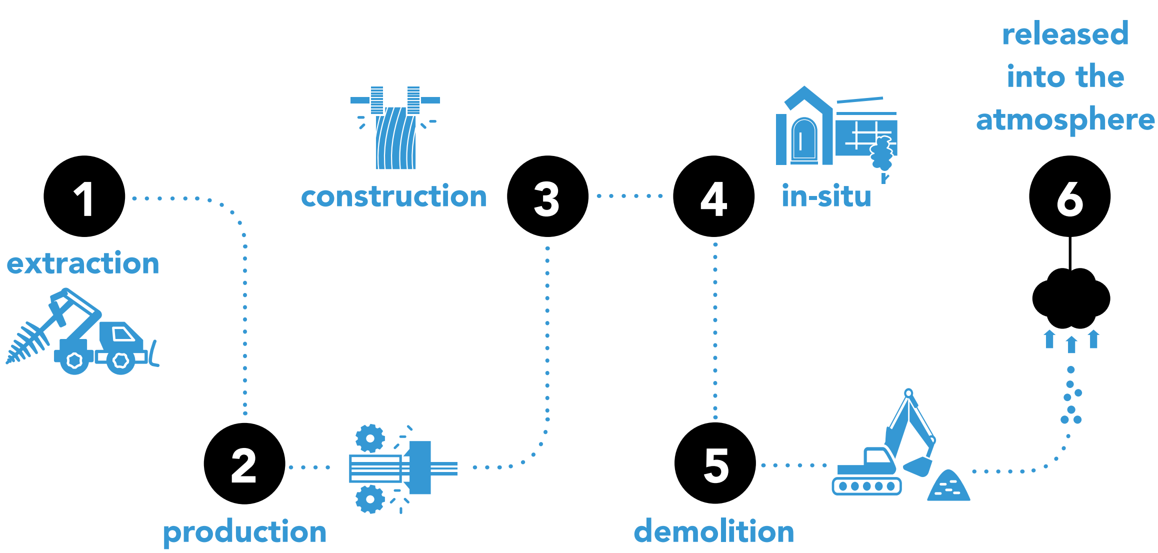
In addition, it's important to acknowledge whether the LCA is being developed using an attributional or consequential model. While attributional models measure the environmental impact in current terms of the known impacts for a given quantity of the material, a consequential LCA seeks to quantify the system-level impacts that would occur if the use of a product were to increase.

Unlike other materials, wood is not a cradle-to-cradle material where the majority of products at the end of life are reused or recycled back into new products. It is a cradle-to-grave product that has a distinct end to its life.

The wood used in construction today is sequestering carbon, but that wood will ultimately be demolished, landfilled or burned, releasing the sequestered carbon. This process may take place over an extended period of time (for example, when wood is disposed of in a landfill) or immediately (when wood is incinerated), but either way, the sequestered carbon ultimately reaches the atmosphere.

For this reason, any claim of carbon sequestration must be made on a net rather than absolute basis.

Although wood is a plant material that grows from a seed released by the original tree, it is inaccurate to refer to wood as a regenerative material. It is a bio-based material that does not regenerate itself but rather provides the basis for a new life cycle requiring new resources, including large quantities of water.



Other Impacts to Consider

When reporting environmental impacts, global warming potential measured in CO_2 is only one of a large number of environmental impacts that can be tracked and reported. However, to truly assess the environmental impacts of a material, one must look at all impacts.

The wood industry has consistently listed only impacts relating to global warming potential, ozone depletion, eutrophication, acidification, depletion of stratospheric ozone, and formation of tropospheric ozone. Proponents of wood have strongly resisted the quantification of impacts related to land use, resource consumption, human health impacts, toxicity, habitat alteration, and biodiversity.

"This has led the Sierra Club to negatively comment on wood industry environmental product declarations (EPDs). "The primary purpose of current EPDs for wood appears to be to divert attention away from destructive forest management practices which cause disturbances to forests, streams, wetlands, and eliminates habitat for wildlife, all to sell more wood," the group said in 2013.[16]

LCAs: THEN VERSUS NOW

LCAs were originally intended to provide a tool for monitoring the improvement in the production of a given product.

However, LCAs are now seen as a way to compare two dissimilar products. The difficulty with this, however, is making sure the comparison is apples-to-apples. For example, comparing the environmental impact of one ton of wood framing to one ton of steel framing is invalid because different quantities are required to create similar structures. Instead, LCAs need to include a project-to-project comparison, of which the framing material is only one component.

Looking at the environmental impacts on a project-to-project basis yields substantially different and sometimes very surprising results. When looking at environmental impacts more fully, it is simply wrong to claim that wood is “greener” than other materials.

VALID CONCLUSIONS

An accurate whole-building, LCA-level comparison is only possible when two buildings with similar requirements and configurations are designed to a level of detail necessary for an accurate estimation of structural quantities (and not simply based on parametric estimates from a simplified LCA tool).

Such an exercise would yield a legitimate conclusion similar to the following:

"For this structure, in this location, with these requirements, a structural framing system using material A contributes to a lower level of environmental impacts than a structural framing system using material B."

Unless a project-based, whole-building LCA is performed, claims that one material is environmentally superior compared to another are worthless marketing hype.

One of the most recent studies that met these requirements was undertaken by Magnusson Klemencic Associates and published in the 2018 compendium "Embodied Carbon in Buildings." According to the authors of that study: "This paper does not show that a decisive winner can be chosen between the four different building frame options studied, based upon a material system choice alone."[17] Instead, the authors contend "designers should choose materials that are most materially efficient for the intended building use, and then optimize and economize the design to save on quantities while also finding ways to decrease the embodied carbon of that material choice."

Takeaways

It's always critical to remember the Latin warning of caveat emptor ("let the buyer beware"). Before taking wood-related claims at face value, be sure to do your due diligence and research.

probe the assumptions

examine sources for potential biases

evaluate the methodologies

use a rigorous process to compare the environmental impacts of alternative construction materials on a whole-building LCA basis

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[3] American Forestry and Paper Products. (2014). AF&PA White Paper—Sustainable Forestry and Certification Programs in the United States. Retrieved March 22, 2019 from **twosidesna.org/wp-content/uploads/sites/16/2018/05/sustainable-forestry-and-certification-programs-in-the-united-states.pdf**

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[7] Eliminating the Waste in Wood Processing. (n.d.) Retrieved March 26, 2019 from **www.borealforest.org/world/innova/processing.htm**

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[9] Environmental Protection Agency. (n.d.) Ingredients Used in Pesticide Products: 2,4-D. Retrieved March 22, 2019 from **www.epa.gov/ingredients-used-pesticide-products/24-d**

[10] Bay Area Air Quality Management District. (n.d.). Reducing Wood Smoke: A Burning Health Issue. Retrieved March 22, 2019 from **www.baaqmd.gov/~/media/Files/Communications%20and%20 Outreach/RedWoodSmoke.ashx**

[11] Families for Clean Air. (n.d.) The Environmental Impact of Wood Smoke. Retrieved March 22, 2019 from **www.familiesforcleanair.org/environment/environment2/**

[12] Booth, M. S. (2014). Trees, Trash, and Toxics: How Biomass Energy Has Become the New Coal. Partnership for Policy Integrity. Retrieved March 22, 2019 from **www.pfpi.net/wp-content/uploads/2014/04/PFPI-Biomass-is-the-New-Coal-April-2-2014.pdf.**
It should be noted that based on permit submission, the "cleanest" of the biomass plants emit >150% nitrogen oxides, >600% VOCs, >90% particulate matter, and >125% carbon monoxide. Compared to natural gas, wood exceeds natural gas emissions in every category by >800%.

[13] Bratkovich, S., Howe, J., Bowyer, J., Pepke, E., Frank, M. & Fernholz, K. (2014). Municipal Solid Waste (MSW) and Construction and Demolition (C&D) Wood Waste Generation and Recovery in the United States. Minneapolis, MN.: Dovetail Partners. Retrieved March 22, 2019 from **www.dovetailinc.org/report_pdfs/2014/dovetailwoodrecovery0914.pdf**

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