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Do we really want to exclude all roundwood from being used to make pellet fuel?

Forest Dynamics, Wood-Based Products, and Carbon Sequestration

[This white paper is complimented with an interactive online dashboard]

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There has been high-level discussion from some government policymakers in the EU about restricting the use of "roundwood" [1] as feedstock for pellet fuel. While the spirit of the policymaking exercise is properly grounded as a tactic to disallow deforestation and encourage the most efficient use of a renewing resource, a blanket exclusion of "roundwood" is misguided. This brief white paper attempts to explain why.

This white paper also discusses the dynamics of forest growth and carbon sequestration.

First, there is no place for permanent deforestation anywhere in the forest products industry. The foundational and absolutely necessary condition that underpins the definition of wood as a renewable resource is that the stock of trees in a managed forest[2] must remain constant or growing.

This is both good for the environment and good for business. For owners of sawmills, pulp and paper mills, pellet mills, and other capital cost intensive factories that rely on a constant flow of logs and chips, matching their annual feedstock demand to the ability of the regional managed forests to supply wood is essential to the business model. It would make no sense for the investors of hundreds of millions of dollars to expect to deplete the project's essential raw material and face cost pressure due to increasing scarcity and risk financial failure. Wood pellet exporters operate under these same constraints and have the added oversight of having to have independent certification that their raw material sources are sustainably managed.

There are nearly 1,500 operating mills in north America (US and Canada) that use wood as their primary input. North America's managed forests supply hundreds of millions of metric tonnes per year for the production of products that many of us take for granted. The table below shows the estimated annual demand by industry segment.

[1] Roundwood typically references the part of the stem of a tree that is not sawn into lumber.
[2] A managed forest is essentially a tree farm with many plots in many stages of the growth cycle. Each plot regrows after every harvest. At the landscape level, across many plots, the new growth equals or exceeds the removals of mature trees and thus the net stock of wood and sequestered carbon, on a contemporaneous basis, is not depleted.

2021 North American Wood Demand at Operating Mills

	Short Tons if at Nameplate Capacity	Percent of Total	Metric Tonnes at an Average Capacity of 80%
Lumber, Furniture, Flooring	310,543,000	41.6%	225,849,000
Pulp and Paper	273,158,373	36.6%	198,661,000
Oriented Strand Board (OSB)	42,122,000	5.6%	30,634,000
Chips (many end uses)	37,037,000	5.0%	26,936,000
Export Pellets	**36,620,000**	**4.9%**	26,633,000
Plywood and Veneer	34,405,000	4.6%	25,022,000
Domestic Pellets for Heating	11,784,000	1.6%	8,570,000

source: Forisk North American Forest Industry Capacity Database, May 2022; Analysis by FutureMetrics

It should be noted that lumber production produces significant quantities of residual by-products that are often used as feedstock in the other listed wood products sectors. Thus, the total annual demand is not the sum of the individual demands since there is spillover of by-products.

When debarking a round sawlog and making it into square lumber, there are slabs, chips, sawdust, and shavings from the planer that are produced as by-products of the sawmilling operations. Depending on the size of the trees and whether it is hardwood or softwood, yields vary.

A typical breakdown of residual production is shown in the table below. Every log will be different and differing species will also result is different residual amounts. The types of equipment used in the sawmill will also impact residual production versus lumber production. This table illustrates one potential outcome.

Metric Tonnes of Residuals
per 1000 Board Feet of Lumber

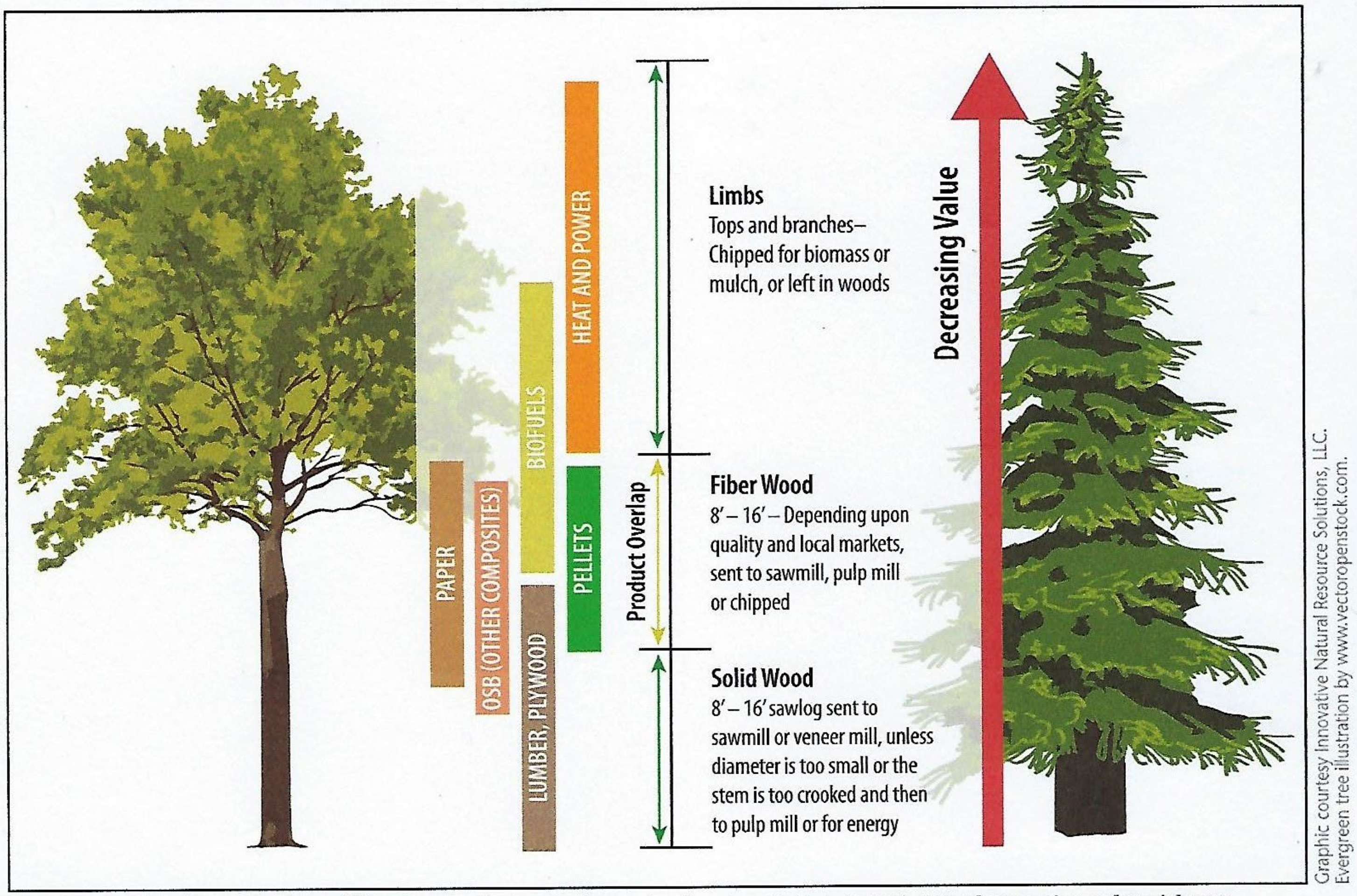
Softwood	
Bark	0.41
Clean chips from slabs	1.36
Sawdust and shavings	0.68
Percent of Log that Becomes Residuals	**42.2%**

The data[3] suggests that sawmilling by-products in north America probably exceeds 80 million metric tonnes per year.

Also note in the table on page 2 that the pellet export sector's use of woody feedstock is a small proportion of the total. The ratio of sawmill residuals to roundwood used in pellet factories in north America varies widely from 0% to 100%. But since some proportion of estimated 26.6 million tonnes per year of wood demand by the export pellet mills is from residuals, the demand for roundwood for export pellet production in north America is significantly less than 26.6 million tonnes per year.

What does make its way to pellet mills in the form of roundwood is the residuals from the harvests that are unsuitable for higher value use or are not marketable in the region of the harvest. The illustration below shows the typical way in which a healthy tree with a straight stem is merchandized.

[3] Forisk North American Forest Industry Capacity Database, May 2022 and data from various sources about sawmill productivity.



Different wood products come from different parts of a tree, and every tree is unique in its potential, depending on size and straightness of the trunk, among other factors.

As the illustration shows, the highest value of a newly harvested tree is the sawlog portion. The working forest's landowner has every incentive to maximize their profit from the harvest by maximizing the production of sawlogs. Using sawlogs for purposes other than making lumber almost never happens.

It is not possible to make lumber from the whole tree. However, it is possible to use those lower value non-sawlog clean[4] harvest residuals for making paper, cardboard, tissue, OSB, and pellets. Export pellet producers can tolerate some bark in the mix as well.

[4] Clean "white" chips are from debarked roundwood and also are mostly devoid of dirt.

Of those potential users, the pellet producers have the most restricted ability to pay[5]. In other words, if there is a pulp mill or OSB mill in the same wood basket as a pellet mill, the pulp and OSB mills can afford to pay a higher price for their chips and roundwood than pellet mills. Pellet mills should not be sited near those types of mills.

Bottom line is that pellet mills are bottom feeders! They take what is left over that no one else wants.

If no other buyers exist that are willing to pay a higher price for the lower value parts of the tree, the pellet fuel factory takes much of what is left over from a harvest; a harvest that was motivated by sawlog sales. Similarly, if there are no other buyers willing to pay a higher price for the sawmill by-products, they take those as well[6].

Managed forest plots are also often thinned at some point early in their growth cycle. The removal of relatively young trees that are diseased, not growing straight, or are too close to other healthier trees improves the crop in general[7]. Those thinnings are typically not suitable for a sawmill but can be suitable for pulp and paper mills or OSB mills, and, if there are no other buyers willing to pay a higher price, are suitable for pellet mills.

To suggest that all roundwood be excluded from pellet feedstock entirely misses the dynamics of how forests are managed, the costs of transporting roundwood longer distances, and how the different parts of a tree can be used for different products.

Pellet producers perform a valuable service by offering a market for residuals that otherwise would rot, perhaps be burned in slash piles, or may have to be landfilled.

> The wood pellet industry ensures that not only 100 per cent of the harvested tree is utilized, but that the whole tree is processed to extract its highest value, with quality logs heading to the sawmill, "and then lower quality logs can go to chips or to other residual uses such as wood pellets."[8]

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[5] The offtake agreements between the pellet producers and the buyers sets the prices. There is a ceiling on the pellet fuel prices that buyers can afford to pay based on their revenue from power sales. That ceiling flows back through the supply chain and limits the price that pellet producers can charge for the pellets. The markets for pulp and OSB usually allow those producers to have the ability to pay a higher price for their wood than pellet producers.

[6] Distance from the harvest site or the sawmill to the end user matters. Longer distances (more diesel fuel) add significant cost to the delivered feedstock. Longer distance also increases the carbon footprint of the material.

[7] See https://en.wikipedia.org/wiki/Silviculture for a description of silviculture.

[8] Excerpted from "Power of Pellets: Responsible Sourcing" by Gordon Murray; https://www.canadianbiomassmagazine.ca/the-power-of-pellets-responsible-sourcing/

What about Carbon Sequestration by Forests?

NGOs and policymakers are rightly concerned about the sustainability of forests and the highest and best use of those valuable renewing resources. While some acknowledge that forests can be sustainably managed and that there is a responsible use for some roundwood as feedstock for pellet fuel, some also question any harvest because, they say, it removes a valuable carbon sink.

As noted at the beginning of this paper, permanent deforestation cannot be supported in any way for the production of any product (lumber, furniture, paper, pellets, etc.). If the annual net growth of new wood across the landscape is being reduced by poor or non-existent forest management in any region, those logs should be subject to intense scrutiny and likely deemed not in compliance.

But, as was noted above, mills that use wood depend on a steady long-term supply and relatively stable prices. That means that they have to match their demand to the ability of the region around them to provide continuous supply without the risk of scarcity. In other words, the growth of new wood has to be equal to or exceed the removals.

If the value added to the sawlogs is local and the sawmills are capital intensive and not portable, then there is every incentive for the mills to support responsible forest management. This certainly describes most of the industry in north America and in many other areas of the world.

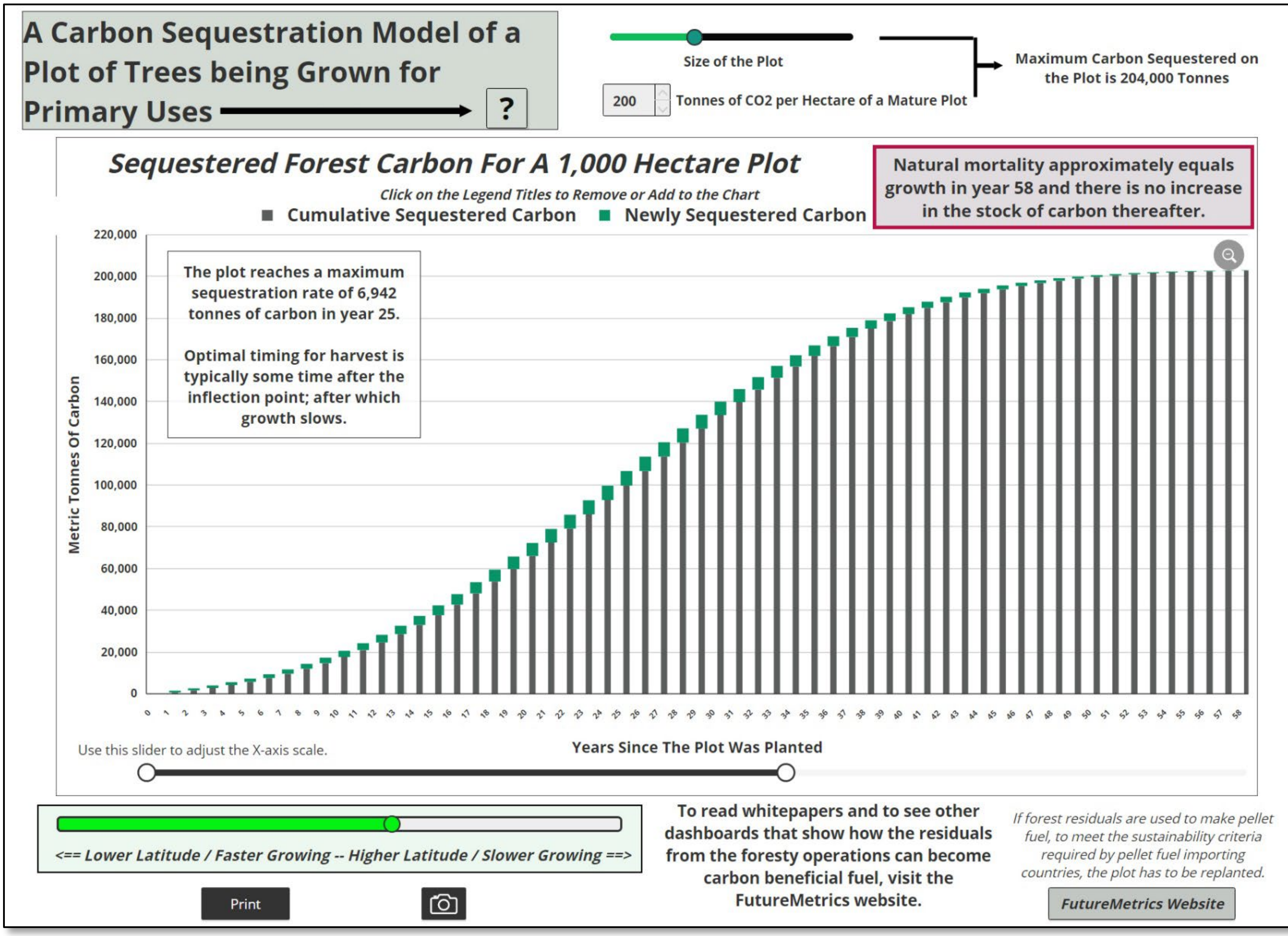
A corollary to the "growth equaling or exceeding removals" condition is that the stock of carbon held across the forest landscape will not be depleted[9].

But what about just leaving the forests, including managed working forests, alone and letting them continue to soak up carbon?

The problem with that argument is that forests do not continue to soak up carbon forever. At some point, a forest will reach a growth equilibrium. Essentially, the morality rate will equal the growth rate and the quantity of wood (and carbon) will reach a limit.

The image on the next page illustrates this. The image is from a new interactive dashboard crated by FutureMetrics that allows the user to experiment with some basic inputs to the growth model. The model is based on a typical S-curve growth function. Different species, geographies, etc. will create growth curves that are not so mathematically perfect. But the pattern in reality is no different than the model: early growth in the stock of wood (and thus carbon) accelerates as young trees grow. Early growth is more rapid than later growth. Eventually the net stock reaches a no-growth equilibrium.

[9] FutureMetrics has several white papers discussing this concept. They are free to download from the FutureMetrics website.



<u>Clicking on the chart image will open the live interactive dashboard in a web browser</u>.

The chart shows the carbon sequestration dynamics over time of a plot. The size of the plot can be changed but in general it is small enough to be considered one of many plots in a larger landscape.

The dashboard settings as shown result in a maximum sequestration rate in year 25 (this can be changed using the green colored slider in the bottom left that changes the growth rate). As the plot approaches its maximum density, the rate of conversion of CO_2 to carbohydrates declines. Around year 58, the plot hits its limit. Leaving this plot alone after year 58 does nothing in terms of increasing the amount of carbon that is sequestered.

For a managed forest, the decision to harvest will likely be after the inflection point but well before the zero-growth milestone. At some point, the low growth rate no longer supports waiting any longer to convert the resource into sawlogs and other types of woody feedstocks.

Some may say that the harvest of that plot creates a carbon debt that will take decades to repay. This argument does not add up empirically if the plot is one of many in the larger forest landscape.

Across the larger landscape the relevant constraint is that the net growth has to equal or exceed the removals. Across multiple plots, trees are in many stages of their growth cycles. All of them are absorbing carbon. If the net absorption of the untouched younger plots equals (or exceeds) what is removed in the harvested plot, there is no depletion of the net stock of carbon held in the forest and thus no carbon debt.

For example, if the harvested plot holds 200,000 tonnes of carbon but the forest at large absorbs 200,000 tonnes within a time period that is less than the time until the next plot is harvested, then there is essentially no depletion of carbon. Are these numbers plausible?

British Columbia (BC), Canada, is one of several major wood growing regions in north America. Most of the forests in BC are owned and managed by the government (about 95%). BC, after careful analysis by government foresters, sets a maximum "annual allowable cut" (AAC) that is always less than the annual new growth[10]. The AAC in BC equates to more than 100,000 tonnes of wood every day (a total of about 50 million cubic yards per year). So, using the dashboard example from the previous page, new growth in BC completely replaces the removal from 1000 hectares in a matter of days.

This is in stark contrast to the carbon debt proponents who say that it takes many decades to repay.

The state of Georgia in the US has 21,979,000 acres (8,894,000 hectares) of private forestland that supports about 185 sawmills, pulp and paper mills, pellet mills, and other wood-based manufacturing.[11]. Those mills receive a continuous supply of raw materials; and many have been for many decades. That is only possible if the managed forestland produces as much (or more) new wood on a daily basis as is removed on a daily basis.

In forests that are professionally managed to produce a continuous supply of raw materials, the net stock of wood in the forest is not shrinking and therefore there is no carbon debt from a harvest.

Conclusion

Anyone who uses tissue (most of us do at least once a day!), has furniture made from wood, who lives in a building with wooden components and wooden cabinets, gets packages from online retailers, walks on

[10] https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory
[11] https://www.afandpa.org/node/808

wooden floors, and reads books, is supporting the harvest of trees. Different parts of the tree become different goods that most of us take for granted.

The market provides very strong price signals that define the cascade of uses. And, as this paper has shown, there are some parts of a harvest or of sawlogs left over that have no higher or better use other than to become feedstock for pellet fuel. Some of those parts are stem sections or large branch sections that are "roundwood".

Policy stipulations about roundwood that result in increasing the proportion of the tree that has no commercial value, and is thus wasted, is certainly not the intent of policymakers or enlightened NGOs.

The carbon benefits of forests are non-controversial. And, as this paper has shown, the resource, if managed as it should be (and is in many locations), can be used without depleting the sequestered carbon.

Given that much of the harvest becomes long-lived wooden materials, the working forest is a conduit to semi-permanent sequestration. The fuel pellets that are produced from the leftovers from the declining value adding cascade of uses, some from sawmill residuals and some from forest residuals in the form of roundwood, contribute significantly to the generation of renewable carbon beneficial energy and heat[12].

The continuous turnover of working forests combined with an environmentally and economically motivated full use of the harvested tree and its by-products is the foundation for the carbon beneficial pellet industry.

Rational policy should not change that.

[12] See FutureMetrics papers and dashboard about bioenergy carbon capture and sequestration (BECCS) at the FutureMetrics website for a discussion of how pellet fuel replacing coal for power generation is the only pathway to baseload, load-following, or on-demand power that is carbon negative.