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The World Resources Institute is Wrong on Wood Pellets

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The World Resources Institute (WRI) recently published a working paper entitled "Avoiding Bioenergy Competition for Food Crops and Land."[1] While we agree with some of the material presented by the authors Tim Searchinger and Ralph Heimlich, we strongly disagree with not only their perspective on the industrial wood pellet sector but also on their characterization of how that sector, according to them, causes a net negative impact on global carbon emissions. This white paper discusses those issues.

The authors do not appear to grasp the size and scope of North America's forest products industry. Hundreds of millions of acres of land in the US and Canada are forested. Most of those forests are "working forests" that have been managed for generations to produce the raw materials for lumber, engineered wood products[2], pulp and paper, and, more recently, wood pellets.

They authors appear to be unfamiliar with how those products are derived from the forest. They seem to think that forests not used for energy purposes will be left to grow and therefore the carbon benefit that pellets provide is simply the result of "double counting"[3] (more on this later in this white paper).

Managed working forests are in a continuous state of growth so that in any given year only a small portion, depending on the growth rate of the trees, is harvested. Depending on the location and species, the areas of harvest are replanted or allowed to naturally regenerate. Almost all medium to large forest landowners have forestry plans that define the annual allowable cut. The strategy is to have a nearly continuous supply of healthy fully grown trees that provide large diameter logs that are desirable to the sawmilling sector[4].

Most forest landowners should be thought of as tree farmers with crops that take 15 to 50 years to grow. The primary product they are growing are sawlogs which are the larger diameter lower sections of a tree that are used to make lumber. When a tree is harvested, the landowner is counting on the sawlog portion of that tree for the majority of their income. The middle part of the main tree stem, the pulpwood and/or pellet feedstock portion of the tree, is less valuable. The upper parts of the tree have very little value and in many cases are left in the woods to rot. Forestry business models would fail if the whole mature tree were sold into the pellet making sector. That simply does not happen.

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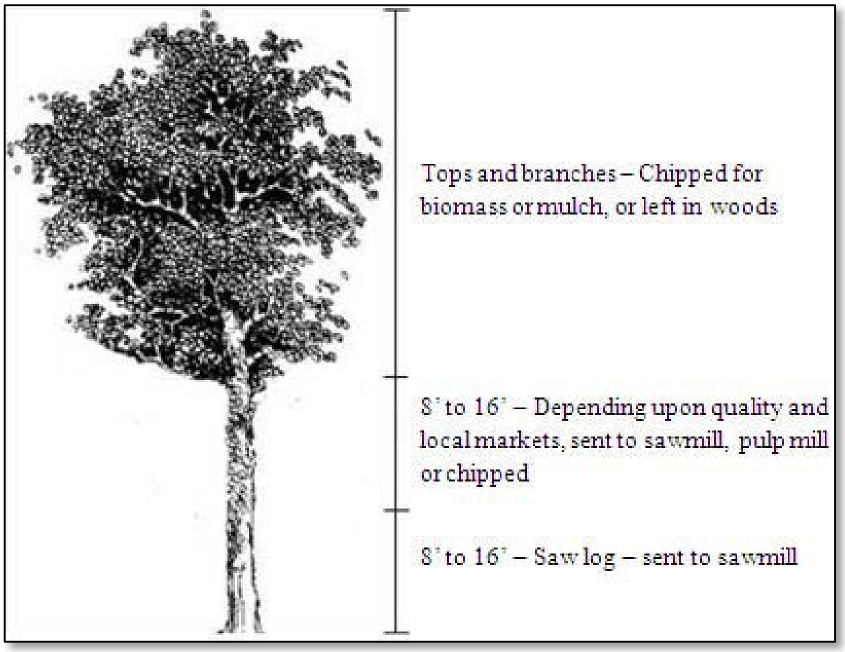
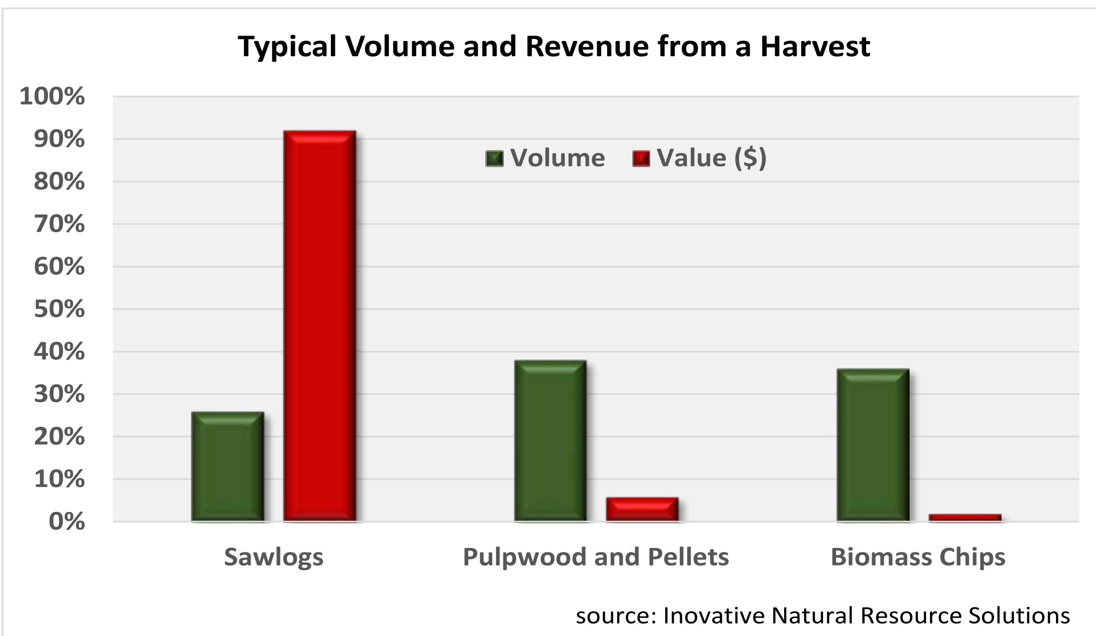
[1] http://www.wri.org/publication/avoiding-bioenergy-competition-food-crops-and-land Jan
[2] Examples of engineered wood products are plywood, oriented strand board (OSB) and medium density fiberboard (MDF).
[3] Page 4 of the WRI report, and in more detail in Appendix A beginning on page 29 of the report.
[4] Well cared for stands are thinned several times over a growth rotation for the health and quality of the stands.

The image below shows a typical example of how a ready to harvest tree is merchandized. The chart below the image shows a typical example of how most of the revenue from forestry operations are generated by the larger diameter logs that become lumber[5].





[5] Both the image and the chart data are from Innovative Natural Resource Solutions. The proportions shown in the image will vary but they are representative of a typical breakdown. For pre-commercial thinning the sawlog component may be missing or much smaller. The volume and revenue data is based on actual state data from New Hampshire.

Industrial pellets are able to use some or all of the tops and branches (depending on tree species) along with the center portion that traditionally went to the pulp mills for paper making. Forest landowners will never sell sawlog quality roundwood to a pellet mill and no pellet mill can afford to pay for feedstock at sawlog prices.

Tree Farming is Not Different than Food Crop Farming (it just takes longer!)

Much of the wood fiber used to make pellets is from sawmill residuals (sawdust and other byproducts from cutting logs into boards, and board shavings). Some of the feedstock for pellet mills comes from that middle portion of the tree; wood that used to be used to make pulp and paper. The pulp and paper industry in North America is in gradual decline due to changes in paper demand and competition from lower cost producers in other parts of the world.

Another important feedstock for pellet mills are so-called pre-commercial thinnings. These are small diameter younger trees that are too small for sawlogs but perfect for pellets. Imagine trying to grow food crops without managing the soil and minimizing invasive plants and pests. Productivity would be very low. That same logic applies to working forests. Selective thinning improves the growth rate and health of the remaining trees. It also mitigates wildfire risk[6]. And the thinnings are no longer “pre-commercial” if the pellet mill is ready to buy the wood.

The WRI report’s authors seem to have ignored the entire tree farming sector. Working forests are not old growth stands. They are managed to maintain or increase the stock of trees over time and provide a sustainable source of materials to the forest products industries (including the pellet sector) and provide income to the landowners.

Wood Pellets Produced from Sustainably Managed Forests are Renewable Energy that Provides Significant Carbon Benefits versus Coal

On page 29 of the WRI report the authors write:

> “**Double counting net forest growth.** Many studies assume that the biomass accumulating in the world’s forests also provides a carbon-free source of bioenergy…
> The fact that forests are accumulating carbon is exactly the reason why their use as bioenergy does not reduce emissions. The biomass and carbon being stored in forests is already limiting the rise in carbon dioxide in the atmosphere. Consuming this biomass instead for bioenergy does not reduce emissions compared to using coal or natural gas for electricity because any gain from reductions in emissions in fossil carbon is lost through the reduction of the forest carbon sink. In fact, because of inherent inefficiencies in harvesting, transporting, and burning that forest carbon, the loss of carbon storage due to the replacement of coal or natural

[6] See numerous studies at the Ecological Restoration Institute (Arizona State University) on these topics. http://nau.edu/ERI/

gas with wood far exceeds the reduction in emissions from fossil fuels for many years until and unless the forest grows back."

The statement above is wrong in a couple of important ways. (1) They are incorrect in their statement suggesting that forest carbon is reduced by the use of wood for energy. Using biomass for energy does not reduce the carbon sinks as long as the biomass is sourced from managed forests in which the growth rate equals or exceeds the harvest rate. (2) They are also wrong in stating that the supply chain is inefficient and there for using pellets results in higher carbon emissions than coal. The wood pellet supply chain and the conversion of pellets to power is many times lower in CO_2 emissions than the coal supply chain and coal's conversion to power. Each of these points are discussed in more detail below.

The forest carbon sink is not reduced by using trees harvested from sustainably managed forests.

Perhaps some people living in urban environments cannot envision the vast forested lands in the US and Canada that have for generations been producing wood fiber for everything from lumber to paper to packaging to pellets. These forests are in many stages of growth. There are new young trees replacing a recent harvest, and there are trees of all ages up to mature trees that are ready to provide their benefit to the end users of forest products with things that many take for granted such as lumber, cardboard boxes, and paper (including toilet tissue). Those forests also provide benefit to the landowners, forestry workers, and mill workers as income.

By harvesting a stand of trees that are ready for the markets, the forest does not lose any of its carbon sink.

To illustrate the logic for why a sustainably managed forest maintains its stock of carbon and why wood pellets are carbon neutral in combustion, we can look to how the real world of working forests operate.

The growth rates for forests vary considerably due to climate and species. Assume for this example that the growth rate for our working forest is 2 tons per acre per year. Growth rates are less than in some areas and more in others.

Assume that we are a large landowner in the state of Maine that has 1.0 million acres under management (there is such an entity and Maine has more almost 18 million acres of working forests). That landowner's forests produce 1.0 million acres times 2 tons per acre per year of new growth. That is 2.0 million tons per year of new growth. That is 5,480 tons per day of new growth. Suppose their forester sets the maximum allowable cut at 4,500 tons per day. If 50% of the cut were to be used for pellet production, that one landowner would supply enough wood fiber to make about 430,000 tons per year of pellets (1,180 tons per day).

Suppose now that those pellets are supplied to a coal fired power plant that has converted from coal to pellet fuel. That power plant would consume 1,180 tons per day of pellet fuel instead of about 900 tons per day of coal.

Every day the 5,480 tons of new growth on the 1.0 million acres of forestland will absorb all, and more, of the carbon released in the combustion of those pellets. As long as the harvest and consumption of wood to make pellet fuel does not exceed the growth rate, there is no new net carbon added to the atmosphere. In fact, since the forester in our example set a significant buffer between the actual growth rate and the harvest rate, the forest is still a carbon sink.

If that power plant were not using pellet fuel, every ton of coal used to generate power would add carbon to the atmosphere. The only solution would be to have more and more forests absorbing carbon. But there are two problems with that supposed solution: Forests reach a growth equilibrium, and, unless there is money to be made in forestry, some forested lands will be converted to other uses and those carbon sinks will be forever lost.

How many years into a growth cycle it takes before a forest stops increasing its storage of carbon depends again on climate and species. But they all reach a point where growth and mortality equal out. At that point the only way to increase the carbon sink is to make more land into forest. But if there is no forest products industry, exactly the opposite is likely.

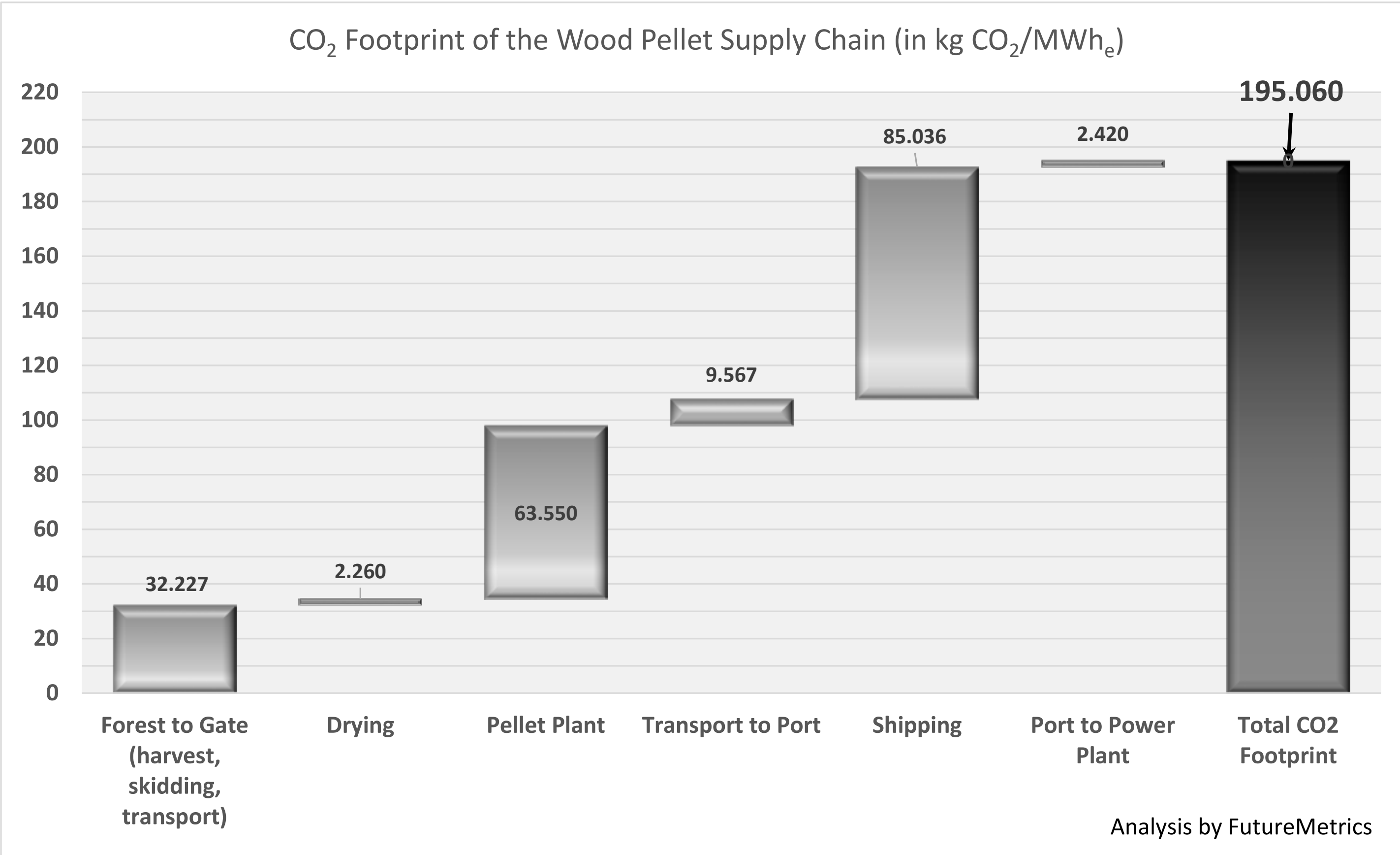
In North America, the industrial wood pellet sector has the potential to replace the gradually declining pulp and paper sector. By providing a market for the medium value parts of the trees, the pellet sector will contribute to keeping forested land as forested land.

Using pellets in converted coal power plants provides significant carbon benefits.

The second incorrect part of the statement quoted above is about the "inherent inefficiencies in harvesting, transporting, and burning that forest carbon." Of course the transport of a lower energy density fuel is less efficient in terms of diesel fuel and other fossil fuels used per unit of energy delivered to the end user. The amount of carbon generated per ton per mile per unit of energy transported is higher with pellets than with most coal.

But the difference is not that great. The chart below shows the carbon footprint accumulated by the wood pellet supply chain for pellets going from the southeast US to the UK's Drax power station[7].

[7] The analysis in the chart is based on the UK's Department of Energy and Climate Change (DECC) calculator. FutureMetrics' website has an interactive CO_2 footprint calculator that allows the user to input all of the relevant assumptions on energy intensity in the wood harvesting and delivery, of the wood to pellet conversion process, of transport and transport distances to ship, by ship, and to the power plant. www.FutureMetrics.com



Since the average net bulk and energy density of coal is about 1.3 times that of wood pellets, a similar analysis for the coal supply chain, from mining and extraction, to milling, to shipping, and to delivery to the Drax power station, would result in about 150 kg of CO_2 per MWh of electricity generated just from getting the coal from the mine to the power station. Pellets produce about 45 kg/MWh_e more CO_2 in the supply chain.

But as shown above, pellets that are sourced from forests that are managed so that the growth rate exceeds the harvest rate are carbon neutral in combustion. That is not at all true for coal. Each MWh of electricity generated by the Drax station from coal produces almost 1000 kg of CO_2 (lignite coal makes 990 kg CO2/MWh_e)[8]. Including the supply chain carbon footprints of coal and pellets, that is almost 6 times more CO_2 from coal than from pellets for the same power output.

The units running on pellets are saving a net of 83% on carbon emissions versus coal[9]. England's largest power plant, the Drax power station (shown in the image below), requires wood pellet fuel that is

[8] The Drax station runs two of six 650 MW lines on 100% wood pellets. The other four lines still run on coal. Conversion of two more units is probable. The power output of the two pellet fueled lines is the same as it was with coal. The net efficiency of the boiler/turbine/generator is 38% for pellets and is 38% for coal. There is no loss of efficiency or generating capacity from using wood pellets.
[9] This assumes a heat rate of 10,100 BTU/kWh. The Drax station has a slightly lower heat rate (higher efficiency).

certified to be produced from wood that is derived from forests that are maintaining the stock of carbon.

Conclusion

It is unfortunate that WRI and its lead authors of the report "Avoiding Bioenergy Competition for Food Crops and Land" paint industrial wood pellets with the same smear of dark paint as other biomass-to-energy pathways. Advocates of cellulosic ethanol and other uses of agricultural products and by-products for energy probably have their own opinions on the report.

FutureMetrics does not think that the WRI authors willfully ignored the facts about how wood pellets are made and used. The only explanation for their inaccurate analysis and conclusions on wood pellets is that they simply failed to do their research.

There are significant carbon benefits to the power production industry (and all of the planet's stakeholders) from substituting some or all of the coal used for generation at some of the world's coal fired power plants with wood pellets produced from continuously renewing forests. The strategy of converting from coal to pellets, or cofiring pellets with coal, to lower CO_2 emissions should be an important component of any country's policy on dealing with climate change.

[Note that this white paper does not discuss the heating pellet markets. Those markets consume more pellets than the industrial utility sector. They also lower carbon emissions by substituting low carbon pellet fuel for natural gas, heating oil, and propane in homes and businesses.]