**Forest Ecosystem Carbon Removal in the Power Line Right of Way**

**for 145 Miles of the New England Clean Energy Connect Corridor**

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**Introduction**

All systems for generating electricity, even ones considered “green” or “carbon free,” have environmental and carbon footprints. The goal is to choose the options with the biggest reductions in carbon emissions, for the lowest cost, and with the smallest environmental footprint. For big hydro projects, the electricity is generated by falling water—no carbon emissions. But there *are* environmental and carbon footprints from:

* clearing land for the impoundment;
* building the dams (heavy equipment, concrete, steel);
* leakage of methane and carbon dioxide from submerged vegetation;
* ecosystem carbon losses from removing trees in the powerline corridor;
* building towers and wires for the transmission lines; and
* maintaining the dam and transmission lines.

This report has a narrow focus—the carbon impact of clearing forests in the corridor. It does not address the energy used in cutting, shipping, and processing the trees. It does not address the energy used to manufacture and construct the towers and lines. *The report only addresses the carbon in the trees removed to clear the path for the powerline*.

Powerline corridors are not unique to hydro, but, because of the length and width of what is being proposed for clearing (53 miles at 150 feet wide and 92 miles at 75 feet wide), there is a significant impact that needs to be considered.

**Why does clearing of forests matter?**

There are two important strategies for minimizing global warming and preventing catastrophic climate change; reducing carbon emissions and increasing carbon sequestration. Carbon dioxide can stay in the atmosphere for decades—or even more than a century. Even if emissions are reduced, the carbon dioxide in the atmosphere can continue to increase. While carbon capture and storage technologies are not, currently, viable on a large scale, there are natural ways to capture carbon dioxide and store carbon that are viable right now. One of these is to increase the acreage and volume of forests.

The Nature Conservancy estimates that “natural climate solutions.” Including increasing forest areas and volumes, can provide up to 37% of the carbon reductions needed to meet 2050 goals to keep global temperature increases under 2 degrees centigrade.[[1]](#footnote-1)

This paper, therefore, looks at both the amount of carbon that would be removed from the forest and emitted into the atmosphere if the trees get cut, as well as the carbon that would be captured and stored annually if the trees are not cut.

**Methods**

To roughly calculate these numbers, without actually measuring ecosystem carbon in the corridor, I have:

* estimated acreage of forest in the proposed corridor;
* estimated the percent of the corridor in each of three counties—Androscoggin, Franklin, and Somerset;
* calculated the percent of forest by forest type, and then acres by forest type of the corridor within each of the three counties;
* used a program from the USDA Forest Service to estimate the volume per acre by timber type by County;
* used a carbon estimation program, based on USDA Forest Service data, to estimate metric tons of carbon in the area based on volume per acre by timber type;
* used the same program to estimate the metric tons of carbon remaining in the corridor after the trees have been cut;
* estimated the amount of carbon that would be removed (by subtracting the remaining carbon from the starting carbon);
* used the program to estimate how much carbon would be captured and stored per year if the forest is not cut.

To help the reader visualize the scale of carbon sequestration and emissions, I compared the quantity of carbon dioxide that would be released from forest clearing in the corridor to miles that cars would have to travel to emit an equivalent amount of carbon dioxide. I also compared this quantity to the kilowatt hours of electricity that the average utility would generate to create an equivalent amount of carbon.

**Acreage**

The corridor, if built, would have 53 miles of new corridor cleared to 150 feet wide, and 92 miles of existing corridor widened by 75 or so feet. Using these figures, and making an allowance of 4% for non-forested lands, such as bogs, marshes, or swamps, or unproductive forestlands I came up with 1,728 acres that would be deforested for the powerline. Using a map of the corridor I made a rough estimate as to the proportion of the total acreage of clearings in each of the three counties and came up with:

* 11% in Androscoggin,
* 23% in Franklin, and
* 66% in Somerset Counties.

**Forest Type**

Using USDA Forest Service Inventory data, I estimated the acreage by county of the major timber types—White/Red Pine, Spruce/Fir, Maple/Beach/Birch, and Aspen/Birch. These represented 97% of acres in Franklin and Somerset counties. I added two other timber types, Elm/Ash/Cottonwood and Oak/Hickory, to Androscoggin, because it is in a very different zone, with no spruce/fir, though it has the other three forest types. These forest types covered more than 96% of acres in Androscoggin County.

**Volume**

I used a program called the Evalidator[[2]](#footnote-2) to calculate the average volume per acre by timber type and by county. Somerset, which is dominated by industrial forestry, has 15.5 cords to the acre for all species. Franklin, which is more of a transition county, has 18.5 cords to the acre. Androscoggin, south of the industrial forest, has mostly smaller ownerships and averages 26 cords to the acre. The extremes were an average of 39.5 cords to the acre for pine forests in Androscoggin, and an average of 14.9 cords per acre of spruce/fir forests in Somerset County.

**Carbon Estimation**

I then plugged the data for acreage and stand volumes, by forest type, into the Maine Forest Carbon Estimator (derived from USDA Forest Service inventories from a multi-state region). This program has data for biomass and carbon for whole forest ecosystems (including soil, forest litter, live trees, and dead trees) and for individual carbon pools.[[3]](#footnote-3)

I used the program to estimate the total carbon in the forest before clearing, and then estimated the carbon that would be left after the corridor is cleared. The difference is the amount of carbon removed.

Removing the timber, surprisingly, only lowers total ecosystem carbon by around 30%. Most of the carbon is in the soil or on the ground.

The program also allows one to estimate the annual increase of carbon per acre by volume per acre and timber type. Because it does not integrate all the estimates into one figure, I calculated a weighted average of carbon increase per acre per year for combined timber types in the corridor. I then multiplied this figure times the number of acres.

**Note**: Using the carbon estimation program is not the same as actually measuring the carbon. It estimates based on *averages* of many forest sites. It should, however, give credible figures of the amount of carbon in an “average” stand of a similar volume by forest type. The program is based on even-aged stands and might not be as accurate for multi-aged stands.

**Findings**

Here are key findings:

* Total ecosystem carbon (in all carbon pools, including live trees, dead trees, litter, roots tops and branches, saplings, and soil) was estimated at 163,063 metric tons.
* Ecosystem carbon after clearing was 118,575 metric tons.
* Carbon removed would therefore be 44,547 metric tons.
* This carbon removal would be equivalent of the emissions of 45,000 cars, getting 30 miles per gallon and driving 12,000 miles a year, or the equivalent of emissions from average US utilities generating 319 million kilowatts of electricity.
* The annual increase in carbon captured and stored by the forest *if the corridor is not cleared*, assuming average stocking based on county and timber type data, would be 836 metric tons of carbon from 6,765,205 pounds of carbon dioxide per year for the 1,728 acres.
* This annual sequestration rate would be the equivalent of the carbon dioxide emissions from generating 6 million kilowatts of electricity by the average US utility.

**Conclusion**

At a time when we need to increase the acreage and volume of forests to help *reduce* atmospheric carbon, we are being confronted with energy proposals that can, conceivably, reduce carbon emissions from electric generation plants, but will, unfortunately, reduce both the carbon that is already sequestered and stored in trees and the carbon that would be sequestered from the atmosphere each year from growing trees. Removing existing forests, ironically, is considered an acceptable consequence towards “saving the planet.”

The benefit of the NECEC hydro electricity is promoted as the equivalent of 3 million metric tons of carbon emissions prevented per year, far more than the carbon impacts of cutting trees on close to 1,800 acres. It is not clear, however, if the carbon footprints mentioned in this report were deducted from this metric- ton figure. Clearing of forests is just one of the carbon impacts that should be examined if there is a rigorous analysis of carbon costs and benefits.

It is a national policy to ensure no net loss of *wetlands*, but currently only a few states, such as Maryland, have a policy of no net loss of *forests*. If we had such a policy, significant forest clearing for federally approved projects would have to either avoid permanently clearing forests or mitigate or offset unavoidable clearing. Forests are no longer endless resources that can be squandered.

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**A note on soil impacts of cutting**

Heavy cutting of forests yields not only forest products, nearly half the dry weight of which is carbon, but can also impact forest soils. The direct sunlight, rain, and soil disturbance, and the disruption of microorganisms and fungi can lead to a faster breakdown of organic matter and a release of soil carbon until adequate ground cover is established. This impact was not modeled by the program I used, but some studies have suggested that this soil carbon loss can be significant and can create a carbon debt that lasts for decades.

**A note on Forest Products**

Only around 1/3 of what is cut in Maine is used for sawlogs. The rest is either burned as biomass or is pulped for paper. Biomass plants release more carbon dioxide to the atmosphere per unit of electricity produced than even coal. Paper making is a very energy-intensive manufacturing process. Much of the paper produced has a relatively short use time before it is thrown in the trash.

A significant percentage of wood used for sawlogs also ends up being burned or pulped. This includes culls, slabs, sawdust, and planer shavings. This “waste wood” could take up as much as 40% of a log, depending on its size and condition. So, only around 20% of what gets cut is turned into lumber. Turning a log into lumber involves carbon emissions from harvesting, transporting, milling, processing, kiln drying, and manufacturing of lumber products. These emissions would be deducted from any benefit of carbon sequestered in the lumber.

**Carbon emission equivalences—explanation of the math**

*Car exhaust equivalents*

To calculate how many pounds are in a metric ton, multiply by 2205. 44,547.3 metric tons times 2205 equals 98,226,796.5 pounds of carbon removed from the power-line corridor.

CO2 has a molecular weight of 44. Carbon has a molecular weight of 12. Forty four divided by 12 gives 3.67. Thus carbon converted to carbon dioxide creates a molecule that is 3.67 times heavier than carbon alone. If all the wood is burned (and combined with oxygen), it would therefore emit 98,226,797 times 3.67 or 360,492,343 pounds of carbon dioxide.

 A gallon of gasoline, when burned, converts to 20 pounds of CO2. A car that gets 30 miles per gallon thus emits 0.667 pounds of CO2 per mile. To find the miles a 30 mpg car has to go to emit a given amount of CO2, divide the CO2 (in pounds) by 0.667.

To calculate how far a car that gets 30 miles per gallon would go if it emits the same amount of carbon dioxide as would be created by burning the trees removed from the corridor, divide the figure for CO2 by 0.667, which equals 540,468,281 car miles.

To make this big number of car miles more understandable, we can assume that these cars that get 30 miles per gallon drive 12,000 miles a year. So, we’ll divide by 12,000*. That same amount of CO2 from burning all the wood cut from the corridor would be the equivalent of 45,039 such car*s.

Using the same formulae, we can calculate that the 836 metric tons of carbon that would be sequestered by the forest in the corridor, if it is not cut down, would be the equivalent *of 845 cars getting 30 miles per gallon and driving 12,000 miles per year.*

*Fossil fuel generated kilowatt hour equivalents*

A review of major utilities in the US came up with a national average of 1.13 pounds of carbon dioxide per kilowatt hour of generated electricity[[4]](#footnote-4). So, the amount of carbon dioxide from clearing the corridor, 360,492,343 pounds, is the equivalent of the carbon dioxide emitted by an average electric utility as it generates 319,019,773 kilowatt hours of electric power (number derived by dividing by 1.12).

By the same logic, the forest in the corridor if it is not cleared would sequester 836 metric tons of carbon, which is 1,843,380 pounds of carbon, which would be the equivalent of 6,765,205 pounds of carbon dioxide which is what an average US utility would emit by generating 5,986,907 kilowatt hours of electric power.

The following graph from the Maine Forest Carbon Estimator program shows the change in forest carbon pools (such as soil, standing dead, litter, understory, down dead and live trees (including roots tops, branches, and boles)) over time after a clearcut.

Live tree carbon changes the most of any forest carbon pool over time. The reason that clearing the forest in the powerline corridor only removes around 30% of the total ecosystem carbon is because the forest in the industrial forest management zone of the corridor, most of which is in Somerset County, only averages an equivalent volume of a forest that is 35 to 40 years old.

1. https://global.nature.org/initiatives/natural-climate-solutions/ncs-about [↑](#footnote-ref-1)
2. https://apps.fs.fed.us/Evalidator/evalidator.jsp [↑](#footnote-ref-2)
3. See [www.lowimpactforestry.org](http://www.lowimpactforestry.org) for Maine Forest Carbon Calculator (3 spreadsheets and an introduction) [↑](#footnote-ref-3)
4. <https://blueskymodel.org/kilowatt-hour> [↑](#footnote-ref-4)