CORRIM FACT SHEET **9**

Consortium for Research on Renewable Industrial Materials *June 2010*

Forest Management Impacts on Carbon Pools in the Inland West

By Elaine Oneil and Bruce Lippke

Increases in average area burned by wildfire in the Inland Northwest are resulting in increased carbon emissions and reduced opportunities to store carbon in wood products and to displace fossil intensive products like steel and concrete. Private management regimes tend to maximize sustainable harvest removals and their use as structural materials while avoiding overly dense stands with high fire risk. Preservation strategies on federal lands coupled with fire suppression have resulted in overly dense stands and increasing rates of fire. While thin from below strategies designed to restore an old forest overstory can reduce fire risks they convert relatively low volumes into product carbon stores and offsets. The science of life-cycle-analysis (LCA) provides carbon tracking across these many carbon pools to demonstrate the range of impacts on carbon mitigation. These findings are part of a larger set of studies produced by the Consortium for Research on Renewable Industrial Materials (CORRIM) that used life cycle inventory (LCI) and life cycle analysis (LCA) methods to quantify the carbon consequences of timber growth, harvest, manufacturing and wood uses for the four main timber supply regions of the USA. This study demonstrates that continued private management can increase carbon stores and offsets by 2.3 t/ha/yr. On federal lands, current fire risk reduction thinnings could produce carbon stores and offsets of 0.6 t/ha/yr, or more with proportional thinning that still retains a large tree overstory, but the gain would require a four-fold increase in area treated and effective fire control on untreated acres.

Forest and Carbon Modeling:

Representative stands in the Inland Region based on sample inventory plots (FIA) were modeled using the Forest Vegetation Simulation (growth) model and Fire & Fuel Extension (FFE) fire risk evaluator for each of several forest types and owner specific management strategies[1]. Simulated treatments included: pre-commercial thinning; even-aged silviculture systems including clearcut, seedtree, and shelterwood; and uneven aged silviculture systems, which cut either the merchantable or non-merchantable materials depending on owner objectives. Decisions on the simulated treatment were based on management objectives and existing stand conditions with multiple treatment paths within a given ownership-prescription class. State and Private simulations included regeneration with seral species in the range of 620-865 TPH with additional natural regeneration added to reflect the species diversity in the overstory. Seral species include ponderosa pine, larch, and white pine depending on the habitat type.

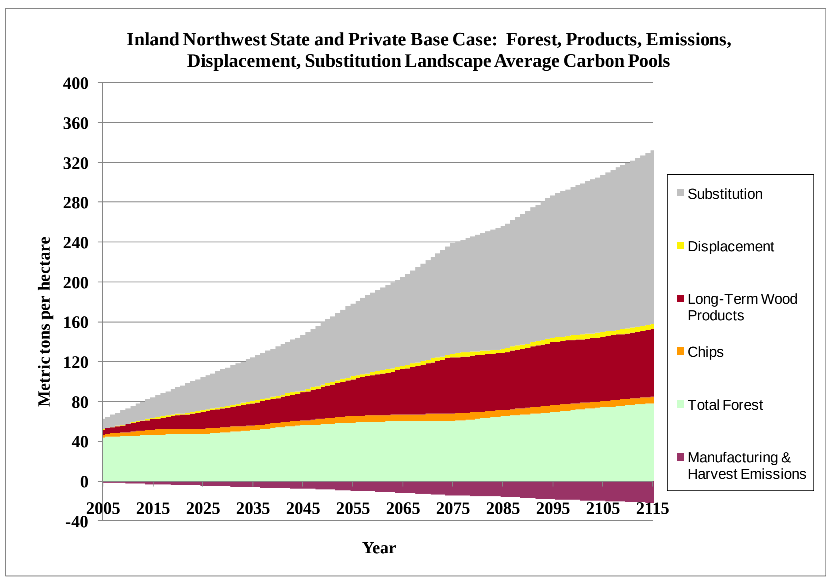
For high elevation and wet forests on private lands even-aged harvest systems were simulated while leaving a minimum of 10 trees per hectare (TPH) greater than 25 cm in diameter at breast height (DBH) to meet statutory requirements for green retention trees. On private dry forests, seed tree and/or shelterwood regimes were simulated to re-establish the next crop, but with no retention of the dominant cohort except for statutory requirements. On private moist forests, regular entries removed merchantable volume, with only minimal stand improvements.

For National Forests, thin from below strategies to restore the historic old forest overstory and reduce fire risk were simulated for 25% of eligible acres to reflect current management intensity. Natural regeneration produces species compositions based on forest type, overstory species composition, and habitat type.

Landscape level results were developed from stratified simulations of representative inventory plots to illustrate the average landscape level impact on forest carbon and harvested wood using CORRIM's survey data on mill allocations and ultimate wood uses in buildings and other products. The carbon pools include the forest, wood products, the benefit gained from using wood products as substitutes for alternative products that are fossil fuel intensive to produce, processing emissions, and the displacement value of the mill residuals used as an energy feedstock instead of fossil fuel. Every carbon pool is simulated dynamically to grow or die and decompose or reflect harvest removals and ultimate uses. Soil carbon (not shown) was assumed to remain stable consistent with a stable to increasing inventory of forest carbon.

The Inland Northwest analysis covers the timber producing acres in Idaho, Montana, and the area east of the Cascade Mountains in Washington State where manufacturing infrastructure still remains. It accounts for 91% of the roundwood production for the Rocky Mountain Region and 10% of the roundwood production for the Pacific Northwest Region with most of that harvest volume coming from private and state sources. Federal forests occupy 63% of the land base but contribute only a minor share to the total harvest.

State and Private Carbon Flows:



A baseline scenario using historical harvest rates and growth model projections results in a slight long term increase in forest carbon from these management simulations. The simulations do not assume carbon neutrality but results are consistent with the assertion that the overall impact of sustainable forest management activities on forest carbon is neutral (or positive) when assessed at the landscape level.

While the carbon in the forest remains relatively stable, the carbon in products continues to grow with each year's harvest when even a portion of the harvested log is used in long-lived applications. Based on mill survey data for the region[2] approximately 50% of the harvested logs are used in mid to long-lived applications. Energy used to grow, harvest, transport, and process the logs into wood products is identified as manufacturing and harvest emissions (below the x-axis) but are small relative to the carbon stored in products, and are partially offset by using mill residuals for energy providing a displacement (offset) for a substantial portion of the fossil energy that would otherwise be used in manufacturing.

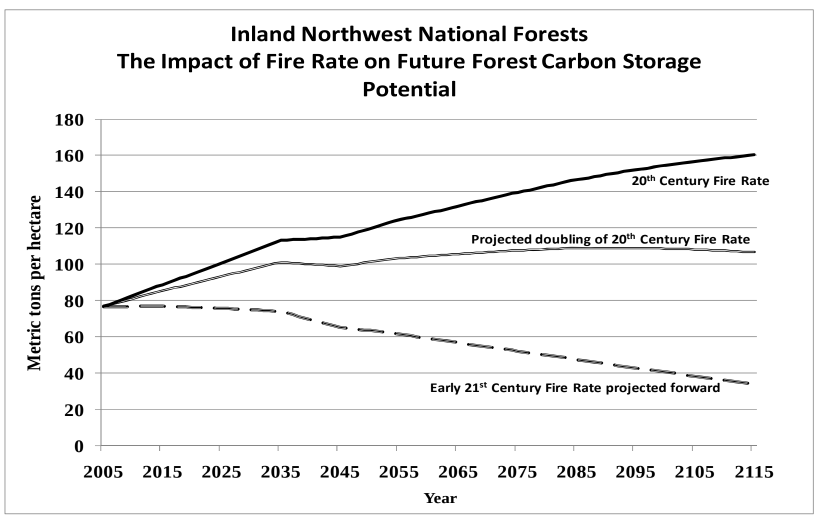
The substitution for fossil intensive products such as steel and concrete has the highest leverage given the high fossil intensity of the non-wood substitute products[3]. The figure shows that even with increasing forest carbon, the carbon in products, displacement and substitution pools grows sustainably and substantially exceeds the carbon storage potential of the forest alone by the end of the simulation period. Not shown are the potentials to recycle products (extending the product carbon pool), capture an end of product life energy offset by using the demolition waste as a biofuel (replacing the initial product carbon pool by a nearly equivalent fossil emission offset), or account for sequestration of the product carbon in a landfill (a slow rather than immediate degradation of the product carbon pool depending upon landfill emission management). Each of these potentials will add to the total carbon across all pools.

While average forest carbon for the simulation period was 57 t/ha, including the other pools (net of their emissions) increases the average carbon stored over the 100 year period to 175 t/ha for State and Private owners. This threefold increase in carbon reflects the potential of well-managed forests to contribute positively and sustainably toward offsetting carbon emission trends. While the carbon stored in the forest remains fairly stable over time, the carbon storage and offsets in carbon pools outside the forest continues to grow with each harvest. While there is no retroactive reporting of the non-forest carbon pools from earlier harvests, we could expect that at least 75 t/ha (not shown) would have already been sequestered in offsite uses from just the harvest outputs from the 30 years prior to the beginning of the simulation.
The harvest translates into substantial and sustainable increases in products carbon and substitution. Substitution averages 78 t/ha over the 100 year period or 37% higher than the average forest carbon storage. The product pool surpasses the forest as a carbon storage pool after 40 years and averages 45 t/ha over the 100 year period or 79% of the total forest carbon. By 100 years the 294 tons of carbon stored in all pools is 4 times greater than the carbon stored in the forest and the average growth in all carbon pools is 2.3 t/ha/yr. The longest-lived products were demolished and burned in 80 years without further use and the short lived products were assumed not to result in significant accumulation of carbon from one rotation to the next. From the perspective of sustainably managing a unit of land, the carbon pools supported by the forest are much better than permanent, increasing year after year.

Impact of Changing Fire Rates:

In recent years the extent and severity of wildfire is increasing, with a multiplicity of key drivers. A century of fire suppression has resulted in overly dense stands on mostly federal lands with some increase in forest carbon but also greater stress from climate change. Recent fire rates on federal lands are many times higher than on state and private lands and climate impacts research indicates that we can expect at least a doubling of the burned area in the future[4]. The first decade of the 21st century fire rates are even higher than the predicted doubling.

Fire simulations show that based on the fire rates of the ***20th century***, in conjunction with fire suppression, forest carbon could increase further albeit not accounting for the impact of other mortality agents like the mountain pine beetle. The projected ***doubling*** of fire rates essentially caps the carbon that will be stored in the forest. Early ***21st century*** fire rates indicate the forest has already become a carbon source.



Federal Forest Carbon Flows:

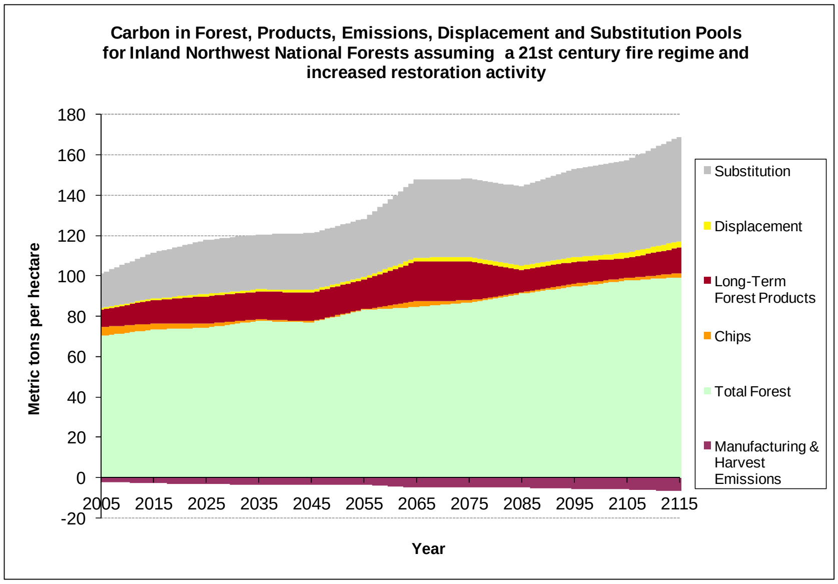
In order to reduce the increasing risk of fires a more rapid introduction of aggressive thinning treatments to reduce fire risk was simulated. Thinning only those trees less than 30 cm in diameter can reduce fire risk while restoring a savanna-like overstory of larger trees similar to pre-European conditions. Included were treatments of lodgepole pine forests to address mountain pine beetle risks and infestations while recognizing that these treatments would not be successful in ameliorating fire risk.

Assuming a 400% increase in the amount of area treated over the past decade, early and substantial treatments on the most susceptible stands, and a future fire rate equal to a doubling of the 20th century fire rate generates an estimate of increased growth in all carbon pools of 0.6 t/ha/yr on federal lands. Additional carbon gains could be obtained by removing larger diameter trees using proportional thinning approaches that take trees from all size classes, produce more merchantable logs, and subsequently more long lived products and offset benefits. A proportional thinning approach could also contribute substantially to reducing fires[4] as well as increasing total carbon.

Summary of Impacts:

A landscape level assessment of projected carbon storage by owner group shows that by 100 years, management on State and Private forests can sequester or avoid emissions equal to 294 t/ha of carbon, which equals over 1.9 billion t of carbon across 6.5 million ha of Inland forests. Seventy nine percent of the carbon accumulates beyond current forest carbon inventories. On National Forests carbon sequestration and avoided emissions for accelerated thinnings are 152 t/ha over 11 million ha of unreserved forests for 1.4 billion t of carbon stored.

In the Inland Northwest, where the forest land base is dominated by federal ownership and the forests are managed for a multitude of benefits, life cycle analysis suggests that the optimal solution for maximizing carbon gain under both current and future climate conditions is to manage forests to maximize long-lived wood products and to minimize the risk of severe wildfires. The carbon storage in buildings and the substitution benefits override the potential gains of attempting to leave high carbon stocks stored in the forest. Because of increasing wildfire severity and increased acreage burned, Inland Northwest forests will convert from a carbon sink to a carbon source without active forest management.



References:

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