
RTI News

Summer 2004

Newsletter of the Rural Technology Initiative

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RTI Director's Notes

This edition of the RTI newsletter focuses on carbon, smoke, and the work that RTI has done to incorporate consideration of these environmental impacts into our research and technology applications. The concern about carbon is that increased carbon dioxide (CO₂) in the atmosphere will cause global warming in the long term. Forests play an important role in the carbon cycle, as trees actually pull carbon dioxide out of the atmosphere through photosynthesis and store it as wood, leaves, etc. until such time as the tree burns or decomposes, releasing the carbon back into the atmosphere. There

is increasing recognition of carbon sequestration as one of the many public benefits that forests provide, and in some cases these benefits translate into market incentives known as carbon credits.

The story does not end there, though. Often there is the misconception that choosing to not harvest forests is the best way to maximize carbon storage. However, a broader perspective reveals that forest products also play a role. When timber is harvested and converted to products, that carbon in the wood fiber remains stored for the life of the product. Then if new trees are planted, more carbon is taken out of the atmosphere. In addition, the use of wood products precludes the use of fossil-fuel intensive alternatives like steel and concrete, reducing carbon emissions through an effect known as substitution. With these concepts in mind, actively managed forests that utilize growing trees to produce forest products, that result in substitution for fossil intensive products can play a huge role in reducing atmospheric carbon. Jeff Comnick and I cover this "Carbon Life Cycle Analysis" in more detail in this newsletter. You can also read from Jeff and Jim McCarter about how this type of analysis has been integrated with the Landscape Management System (LMS), allowing carbon to be included with the many non-market forest values that LMS can assess.

Another link between forestry and carbon is through "bio-energy." Bio-energy is produced when wood (usually small

diameter material or mill byproducts like hogfuel) is burned in a wood boiler to generate electricity. The carbon released by burning wood is that which has been pulled from the atmosphere by photosynthesis, completing a sustainable, solar energy driven cycle. In contrast, burning fossil fuels releases carbon stored in the earth. Using bio-energy instead of fossil fuels is known as displacement and results in a reduction of net emissions.

Jim Walls from the Lake County Resources Initiative in Oregon completes the carbon picture in his article about a proposed bio-energy plant. This plant would use as fuel the large volumes of small diameter material that would result from thinning overstocked forests that are at high risk of a catastrophic wildfire. Using wood biomass to generate electricity releases far less carbon to the atmosphere than wood burned in wildfires. This is a win-win situation in which catastrophic fires and the associated large releases of carbon are avoided and a renewable source of energy is utilized that displaces fossil fuels. If carbon credits are considered, the project would also produce economic (market) benefits in addition to these non-market benefits. To make real headway in reducing carbon emissions, some form of credits seems essential.

Carbon is not the only emission of concern when it comes to forest fires. Larry Mason reports on the other negative aspects of forest fire smoke, the health consequences, and a new computer model being used to predict smoke patterns from forest fires. Carbon life cycle analysis, bio-energy, and smoke management are growing areas of research and technology that will become increasingly important in the years to come. RTI will continue to study these issues and find useful and innovative ways to integrate carbon and smoke analysis in our programs.

Bruce Lippke, Director
Email: rti@u.washington.edu
(206) 616-3218



The Life Cycle of Wood Plays an Important Role in Reducing Carbon Emissions

Concerns over global warming are increasing interest in the emission, sequestration, and storage of carbon. Forests play an important role in the carbon cycle. Through photosynthesis, trees utilize carbon dioxide from the air to grow, removing carbon from the atmosphere and storing it for long periods of time. Some of that carbon can then be transferred to forest products through harvest and manufacturing. Wood products used in housing construction generally last a long time, producing an increasing pool of stored carbon. In addition, using wood products precludes the use of alternative materials such as steel and concrete, the manufacturing of which requires burning fossil fuels that release carbon from the earth into the atmosphere. With this in mind, forest management that includes harvesting timber to create wood products may keep more carbon out of the atmosphere than no-harvest alternatives. To truly measure the potential for forests to counter global warming, a life-cycle analysis is needed that accounts for carbon during all stages of regeneration, materials processing, construction, and product or building use.

The carbon life-cycle analysis first accounts for all processes that increase or decrease the amount of carbon in the forest or that move carbon from the forest to other stages. Processes that increase carbon include growth of the stem, roots, and crown of all tree species. Reforestation and afforestation are important occasions of new growth. Processes that release carbon to the atmosphere include the decomposition of snags, logs, roots, and litter, as well as combustion during fire events. Carbon changes in the soil and understory vegetation may also be significant in some circumstances. Mortality shifts carbon from living trees to snags or logs. Similarly, silvicultural operations can shift carbon from living trees to snags, logs, or products. Carbon must be tracked as it enters or leaves each one of these categories, which are called Carbon Pools.

When wood products are removed from the forest, the carbon stored in the wood will continue to be stored in lumber and mill byproducts. Carbon stored in products is only released as the products decompose, which depends on the life cycle of the product. Lumber used in construction can store carbon for a 100 years or longer. Wood byproducts such as hog fuel or other low-valued residuals can be burned in a wood boiler to generate bio-energy. This precludes the use of an equivalent amount of fossil-energy (e.g. diesel, coal, or natural gas), reducing net carbon emissions. The replacement of fossil-energy with bio-energy is termed 'displacement,' which is a key carbon pool.

Similarly, if lumber is used as a construction material, steel and concrete are not used, and therefore do not need to be manufactured. This

permanently avoids the carbon emissions from the fossil fuels used to manufacture each material, which can be a significant amount of carbon. This is another important carbon pool known as 'substitution.'

When forest management alternatives are investigated using this carbon life-cycle analysis, the significance of the product, displacement, and substitution pools becomes apparent. The product and substitution pools from a management alternative that includes harvest, may store more carbon than an alternative without harvest. In ecosystems where disturbances can be expected, such as forests with high fire risk, products will likely store carbon for a longer period than the forest would. Finally, because of the permanent benefits of avoiding the carbon emissions from fossil fuel use, substitution and displacement are very important, especially in the long-term.

It is important to consider a complete carbon life-cycle when evaluating different management and policy alternatives. RTI has incorporated life cycle research on wood products into the Landscape Management System to provide a complete accounting of carbon pools from forest regeneration through processing, construction, and ultimate demolition. The Consortium for Research on Renewable Industrial Materials (CORRIM) has recently published a life cycle study on wood products in the June 2004 Forest Products Journal. Copies are available for download at www.CORRIM.org.

- Bruce Lippke & Jeff Cornick, RTI -

Tracking Carbon Pools in LMS with Different Management Strategies

RTI has implemented a carbon life-cycle analysis model in the Landscape Management System (LMS). Based on studies of the amount of biomass in a tree, the amount of lumber and by-products produced at mills, and energy requirements to manufacture steel and concrete construction materials, the model determines carbon storage under a range of management options for a single stand or portfolio of stands. The model predicts metric tons of carbon in the forest for stems, roots, crowns, litter, and dead material (snags and logs). Users can choose from several equations for each tree component and adjust species-specific coefficients for each equation if local information is available.

The model predicts product carbon for lumber, chips, and hogfuel. Users can also specify whether chips or hogfuel should be burned in a wood boiler to generate bio-energy. If so, carbon is immediately removed from the byproducts carbon pool but the carbon credit from displacement increases. Although the displacement increase does not represent a large amount of carbon, it is permanent and becomes more significant over several timber rotations.

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Lumber production shifts carbon from the forest to products but also determines the amount of carbon credit from substitution for fossil-fuel intensive products such as steel and concrete. Users can select whether steel or concrete is used as the alternative building material to calculate the amount of carbon emissions avoided by using wood.

Selecting the carbon table from LMS will generate the results in the Carbon Life Cycle Analysis Excel template. This template allows the user to view the raw results (Figure 1), or tabular results summarized by category for the landscape, or graphical results for an individual carbon category or combined over all categories.

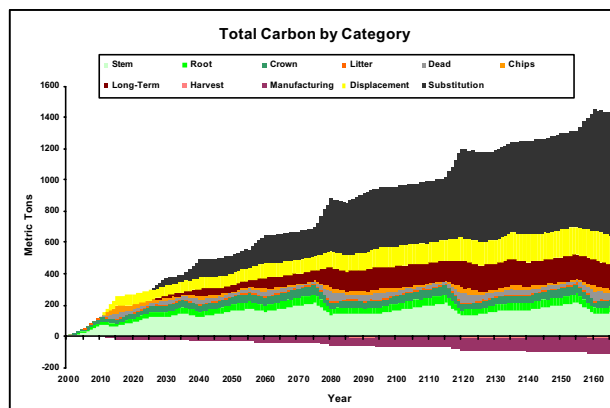


Figure 1: The Carbon Life-Cycle Analysis Template automatically creates graphs like this showing the amount of carbon over time in each category.

Implementing the carbon life-cycle analysis model in LMS has two important advantages. First, analyzing the amount of carbon stored in the forest, products, or offset by substitution for a single stand or an entire landscape is as simple as selecting a table from LMS. This allows for quick comparisons of carbon storage outcomes from simulations of management alternatives. Because charts are automatically generated in the spreadsheet, results are easy to communicate.

The second advantage is that carbon can now be analyzed with the same growth model and treatment assumptions used to generate all other market and non-market values available from LMS. This promotes an unbiased and more inclusive analysis that allows trade-offs between objectives and management alternatives to be determined. Understanding the consequences of a management alternative on carbon, as well as economics, wildlife habitat, and other values, will only increase in importance. RTI and other LMS users now have the capabilities to analyze another important value provided by forests.

- Jeff Comnick and Jim McCarter, RTI Staff -

Carbon Credits – The Lakeview Experience

Lake County is located in South Central Oregon near the California and Nevada borders. Lake County forests naturally burned at low intensity on a 15-25 year interval and were dominated by large, widely-spaced Ponderosa Pine. In 2002 a study completed by the Rural Technology Initiative showed that 77 % of the Fremont National Forest is in high to medium fire hazard condition and that when a fire does occur it is likely to be catastrophic in nature. Our recent fire history shows this to be true on a 2-3 year interval we are experiencing 200,000 acres of catastrophic fires.

These conditions were brought on by forest management policies that focused on aggressive fire suppression and logging of large old-growth trees. Consequently, forest composition and natural fire disturbance regimes have been dramatically altered. Combined with a decade of drought conditions, this has resulted in increased insect infestations and high fuel loads. The 2002 study showed that restoring the Fremont National Forest to natural stand conditions and fire regimes would require an extensive thinning and under-burning program that would yield tremendous volumes of small diameter material. The only economically proven technology that could consume this large volume would be a biomass plant.

In December 2003 Lake County Resources contracted with CH2M Hill to develop a business plan and preliminary engineering for a biomass plant. Going into the project we knew that most biomass plants are uneconomical under today's electrical prices. We decided to look at what influence carbon credits, energy credits and Forest Service Stewardship contracts would have on the economics of a biomass plant. In the State of Oregon any new fossil fuel power plant being built must mitigate for the carbon dioxide (CO₂) emissions. In neighboring Klamath County, a 600 megawatt (MW) natural gas plant is being proposed, and the reported CO₂ mitigation expense is going to be approximately \$12-14 million. The 2002 study by the University of Washington showed that by thinning to restore natural stand conditions versus a wildfire would save 41 metric tons/acre of carbon from going into the atmosphere over a 30-year period.

In Oregon, between 1992 and 2001 (the last year data is available), CO₂ emissions from uncontrolled forest wildfires ranged from a low of 0.5 million metric tons/year in 1993 and 1997 to a high of 22.3 million metric tons in 1996 (Figure 1). It is our goal to obtain recognition of carbon credits for reducing conditions that lead to catastrophic fire events. In the case of the Fremont National Forest, that would be a savings of 41 metric tons of carbon/acre or in CO₂ equivalents, 145 metric tons of carbon dioxide per acre.

"Carbon Credits" continued from page three

This estimate includes carbon storage in the forest, displacement value of using biomass over natural gas, and product substitution.

Our biomass business plan showed that at current electrical prices, a 15 MW plant would be \$11 million in the red at the end of 20 years. Much of the cost is in the fuel, which for a 15 MW plant that is approximately \$3 million/year for biomass from forest thinnings. Assuming that a catastrophic fire event kills approximately 50% of the trees, if we could get \$3/metric ton of CO₂ as a credit, this would amount to a \$218/acre to assist in reducing fuel costs to the plant (.50 x 145 metric tons/acre x \$3/ton).

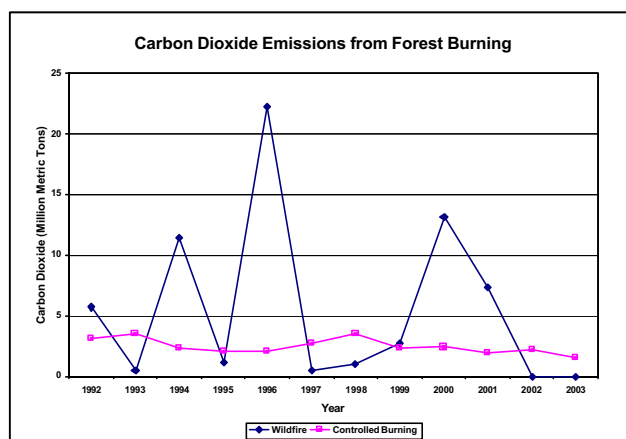


Figure 1: CO₂ emissions from forest burning in Oregon (Source: Oregon Department of Forestry).

The carbon credits, combined with the provisions outlined under the Stewardship Contracts allowed under the Healthy Forest Restoration Act, now make a biomass plant economical. Depending on assumptions, a 7-20% return on investment could be anticipated.

The Landscape Management System (LMS) can perform all of these calculations and provides a monitoring system for verification of credits. We have buyers interested in these credits, if we can get the EPA to review and accept the science behind LMS. The science community also needs to accept the total forest/product carbon cycle outlined in the CORRIM report (<http://www.corrim.org> and associated articles in this newsletter).

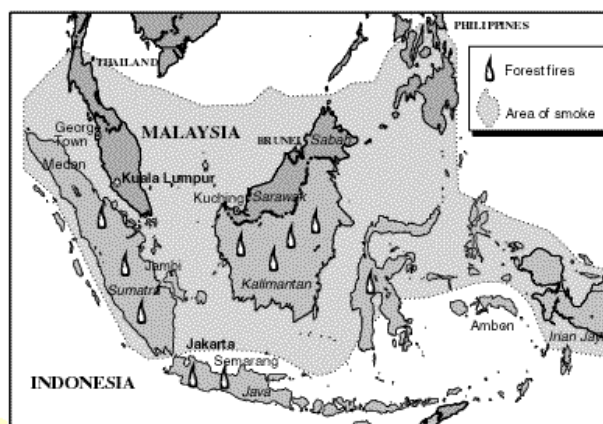
Reducing CO₂ emissions into the atmosphere, producing renewable energy and making our forests healthy again seems like a winner to us. We will keep you informed as this project progresses.

- James K. Walls, Lake County Resources Initiative -

Where There's Fire There's Smoke

In 1997, a widespread series of uncontrolled fires in Indonesia burned close to 40 million acres of drought-stressed tropical forest. By comparison, in 2002 (a record year for forest fires in the United States) approximately 7 million acres were burned. A blanket of thick, smoky haze spread over a large portion of Southeast Asia. Pollution levels reached all-time highs, closing schools and airports and causing tens of thousands of people to seek treatment for respiratory illness. Dramatic short-term health problems, including fatalities, were experienced by at-risk groups such as children, the elderly, and asthmatics. The potential long-term health problems caused by exposure to smoke pollution may not be known for years. 70 million people were affected. Following such large, well-publicized wildfire events, the general public as well as the scientific community are becoming more aware that emissions from forest fires represent a serious and enduring environmental impact.

Smoke is made up of tiny particles, gases, and water vapor. Water vapor makes up the majority of smoke, but the remainder includes carbon monoxide, carbon dioxide, nitrogen oxide, formaldehyde, benzene, and other irritant compounds, toxics, and small particles. Known health effects from smoke exposure can range from burning eyes, runny nose, and bronchitis to congestive heart failure and emphysema. The United States Environmental Protection Agency (EPA) establishes National Ambient Air Quality Standards (NAAQS). It is not uncommon for western communities located within the "wildland urban interface" to experience extended periods of time where smoke from forest fires causes air quality to exceed EPA NAAQS and



Source: <http://www.rand.org/publications/RB/RB5066/>

pose health hazards. While the greatest public health concerns have centered around the fine particulate matter (see http://www.epa.gov/ttn/naaqs/pm/pm25_index.html) present in smoke, additional environmental negatives associated with smoke include release of carbon into the atmosphere adding to long-term concerns about global warming.

Unfortunately the many health impacts associated with forest fire smoke are not generally considered as a public cost (liability) caused by a failure to treat forests to reduce fuel loads and consequently, wildfire incidence and severity. If these negative impacts (public costs) were fully reflected in the market, there could be high motivation to avoid them by making investments to remove excessive fuel loads similar to investments that are made to reduce other forms of air pollution such as industrial smoke emissions.

- Larry Mason, RTI Staff -



Save the Date



Saturday September 18, 2004

Family Forest Field Day

Francis, WA

<http://www.familyforestfoundation.org/pages/fieldday.html>

Sunday, September 19 - Tuesday, September 21, 2004

GIS Training Workshop

Pack Forest, Eatonville, WA

Contact Nicole Stevens at (206) 543-8684 or nms@cfr.washington.edu

*New Date: Saturday November 13, 2004

Fall Education Seminar: *Technology in the Woods*

Pack Forest, Eatonville, WA

Contact Don Hanley at (206) 685-4960 or dhanley@u.washington.edu

Wednesday, December 8 - Friday, December 10, 2004

LMS Training Workshop

Skagit Valley College, Mt. Vernon, WA

Contact Nicole Stevens at (206) 543-8684 or nms@cfr.washington.edu

Thursday January 13, 2005

Introduction to LMS (1-day workshop)

Space is very limited - Contact Don Hanley at (206) 685-4960 or dhanley@u.washington.edu

- Technology Update -

New smoke model is being used to warn communities of potential health impacts from large wildfires

Smoke from wildfires affects air quality. A collection of government and university scientists brought together as the Fire Consortium for the Advanced Modeling of Meteorology and Smoke (FCAMMS) have been working to develop predictive capabilities for anticipating the cumulative impacts of smoke from forest, agricultural, and range fires. The result is a new modeling framework called BlueSky, <http://www.fs.fed.us/bluesky/>. On a nightly basis, BlueSky obtains a regional meteorological forecast and burn information from state and federal agency burn reporting systems. The merging of these data with models of fuel consumption and emission, and dispersion and trajectory models results in a regional forecast of smoke concentrations for the next two days. This modeling capability gives fire managers a much improved ability to estimate how much smoke will be produced, to track the actual smoke produced, and to forecast smoke movement for the next several days. BlueSky has been used to help determine firefighting strategies for large wildfires and to warn nearby communities of potential health impacts. Developing modeling technologies like BlueSky, are also helping scientists to better understand and to predict the magnitude of the social, the environmental, and the economic costs associated with wildfire events.

Website offers up-to-date fire information

The National Interagency Fire Center maintains a very informative web site, that reports current wildfire activity across the nation. The website can be found at <http://www.nifc.gov/fireinfo/nfn.html>.

- LMS Update -

Inventory Wizard 2.1 – Released July, 2004

Economatic 1.1 with Scenario Analyzer – Released August, 2004

Economatic 1.2 – Available September, 2004

Sort Table Wizard 1.0 – Available September, 2004

LMS 3.0 – Available Fall, 2004

Free downloads available from <http://lms.cfr.washington.edu/lmsdownload.php>
(CD-ROMs are also available free of charge upon request).

Readers may send comments to:

Bruce Lippke, Director RTI
CFR, University of Washington
Box 352100
Seattle, WA 98195-2100
Phone: 206-543-8684
email: RTI@u.washington.edu

Janean Creighton, Coordinator RTI News
Department of Natural Resource Sciences
Washington State University
PO Box 646410
Pullman, WA 99164-6410
Phone: 509-335-2877
email: creighton@wsu.edu

RTI is in cooperation with:



University of Washington
Rural Technology Initiative
College of Forest Resources
Box 352100
Seattle, WA 98195-2100

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