

## STAFF REPORT

Agenda Item No:	E
Title and # of Issue:	Forest Vitality - Issue #3
Objective # & Title:	Obj. 5 – Promote the development of forestry carbon-offset markets as an incentive for managing forests, utilizing wood products and maintaining the forestland base.
Presentation Title:	<i>WESTCARB – Phase I Reports</i>
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### SUMMARY

The purpose of this agenda item is to distribute the following reports that were prepared through Phase I of the West Coast Regional Carbon Sequestration Partnership (WESTCARB):

- 1) *Baseline Greenhouse Gas Emissions and Removals for Forest and Agricultural Lands in Oregon.*
- 2) *Carbon Sequestration through Changes in Land Use in Oregon: Costs and Opportunities.*

This distribution is for informational purposes. The Department does not necessarily endorse the methods, analysis and findings of the reports.

### CONTEXT

The reports form part of the Board's research and information effort for promoting the development of carbon-offset markets so that these markets are inclusive of forestry activities and can provide incentives for maintaining forests as forests, improving forest management, and increasing the utilization wood products. The Phase I WESTCARB reports provide a statewide assessment of the status and trends of carbon stocks on Oregon's forest, range, and agricultural lands. They also evaluate possible forestry actions to increase carbon sequestration and storage such as increased rotation lengths, expanded riparian management areas, and the forestation of underproducing agricultural, range and brush lands.

The reports detail the WESTCARB Phase I terrestrial sequestration work for Oregon. The baseline report quantifies changes in carbon stocks on forest and agricultural lands in Oregon for the 1990's and provides an estimate of the emissions and removals (i.e., sequestration) of greenhouse gases attributable to land use change and forestry land use. The cost and opportunities report estimates the carbon sequestration potential from several land use activities in Oregon: afforestation of rangelands and croplands; extending timber harvest

rotations, widening riparian buffers; and hazardous fuel reduction to reduce emissions from wildfire. The reports were prepared by Winrock International – a non-governmental organization that works internationally on climate change matters and has specialized expertise in the measurement, monitoring and accounting of the carbon dioxide emission benefits from forestry activities.

## **BACKGROUND**

WESTCARB – led by the California Energy Commission - is one of seven regional carbon sequestration partnerships funded by the U.S. Department of Energy. The major focus of the partnerships is to study and demonstrate the feasibility of capturing point-source carbon dioxide emissions and transporting and storing the emissions geologically in underground land formations. Some of the partnerships, including WESTCARB, are also studying and demonstrating terrestrial carbon sequestration, including forests, as a means to offset carbon dioxide emissions. The Department has been a participant in WESTCARB since its initial funding in 2003. Phase I of WESTCARB – which characterized sources of carbon dioxide, established baseline emission trends and investigated carbon sequestration and storage opportunities – concluded in 2005. WESTCARB was awarded a Phase II extension to further characterize sources and investigate opportunities as well as to test and demonstrate the feasibility of carbon sequestration and storage as a means to reduce or offset carbon dioxide emissions. In Phase II, Oregon hosts the Lake County Terrestrial Sequestration Pilot Project – a project that is designed to investigate whether planned fuels treatments implemented at a landscape scale – lead to overall carbon dioxide emission benefits in the form of avoided emissions from wildfire and in the form of improved sequestration and storage in residual forests made more resilient to wildfire as a result of the fuel treatments.

## **DISCUSSION**

### *Baseline Greenhouse Gas Emissions and Removals for Forest and Agricultural Lands*

The analysis of trends in forestland area and associated equivalents with respect to carbon dioxide losses to, and removals from, the atmosphere is based on an analysis by the USDA Forest Service Northeast Research Station, *Carbon in U.S. forests and wood products, 1987–1997: State-by-state estimates* published in 2003<sup>1</sup> combined with additional analysis of two datasets: the National Resources Inventory (NRI) database and the U.S. Forest Service Forest Inventory and Analysis (FIA) database. The NRI database tracks changes on non-federal lands including agricultural and forest land losses and gains. The FIA database is a compilation of permanent plot inventories covering both non-federal and federal forest lands. Comparison of the FIA inventories from one period to the next estimates changes in forest growing stocks due to growth, mortality and removals.

An estimated 383,000 ha (946,000 ac) of forest were gained on federal and non-federal lands in Oregon between 1987 and 1997. Most of this gain is on federal lands. On non-federal lands, an estimated 28,000 ha (69,000 ac) were lost to development in Oregon State between

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<sup>1</sup> Birdsey, R. A., and G. M. Lewis. 2003. *Carbon in U.S. forests and wood products, 1987–1997: State-by-state estimates*. Gen. Tech. Rep. NE-310. Newtown Square, Pennsylvania: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 42 p.

1987 and 1997 at a rate of 2,788 ha (6,889 ac) per year. An additional 26,022 ha (64,300 ac) were loss to other non-agricultural or range uses. This combined forestland loss is equivalent to a gross emission of between 13.9 and 15.4 million metric tons carbon dioxide equivalent (CO<sub>2</sub>), or 1.39 to 1.54 million metric tons CO<sub>2</sub> per year. However, this loss of non-federal forest land to development was offset by a corresponding gain in forestland from pasture and rangeland; 55,322 ha (136,700 ac) over the 1987-1997 period. The result was nearly a net-zero change in non-federal forestland; for non-federal forested lands – a loss of only 5,000 ha (12,000 ac) occurred over the period.

The report analyzed carbon dioxide emissions from wildfire over the 1990 through 1996 period. The researchers reconstructed the area burned from point data for wildland fire occurrence using Normalized Difference Vegetation Index (NDVI) satellite imagery data to determine the area of vegetation loss due to fire. The analysis recorded fires with a total area of 328,000 ha (810,000 ac)—equivalent to an average 54,700 ha per year (135,100 ac/yr). Emissions totaling 25.0 million metric tons CO<sub>2</sub> were estimated to have occurred over the 1990-1996 period. Averaged annually, this is equal to 1.03 million metric tons CO<sub>2</sub> per year. Forty eight percent of the burnt area and 83 percent of the emissions were in forest as opposed to rangeland. Fire incidence varied by year, with high emissions in 1996 and low emissions in 1993 and 1995.

In aggregate (net of forestland losses and wildfire), Oregon's forests are acting as a net sink for carbon both through the expansion of forest land and increased carbon stocks on existing forestland. Oregon's forestlands over the 1987-1997 period sequestered an estimated 229.9 million metric tons CO<sub>2</sub> (23 million metric tons CO<sub>2</sub> per year). When compared to Oregon's reported carbon dioxide emissions (excluding forests) for 2000 (67.7 million metric tons CO<sub>2</sub>), about one-third of Oregon's emissions are being offset by Oregon's forests. Expansion of the analysis to cover the 1997-2003 period led the researcher's concluded that Oregon's forests potentially offset as much as 50 percent of Oregon's reported carbon dioxide emissions.

### *Carbon Sequestration through Changes in Land Use in Oregon: Costs and Opportunities*

This report presents the analysis of opportunities for improving the role Oregon's forests play as a net carbon sink. The analysis addressed the question: given a value for removing or offsetting a metric ton of carbon dioxide, how much of a given forest management investment response would occur. By changing the assumed value for offsets, the approach develops carbon supply curves for potential land-use and forest management activities. Carbon supply curves were estimated for afforestation and changes in forest management such as lengthening forest rotations and expanding riparian management areas. The analysis also included an assessment of hazardous fuel removal from forests with high fuel loads as a means to avoid emissions from wildfire and improve the sequestration and storage ability of forests by increasing their resiliency to uncharacteristic losses from wildfire.

#### Afforestation.

The amount of area converted from agricultural or range land use to forests is price sensitive to the value per metric ton of carbon dioxide. The analysis looked at periods for keeping the converted area in forest use for 20, 40 and 80 years. Longer duration projects fared better because the initial afforestation costs are capitalized over a longer project period. At a price

of  $\leq$  \$2.40/t CO<sub>2</sub>, only afforestation projects on rangelands lasting 80 years enter supply, sequestering 732 million metric tons (MMT) of CO<sub>2</sub>. At a price of \$20/t CO<sub>2</sub>, more productive rangelands and croplands, with higher opportunity costs, enter the supply and sequester almost 280 MMT CO<sub>2</sub> with projects that last only 20 years. The total amount rises sharply to more than 1,813 MMT CO<sub>2</sub> when 40 year long projects become popular and more so when 80 year long projects are included (4,203 MMT CO<sub>2</sub>) at 80 years. At \$20/t CO<sub>2</sub>, this supply translates to an approximate annual rate of 45 MMT CO<sub>2</sub> sequestered each year.

#### Changes in Forest Management

The analysis indicates that the value per ton of metric CO<sub>2</sub> would have to be significantly high to induce lengthening timber rotations – for up to 15 years - from their economically optimal length. Further, the incremental increases in carbon sequestration and storage from the lengthened rotation are relatively small. The analysis did not include the effects of carbon stored in wood products. It would take a value of \$37/t CO<sub>2</sub> to cover the cost of inducing all of the private and nonfederal public land nearing the economically optimal rotation period to increase their rotations for up to 15 years (790,000 acres or 319,700 ha). Further, the net increase in carbon sequestration and storage is 35.6 MMT CO<sub>2</sub>.

Expanding the width of riparian forest management areas requires high values for the carbon removed with very little additional CO<sub>2</sub> sequestered and stored. The potential area of mature forests to be included to expanded 200 foot riparian management areas was estimated at 20,700 acres (8,375 ha) at a value of \$40/t CO<sub>2</sub>. The additional carbon that could be stored on these lands if the forest is relatively miner, only 1.25 MMT CO<sub>2</sub>. However, the analysis was limited in that smaller non-fish bearing streams were not included because of limitations in the scale of the geographic information system stream layer used.

#### Hazardous Fuel Reduction

Historically an estimated 4.17 million ha (10.3 million acres) of Oregon forests had low and mixed severity fire regimes. One potential hazardous fuels treatment involves hazardous fuel harvested in the woods, bunched and skidded to a landing, chipped into a chip van, and hauled to a biomass energy facility for electricity and/or heat generation. The area of forestlands to which this treatment could be applied is approximately 1.17 million ha (2.9 million acres). Two removal scenarios were analyzed: hazardous fuel removals of 4 bone dry tons (BDT) per acre on these lands would yield 12 million BDT biomass fuel for use in energy facilities, while removal of 8 BDT per acre would yield 23 million BDT.

The analysis assumed that during moderate to intense fires, 10 to 70 percent of the biomass stock would burn and be emitted as CO<sub>2</sub>. The analysis suggests that at carbon values ranging between \$2.40/t CO<sub>2</sub> and \$10/t CO<sub>2</sub> would cover the cost of removing and transporting the hazardous material from the forest. Estimating the carbon benefits from such removal in the form of avoided wildland fire emissions, improved sequestration and storage in more resilient and healthier forests and displacement of fossil fuel use at the biomass plant was beyond the scope of the analysis and is being investigated as part of the Phase II WESTCARB work.

## **NEXT STEPS**

The results contained in the WESTCARB Phase I reports will contribute to the 2010 Forest Assessment that will support the Board's development of the 2011 Forestry Program for Oregon.

## **ATTACHMENTS**

- 1) Winrock International. 2007. Baseline Greenhouse Gas Emissions and Removals for Forest and Agricultural Lands in Oregon. Report #CEC-500-2007-025. Sacramento, California: California Energy Commission Public Interest Energy Research. 66 p.
- 2) Winrock International. 2007. Carbon Sequestration through Changes in Land Use in Oregon: Costs and Opportunities. Report #CEC-500-2007-074. Sacramento, California: California Energy Commission Public Interest Energy Research. 84 p.