Nebraska* Forest Biomass Supply Estimate by County[†]

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* Similar estimates are available for other western states, and a final project report cited often herein provides details on methods and assumptions that were used by U.S. Forest Service and University of Idaho researchers to develop these estimates (see Cook and O'Laughlin 2011, in **References Cited** section on page 6).

[†] Estimates for sustainable supplies of forest biomass (i.e., forest health or fire hazard reduction thinning and logging residues) for public and private lands at roadside prices of $10 to $40 per dry ton by $5 increments, plus unused mill residues. This information was originally prepared in December 2009 by the University of Idaho's College of Natural Resources for the Western Governors' Association in fulfillment of Contract #20108-0840.

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Introduction

County-level forest biomass* estimates can help states develop wood bioenergy policies and work with local government officials to plan new wood bioenergy facilities. The U.S. Forest Service continues its efforts to improve the forest biomass supply estimates first made available in the “Billion-ton Supply” report (Perlack et al. 2005), and an update is expected in the near future. Meanwhile the forest biomass estimates herein (**Table 1**) fill an information gap and are likely accurate enough for planning purposes. These estimates could be used to supplement U.S. Forest Service CROP (Coordinated Resource Offering Protocol, see USFS 2011) project assessments of near-term supply plans from public lands where such information exists.

Table 1. Forest biomass supply for western states at roadside prices from $10 to $40 per dry ton.

State	*$10*	*$15*	*$20*	*$25*	*$30*	*$35*	*$40*
AZ	75,829	145,672	170,010	222,846	230,036	231,423	231,601
CA	1,904,370	2,733,657	3,155,708	3,425,863	3,538,764	3,569,309	3,602,018
CO	100,120	123,366	197,806	228,948	274,847	300,161	312,104
ID	796,410	853,887	992,527	1,208,995	1,338,801	1,395,282	1,429,463
KS	8,720	8,720	8,720	8,720	8,720	8,720	8,720
MT	646,769	729,152	1,030,913	1,272,212	1,417,237	1,477,018	1,533,464
NE	4,971	4,971	4,971	4,971	4,971	4,971	4,971
NV	4,799	7,791	7,791	7,871	7,871	7,943	7,943
NM	78,314	90,450	143,710	213,109	279,713	292,336	301,716
ND	265	265	265	265	265	265	265
OR	1,339,728	1,466,478	1,541,285	1,585,410	1,611,490	1,618,589	1,648,377
SD	95,407	95,407	97,729	103,466	108,020	108,020	108,020
TX	3,022	3,022	3,022	3,022	3,022	3,022	3,022
UT	37,927	42,887	50,736	77,294	98,360	104,654	116,094
WA	1,152,105	1,274,302	1,360,558	1,467,007	1,517,302	1,550,350	1,606,562
WY	83,644	105,728	126,208	156,919	183,664	196,388	197,171
Total	6,332,399	7,685,757	8,891,960	9,986,918	10,623,082	10,868,450	11,111,511

As illustrated in **Table 1**, west-wide forest biomass supply increases from about 6.3 million dry tons per year at a roadside price of $10 per dry ton to 11.1 million dry tons at a price of $40 per ton. Five states contribute most of the available forest biomass: California, Oregon, Washington, Montana, and Idaho. The tables in this report, starting on page 7, provide county-level estimates of forest biomass supply for one of the states in **Table 1**.

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* Forest biomass is a category of woody biomass that includes three components: [1] forest thinning (removal of small-diameter trees or brush to reduce hazardous fuels and/or improve forest health conditions), [2] forest residues (logging slash), and [3] mill residues.

Limitations

Before using the county-level tables that begin on page 7, one should know what they do not include. These results are based on U.S. Forest Service assumptions and models that in addition to "sustainability screens" excluded lodgepole pine and spruce-fir forest types from fire hazard thinning because stand-replacing fire is considered the norm in these forest types. Furthermore, moist forests west of the Cascade Range in Oregon and Washington received pre-commercial thinning rather than fire hazard reduction thinning. Further explanation is provided in the **Methods** section below, and in our final project report document (Cook and O'Laughlin 2011).

Background

For several years researchers have been developing and refining estimates of forest biomass supply in the western United States. In 2006, the Biomass Task Force for the Western Governors' Association (WGA) Clean and Diversified Energy project refined a national estimate of biomass supply from the U.S. Departments of Energy and Agriculture "Billion-ton Supply" report (Perlack et al. 2005) to obtain a west-wide estimate (WGA 2006). In 2008, the 2006 west-wide estimate was refined further to provide state-level supply estimates for western states (WGA 2008). These estimates were compiled from county-level estimates that were not published.

Objective

The objective of this project was to further refine the state-level forest biomass supply estimates for western states (WGA 2008) to county-level estimates, similar to published estimates for Idaho (see O'Laughlin 2009), and make county-level data available to interested parties. The county-level estimates of forest biomass supply are in easily-read tabular format and are reported for public and private lands at roadside prices of $10 to $40 per dry ton in $5 increments. This report is one of several made available by the Western Governors' Association for individual western states.

Methods

Although WGA (2008) estimates of biomass supply were reported at the state level, the model used to derive the estimates was based on county-level data provided from a U.S. Forest Service (USFS) Forest Inventory and Analysis (FIA) project. We obtained the unpublished, county-level data and spreadsheet model from Dr. Ken Skog of the U.S. Forest Service (Skog et al. 2007). Our county-level forest biomass estimates are derived from the same data using the same methods, models, and results from which the state-level estimates reported by the WGA (2008) were developed. We describe those methods briefly in the following paragraphs. Due to numerous complexities and assumptions of the modeling process used to create both the 2008 and 2006 WGA forest biomass supply estimates, the appropriate sections of each of those reports were appended to the final project report so users of this information would know exactly what they had (see Cook and O'Laughlin 2011, Appendices A and B).

The most important of these assumptions is that biomass removal is a byproduct, or secondary output, of other forest management objectives including forest health treatment, fire hazard reduction work, or the treatment of fuels after logging (see Cook and O'Laughlin 2011, Appendix A, p. 9). In the earlier WGA (2006) study, it was assumed that 50% off the removals would be used for higher-valued products and 50% available for use as fuel (see Cook and O'Laughlin 2011, Appendix B, pp. 16-17).

The later WGA (2008) study allocated a higher proportion of removals to higher-valued products (30 million dry tons ÷ 43 million dry tons = 70%; see Cook and O'Laughlin 2011, Appendix A, p. 10). It should be noted that previous estimation efforts by the WGA (2006) established "sustainability screens" that imposed constraints on forest management activities in order to protect soil productivity, wildlife habitat, biodiversity maintenance, and water quality. These screens reduced the "Billion-ton Supply" estimates for western states by about one-third. In addition, lodgepole pine and spruce-fir forest types were excluded from fire hazard thinning because stand-replacing fire is considered to be the norm in such forest types, and moist forests west of the Cascade Range in Oregon and Washington pre-commercially thinned instead of fire hazard reduction treatment (see Cook and O'Laughlin 2011, Appendix A, pp. 10-13).

Skog et al. (2007) used the USFS's Forest Inventory and Analysis (FIA) and Timber Products Output (TPO) databases to model forest biomass supply for western states.* In general, forest biomass in the model comes from four sources: [1] thinning of timberland with high fire hazard, [2] logging residue left behind after anticipated logging operations for conventional products, [3] general thinning on private woodlands, and [4] unused mill residue.†

Skog et al. (2007) modeled fire hazard thinnings using two tools developed by U.S. Forest Service researchers. First they used the Fuel Treatment Evaluator 3.0 (Skog and Miles 2006), applying several screens and treatments (see Cook and O'Laughlin 2011, Appendix A). Then they used the Fuel Reduction Cost Simulator (Fight et al. 2006) to estimate forest hazard thinning biomass quantities that would be available at various prices. Fire hazard thinning treatments were not applied to national forest timberlands in counties in western Oregon and Washington; instead a pre-commercial thinning treatment was applied.

We used the same supply assumptions that Skog et al. (2007) used in their Base Case estimates (WGA 2008; see Cook and O'Laughlin 2011, Appendix A). Fire hazard thinning

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* Western states include: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming.

† Skog et al. (2007) also included biomass from treatment of pinyon-juniper woodlands. However, it is excluded in our analysis because the price at which it enters the model ($60 per dry ton) is above our range of analysis ($10 to $40 per dry ton).

volumes are harvested over a period of 22 years, while private timberland thinning volumes for various purposes are harvested over a period of 30 years. Stumpage prices for fire hazard thinnings and logging residues are $0 and $2 per dry ton on public and private lands, respectively, while the cost of chipping biomass is $8 per dry ton for both public and private lands. There is no cost ($0) for unused mill residues.

Difference in modeling method for logging residue. One assumption used in estimating the amount of logging residue in the model is that as thinning to reduce fire hazard increases and general thinning on private land increases (including harvesting biomass for fuels) then the extent of traditional timber harvesting operations will decrease along with associated logging residue. Both the WGA 2008 estimates and our estimates account for this reduction in volume by decreasing logging residue used for fuels by one-quarter unit for each unit increase in biomass for fuels coming from new thinnings (WGA 2008, p. 16). However, the method by which we decrease logging residue is different than the way Skog et al. (2007) did, and our method results in slightly different estimates.

The model used by Skog et al. (2007) model divides biomass from thinnings and logging residue into two land ownership categories: public and private. They computed the reduction in logging residue by subtracting one-quarter unit for each new unit of thinning regardless of land ownership. We compute the reduction for public and private land ownerships separately. Despite the differences in computation, our results aggregated at the state level did not differ by more than 4% from the results attained by Skog et al. (2007).

Dividing "public" categories into federal and state categories. Both fire hazard thinning volumes and logging residue volumes are computed and reported by public and private land categories based on model results by Skog et al. (2007). It was our desire to further divide the public category into federal and state categories. We hypothesize that there are differences in the availability of forest biomass based on land ownership. Federal lands contain a greater proportion of public timberlands and timber volumes in western states than state lands do (Smith et al. 2004). However, federal timberlands tend to be managed under objectives and laws that are more restrictive of biomass removal (e.g., timber harvesting) compared to state trust timberlands that generally are managed for revenue production (Cook and O'Laughlin 2000).

Current forest conditions also may make a difference in biomass availability. Because state trust timberlands tend to be actively managed for revenue production, we hypothesize that there is less need to conduct fire hazard thinning operations on state lands compared to federal lands, which tend to be less actively managed (Koontz 1997). An informal survey of state forest land managers generally confirmed this hypothesis. Both of the above hypotheses led us to attempt to divide the "public" estimates into federal and state categories. Our attempts were unsuccessful for a variety of reasons (see Cook and O'Laughlin 2011, Appendix C); therefore, we report the results herein using only "public" and "private" categories.

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Forest biomass supply at roadside price of **$10** per dry ton

County	Fire hazard thinning		Private land thinning	Logging residue		Unused mill residues	TOTAL
	Public	Private		Public	Private		
Nebraska							
Adams	0	0	0	0	0	0	0
Antelope	0	0	0	0	0	0	0
Arthur	0	0	0	0	0	0	0
Banner	0	0	0	0	0	0	0
Blaine	0	0	0	0	0	0	0
Boone	0	0	0	0	0	0	0
Box Butte	0	0	0	0	0	0	0
Boyd	0	0	0	0	0	0	0
Brown	0	0	0	0	0	0	0
Buffalo	0	0	0	0	0	0	0
Burt	0	0	0	0	0	0	0
Butler	0	0	0	0	0	0	0
Cass	0	0	0	0	0	805	805
Cedar	0	0	0	0	0	0	0
Chase	0	0	0	0	0	0	0
Cherry	0	0	0	0	0	0	0
Cheyenne	0	0	0	0	0	0	0
Clay	0	0	0	0	0	0	0
Colfax	0	0	0	0	0	0	0
Cuming	0	0	0	0	0	3,720	3,720
Custer	0	0	0	0	0	0	0
Dakota	0	0	0	0	0	0	0
Dawes	0	0	0	0	0	0	0
Dawson	0	0	0	0	0	0	0
Deuel	0	0	0	0	0	0	0
Dixon	0	0	0	0	0	0	0
Dodge	0	0	0	0	0	0	0
Douglas	0	0	0	0	0	0	0
Dundy	0	0	0	0	0	0	0
Fillmore	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0
Frontier	0	0	0	0	0	0	0
Furnas	0	0	0	0	0	0	0
Gage	0	0	0	0	0	0	0
Garden	0	0	0	0	0	0	0
Garfield	0	0	0	0	0	0	0
Gosper	0	0	0	0	0	0	0
Grant	0	0	0	0	0	0	0
Greeley	0	0	0	0	0	0	0
Hall	0	0	0	0	0	0	0
Hamilton	0	0	0	0	0	0	0
Harlan	0	0	0	0	0	0	0

Hayes	0	0	0	0	0	0	0
Hitchcock	0	0	0	0	0	0	0
Holt	0	0	0	0	0	0	0
Hooker	0	0	0	0	0	0	0
Howard	0	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0	0
Johnson	0	0	0	0	0	0	0
Kearney	0	0	0	0	0	0	0
Keith	0	0	0	0	0	0	0
Keya Paha	0	0	0	0	0	82	82
Kimball	0	0	0	0	0	0	0
Knox	0	0	0	0	0	0	0
Lancaster	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	364	364
Logan	0	0	0	0	0	0	0
Loup	0	0	0	0	0	0	0
McPherson	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0
Merrick	0	0	0	0	0	0	0
Morrill	0	0	0	0	0	0	0
Nance	0	0	0	0	0	0	0
Nemaha	0	0	0	0	0	0	0
Nuckolls	0	0	0	0	0	0	0
Otoe	0	0	0	0	0	0	0
Pawnee	0	0	0	0	0	0	0
Perkins	0	0	0	0	0	0	0
Phelps	0	0	0	0	0	0	0
Pierce	0	0	0	0	0	0	0
Platte	0	0	0	0	0	0	0
Polk	0	0	0	0	0	0	0
Red Willow	0	0	0	0	0	0	0
Richardson	0	0	0	0	0	0	0
Rock	0	0	0	0	0	0	0
Saline	0	0	0	0	0	0	0
Sarpy	0	0	0	0	0	0	0
Saunders	0	0	0	0	0	0	0
Scotts Bluff	0	0	0	0	0	0	0
Seward	0	0	0	0	0	0	0
Sheridan	0	0	0	0	0	0	0
Sherman	0	0	0	0	0	0	0
Sioux	0	0	0	0	0	0	0
Stanton	0	0	0	0	0	0	0
Thayer	0	0	0	0	0	0	0
Thomas	0	0	0	0	0	0	0
Thurston	0	0	0	0	0	0	0
Valley	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0
Wayne	0	0	0	0	0	0	0

Webster	0	0	0	0	0	0	0
Wheeler	0	0	0	0	0	0	0
York	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	4,971	4,971

NOTE: In Kansas, Nebraska, North Dakota, and Texas woody biomass quantities appear only at $10 per dry ton. For these states, the U.S. Forest Service researchers assumed that all woody biomass is unused mill residues, and all of it entered the supply model at $10 per dry ton. Under this assumption at price levels between $15 to $40 per dry ton no additional woody biomass becomes available.

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