LD JELLISON

Biomass Fuel Resource Study

Clark County Central Campus

District Heating Co-Generation

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CHP EPA COMBINED HEAT AND POWER PARTNERSHIP

FUEL RESOURCE STUDY

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I. EXECUTIVE SUMMARY

Clark County is exploring the feasibility of a woody biomass district heating facility to be located at the county's downtown campus in Vancouver, Washington. The facility would utilize a biomass boiler system, and would have a boiler size that would produce 44,000 pounds per hour (PPH) of steam[1].

Clark County contracted with LD Jellison, Inc. (LD Jellison), a Washington forest products and renewable energy consulting firm, to conduct this Fuel Resource Study to provide a third-party independent analysis of the available woody biomass within the resource areas for the proposed facility.

LD Jellison has more than 100 combined years of experience in the forest products industry and has performed numerous fuel resource studies and biomass feasibility analyses throughout the United States.

In accordance with its scope of services, this study analyzed only the potential biomass available as fuel for the biomass facility. LD Jellison analyzed and conducted interviews with (1) public and private commercial timberland owners, (2) biomass fuel processors and suppliers, and (3) biomass fuel consumers within the resource area. The data from these industry sources was collected, reviewed, and analyzed in order to provide the following analyses:

(1) **A qualitative analysis** determined that the potentially available woody biomass within the potential resource areas is composed of an estimated combined aggregate of 8% of secondary mill residues and urban wood waste.

(2) **A quantitative analysis** determined that approximately 489,085 BDT[2] of accessible woody biomass are potentially available annually from public and private commercial timberlands within the study resource areas.

(3) **An economic analysis** of the projected cost of retrieving the potentially available fuel for the proposed biomass facility determined that the current average delivered price for forest residual biomass (hogfuel) within the potential resource area is approximately $24 per BDT, and that the average long-term forecast delivered price (assuming standard industry price escalators) is estimated to be within the range of $35 to $45 per BDT of hogfuel.

(4) **A competition analysis** reviewed current competitors for woody biomass for the biomass facility within the study resource areas.

After conducting these analyses, this study estimates that there is approximately 489,085 BDT of biomass fuel available annually from within the study area, and that Clark County's estimated 40,000 BDT annual fuel requirement would be reasonably available given the estimated total fuel supply and competing interests within the study resource area.

[1] The biomass boiler system would consume an estimated 40,000 bone dry tons (BDT) of woody biomass annually

[2] A bone dry ton (BDT) is the equivalent of 2,000 pounds of woody material that contains 0% moisture.

II. STUDY OVERVIEW

This study is designed to investigate and analyze four main aspects of the feasibility of acquiring woody biomass for fuel (feedstock) in the defined resource area for the proposed biomass facility:

1) a **qualitative analysis** of the potentially available fuel for the proposed biomass facility within the potential resource areas;

2) a **quantitative analysis** of the potentially available fuel for the proposed biomass facility within the potential resource areas;

3) an **economic analysis** of the projected cost of retrieving the potentially available fuel for the proposed biomass facility from within the potential resource areas; and

4) a **competition analysis** of the current competitors for potentially available fuel for the proposed biomass facility within the potential resource areas.

The purpose of this study is to determine whether from the standpoint of the annual fuel requirement of approximately 40,000 BDT, if the proposed 44,000 PPH biomass boiler system is economically viable and feasible, and whether the fuel can be procured in such a way as to positively promote the sustainability of the forests and environment.

In this study, we conducted interviews with public and private landowners, biomass fuel processors and suppliers, and biomass fuel consumers within the study resource areas. We also obtained and analyzed information from a variety of industry sources, including the USDA Forest Service, the National Renewable Energy Laboratories of the U.S. Department of Energy, the Washington Department of Ecology, Washington State University, University of Washington, the Washington Department of Natural Resources, Oregon Department of Forestry, the Northwest Power and Conservation Council, Atterbury Consultants, Inc., RISI, Inc., various county graphical information services (GIS), third-party consultants, and local news media sources.

LD Jellison made the following assumptions in accordance with performing the analyses for this study and developing conclusions:

1. Woody biomass would be the sole fuel source for the biomass facility.

2. The facility would consume approximately 40,000 BDT of woody biomass annually.

3. The site for the proposed woody biomass facility (Site) would be located on Clark County's downtown campus in Vancouver, Washington.

4. The potential resource areas for available fuel covers everything within a 90 minute haul-time of the Site, as shown on Figure 1 (Study Resource Area),[3] and the following eight counties that make up a majority of the public and private commercial timberlands within the Study Resource Area: Clark County, Cowlitz County, Columbia County, Washington County, Multnomah County, Yamhill County, Marion County, and Clackamas County (Study Resource Counties).

[3] A full 90-Minute Haul Time Map is included in Appendix A.

5. The forecasted long-term current average and inflation-adjusted price for forest residual biomass hogfuel within the study resource areas cannot exceed $45 per BDT in order for the facility to be economically viable and feasible.

6. All information and data collected by or provided to LD Jellison in conducting this study are true, accurate, and complete.

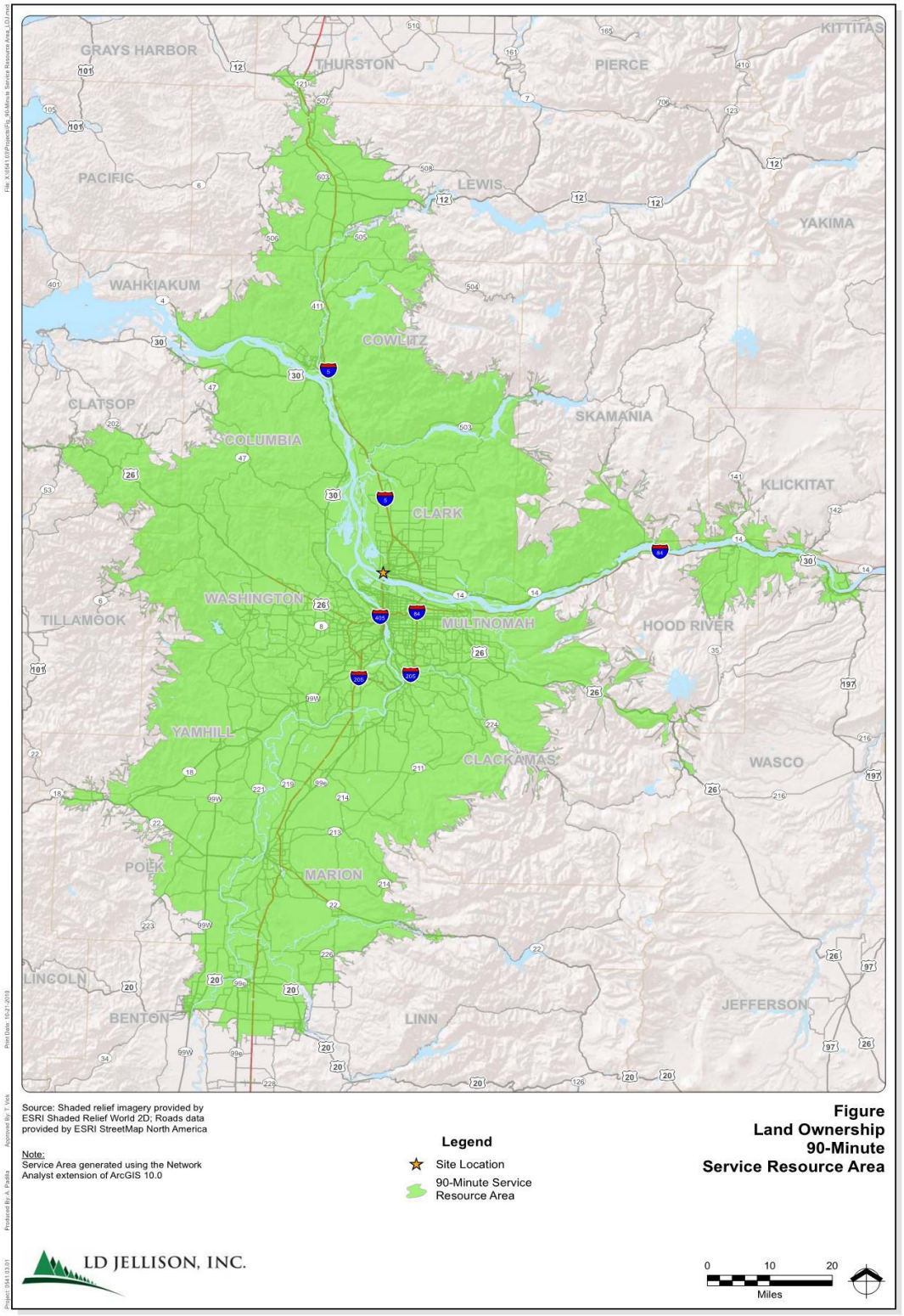

Figure 1: Study Resource Area (90 Minute Haul Time). Source: LD Jellison.90 Minute Haul Time). Source: LD Jellison.

III. QUALITATIVE ANALYSIS: FUEL COMPOSITION AND QUALITY

The forest products industry recognizes four general types of woody biomass: forest residues, primary mill residues, secondary mill residues, and urban wood waste. It is recommended that a maximum of 30% of secondary mill residues and urban wood residues are used to fuel the proposed biomass facility.[4] The following sections describe each of the four types of woody biomass and analyze the availability of each general type of woody biomass in the Study Resource Area.

Forest Residues

Forest residues include logging residues and other removable material left after carrying out silviculture operations and site conversions. Logging residue comprises unused portions of trees cut or killed by logging and left in the woods.[5] Figure 2 illustrates the National Renewable Energy Laboratory's (NREL) 2009 estimate of the national distribution of forest residues, county-by-county across the entire United States.

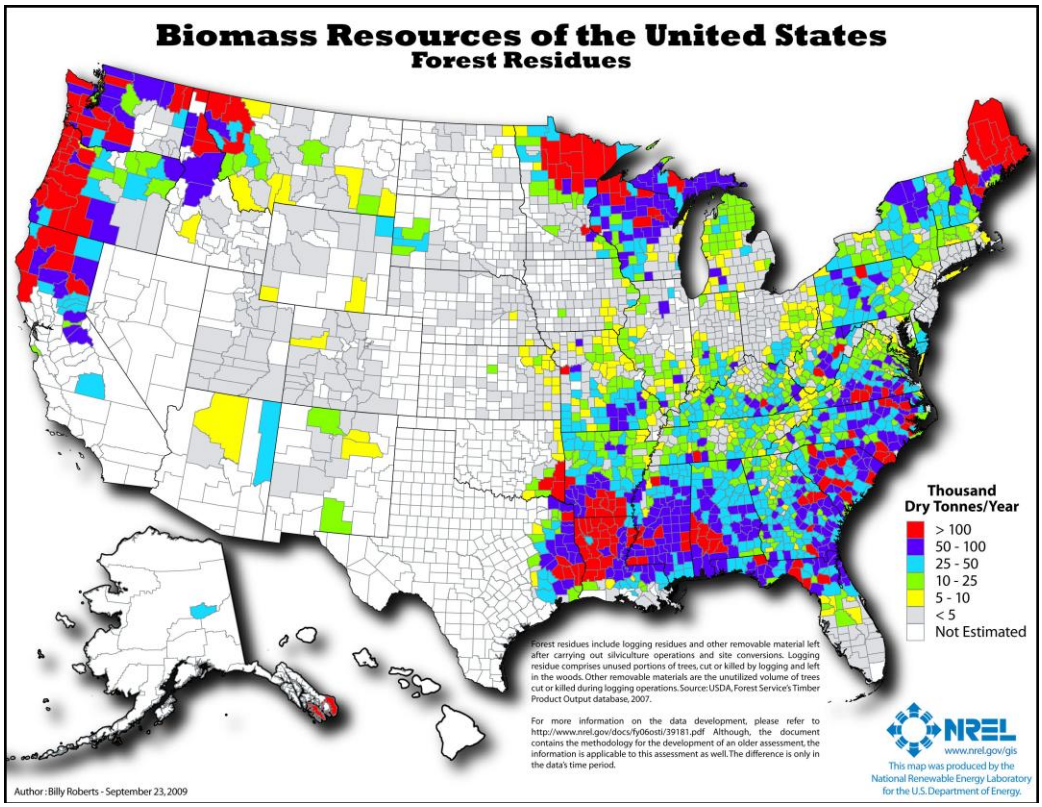

Figure 2: Distribution of forest residues in the United States. Source: National Renewable Energy Laboratories, 2009.

[4] It is essential that the urban wood residues, as with all other fuels, meet the fuel quality and specification standards of the boiler manufacturer in order for the Clark County biomass facility to be successful. While the qualitative analysis of the potentially available woody biomass within the study resource areas addresses the qualities of the types of the fuels, this study did not analyze and sample the actual fuels proposed for the biomass technology and facility.

[5] United States Department of Agriculture/National Renewable Energy Laboratory definition of forest residues.

As shown in Figure 2, high concentrations of forest residues exist in the Study Resource Counties.

Primary Mill Residues

Primary mill residues include wood materials (coarse and fine) and bark generated at manufacturing plants (primary wood-using mills) when round wood products are processed into primary wood products such as slabs, edgings, trimmings, sawdust, veneer clippings and cores, and pulp screenings.[6] Figure 3 illustrates the national distribution of primary mill residues, county-by-county across the United States, as estimated by NREL in 2009.

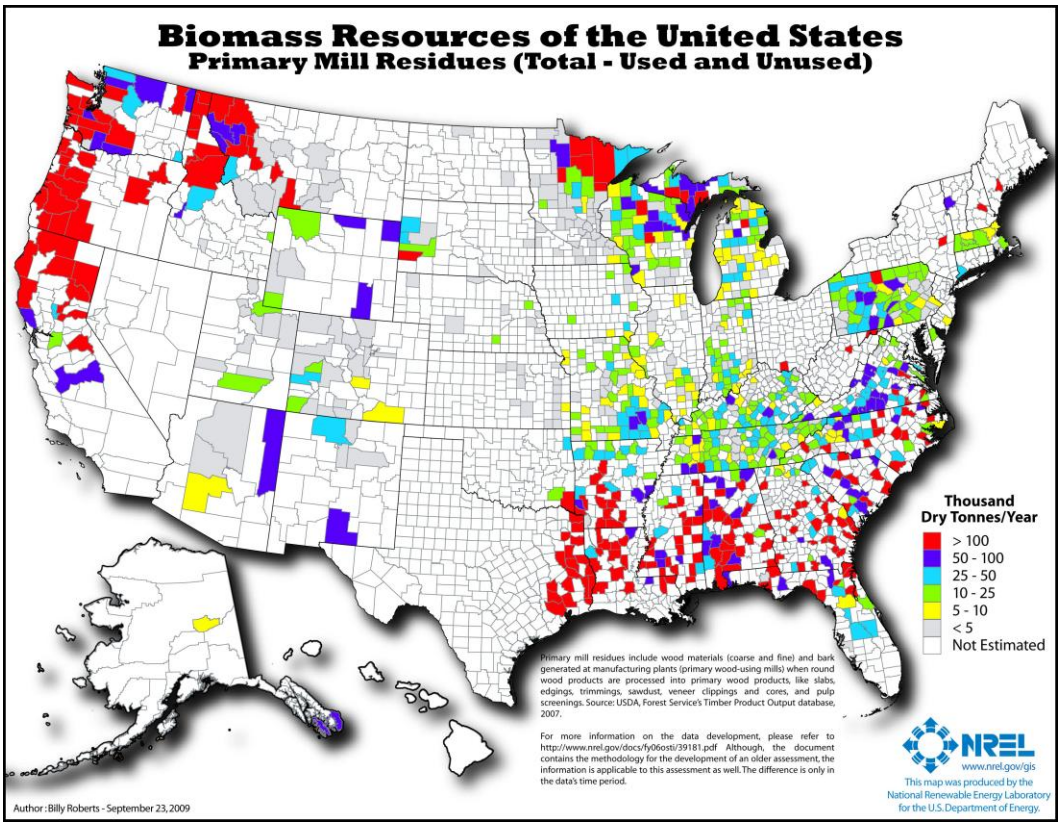

Figure 3: Distribution of primary mill residues in the United States. Source: National Renewable Energy Laboratories, 2009.

As shown in Figure 3, high concentrations of primary mill residues exist in the Study Resource Counties.

[6] NREL definition for primary mill residues.

Secondary Mill Residues

Secondary mill residues include wood scraps and sawdust from woodworking shops, furniture factories, wood container and pallet mills, and wholesale lumberyards.[7] Figure 4 illustrates the national distribution of secondary mill residues county-by-county across the United States, as estimated by NREL in 2009.

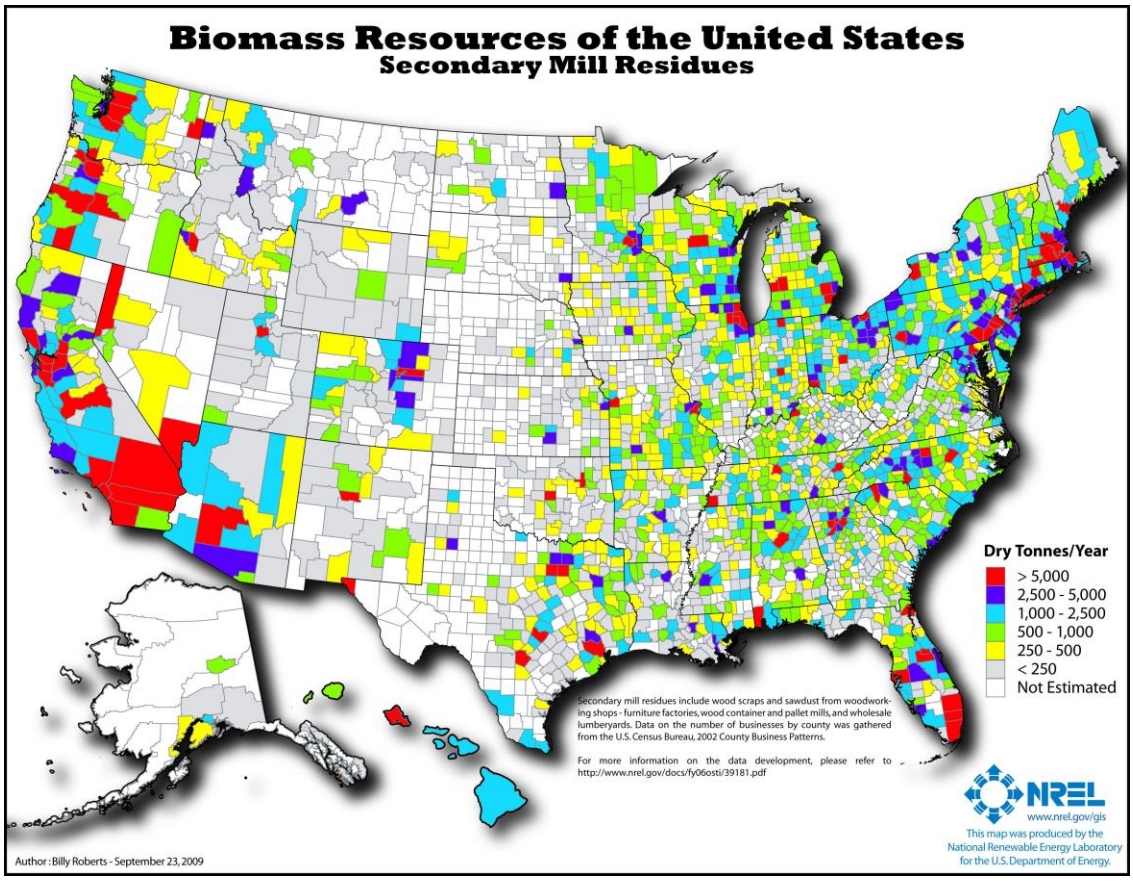

Figure 4: Distribution of secondary mill residues in the United States. Source: National Renewable Energy Laboratories, 2009.

As shown in Figure 4, moderate concentrations of secondary mill residues exist in the Study Resource Counties.

Urban Wood Residues

Urban wood residues include wood residues from municipal solid waste (wood chips and pallets), tree trimming from utilities or from private tree companies, and construction and demolition sites.[8] Figure 5 illustrates the national dispersal of urban wood residues county-by-county across the United States, as estimated by NREL in 2009.

[7] NREL definition for secondary mill residues.
[8] NREL definition for urban wood residues.

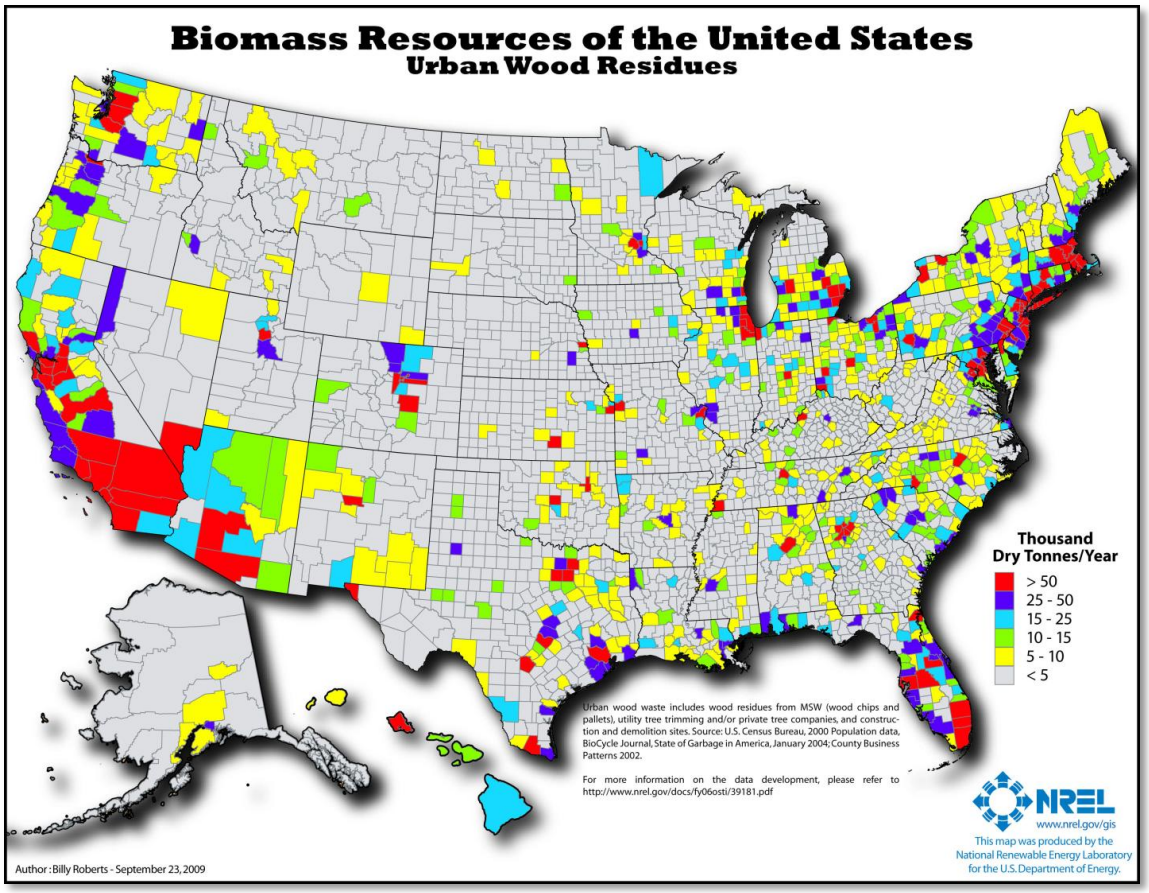

Figure 5: Distribution of urban wood residues in the United States. Source: National Renewable Energy Laboratories, 2009.

As shown in Figure 5, moderate concentrations of urban wood residues exist in the Study Resource Counties.

Woody Biomass Composition

According to 2005 NREL estimates, the composition of all woody biomass (forest residues, primary mill residues, secondary mill residues, and urban wood waste) available annually in Washington and Oregon is shown on Figures 6 and 7.[9]

[9] Anelia Milbrandt. "A Geographic Perspective on the Current Biomass Resource Availability in the United States." National Renewable Energy Laboratory, Golden CO, December 2005.

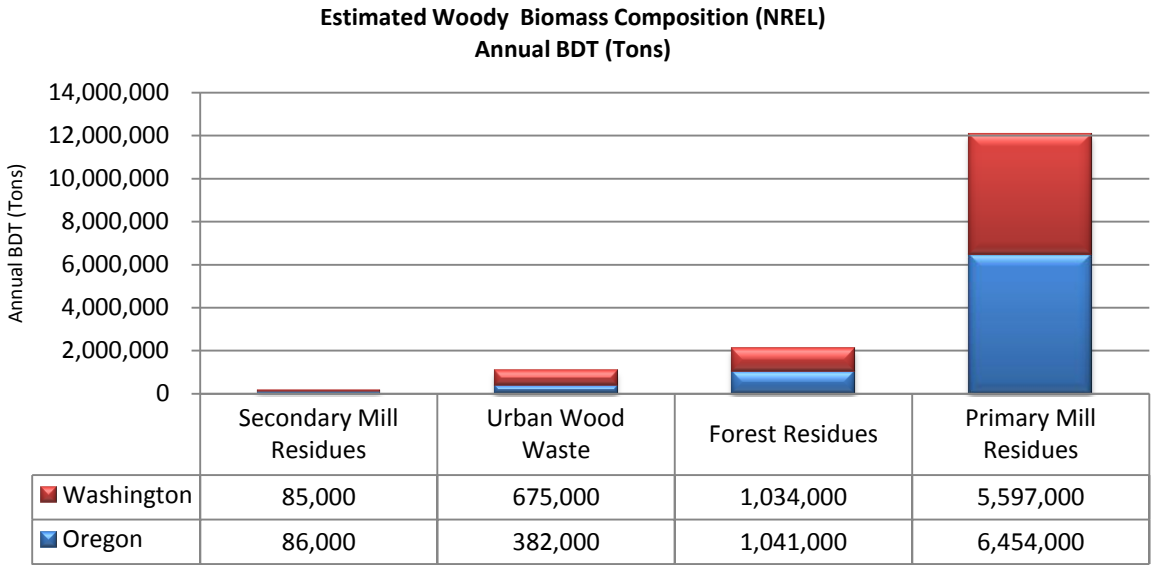

Figure 6: Estimated Woody Biomass Composition (NREL) in Washington and Oregon. Source: National Renewable Energy Laboratories, 2005.

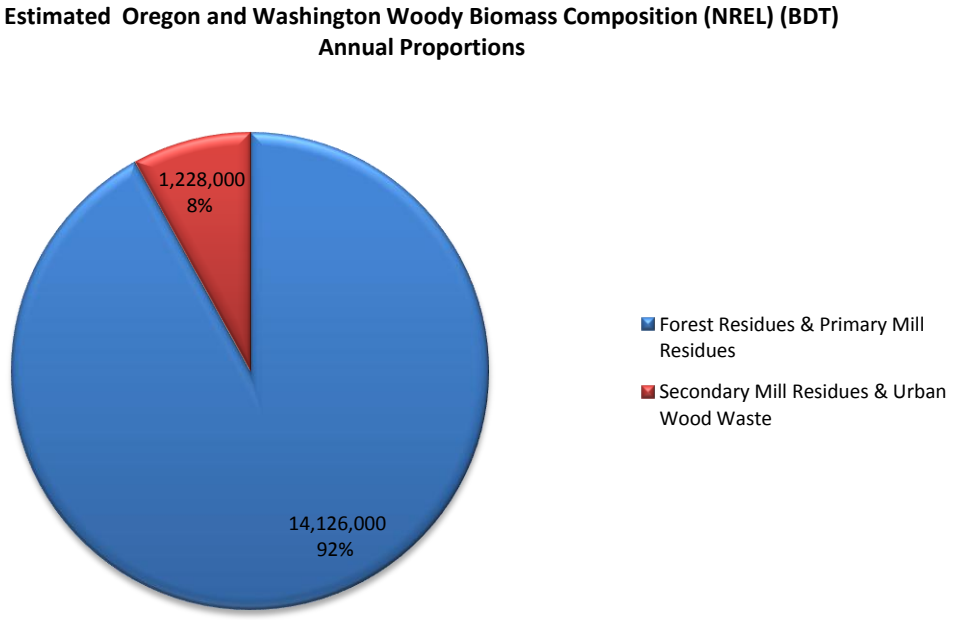

Figure 7: Estimated Washington and Oregon Woody Biomass Composition (NREL). Source: National Renewable Energy Laboratories, 2005.

In addition to the 2005 NREL statewide estimate, a December 2005 Washington Department of Ecology (WDOE) and Washington State University (WSU) study estimated the amount of woody biomass in

Washington[10] to be 8,937,743 BDT of woody biomass available annually for energy use.[11] The results of the WDOE/WSU study are depicted on Figures 8 and 9.

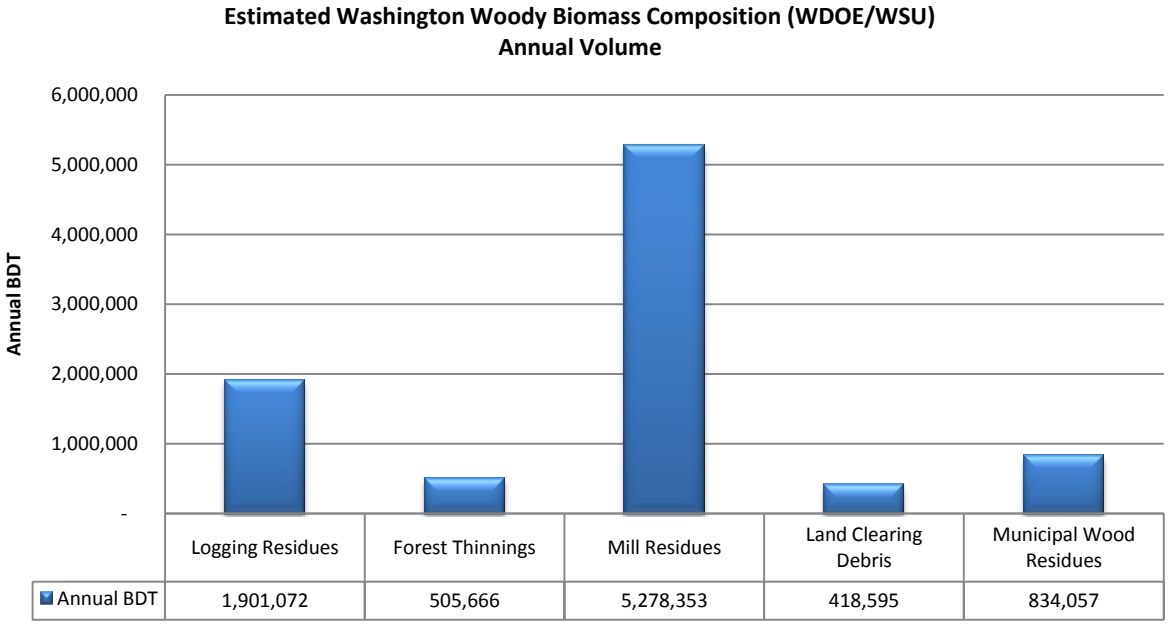

Figure 8: Estimated Washington Woody Biomass Composition (WDOE/WSU). Source: Washington Department of Ecology/Washington State University, 2005.

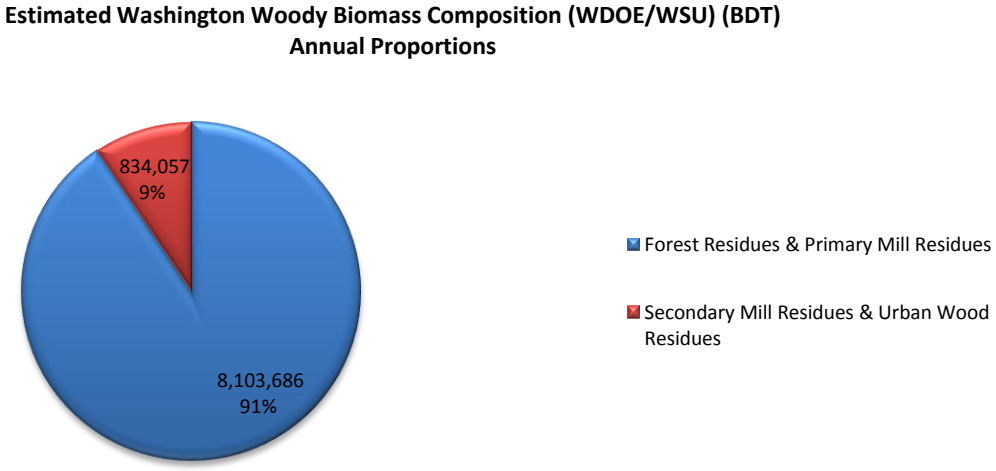

Figure 9: Estimated Washington Woody Biomass Composition (WDOE/WSU). Source: WDOE/WSU, 2005. *WDOE/WSU definitions approximated to NREL definitions of forest residues, primary mill residues, secondary mill residues and urban wood residues.

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[10] Biomass Inventory and Bioenergy Assessment: An Evaluation of Organic Material Resources for Bioenergy Production in Washington State. Mark R. Fuchs, C. Frear et al., December 2005, revised August 2006,

[11] The 2005 Washington Department Of Ecology/Washington State University study did not examine secondary mill residues, which were addressed in the NREL study. As with virtually any estimate of potentially available woody biomass, estimates will vary depending on assumptions of the area needing treatment, the volume removed per acre, the proportion of volume that is biomass versus commercial timber, and the number of years over which treatments are completed.

Assuming that (1) logging residues, forest thinnings, land clearing and debris are substantively equal to forest residues, (2) mill residues are substantively equal to primary mill residues, and (3) urban municipal wood residues is substantively equal to secondary mill residues and urban wood waste, then as a proportion this equates to approximately 91% forest residues and primary mill residues and 9% secondary mill residues and urban wood waste, which is approximately equal to the 10% combined aggregate threshold for secondary mill residuals and urban wood residues.

Summary of Qualitative Analysis

It is recommended that a maximum composition of 10% combined aggregate of secondary mill residues and urban wood residues are used for fuel for the proposed biomass facility. Based on the analysis of available data from the 2005 NREL and 2005 WDOE/WSU studies and our interviews with biomass fuel processors and suppliers, this study concluded that the makeup of the potentially available woody biomass within the study resource area is likely comprised of an estimated aggregate 8% of secondary mill residues and urban wood residues. This means that the composition of woody biomass residues within the study resource area is not overly weighted by secondary mill residues and urban wood residues.

IV. QUANTITATIVE ANALYSIS: FUEL SUPPLY

This analysis considers ownership classes, timberland locations, timberland composition statistics, existing biomass assessments, and historical harvesting trends. In this study, we contacted both public and private landowners, biomass suppliers and processors, biomass consumers, fuel processors, and in-woods grinders within the study resource areas in order to determine the current and anticipated supply and demand for woody biomass. This information, in addition to data analyzed from various governmental agencies and industry sources, allowed us to estimate the current amount of forest residues, primary mill residues, secondary mill residues, and urban wood residues within the study resource areas on an ongoing basis. By analyzing the current supply and demand for woody biomass, we were able to asses whether there is sufficient biomass within the study resource areas, given the current demand, in order to adequately support the proposed biomass facility.

Forest Residues

Land Ownership Analysis

Using geographic information system (GIS) software and data obtained from the USDA Forest Service, this study estimates that the Study Resource Area is composed of approximately 1,827,339 acres of public and private timberland. Figure 10 depicts a map showing the distribution of timberland within the Study Resource Area,[12] while Table 1 depicts the public and private commercial timberland ownership in terms of acreage and percentage distribution.

[12] A full 90-Minute Haul Time Timberland Ownership Map is included in Appendix B.

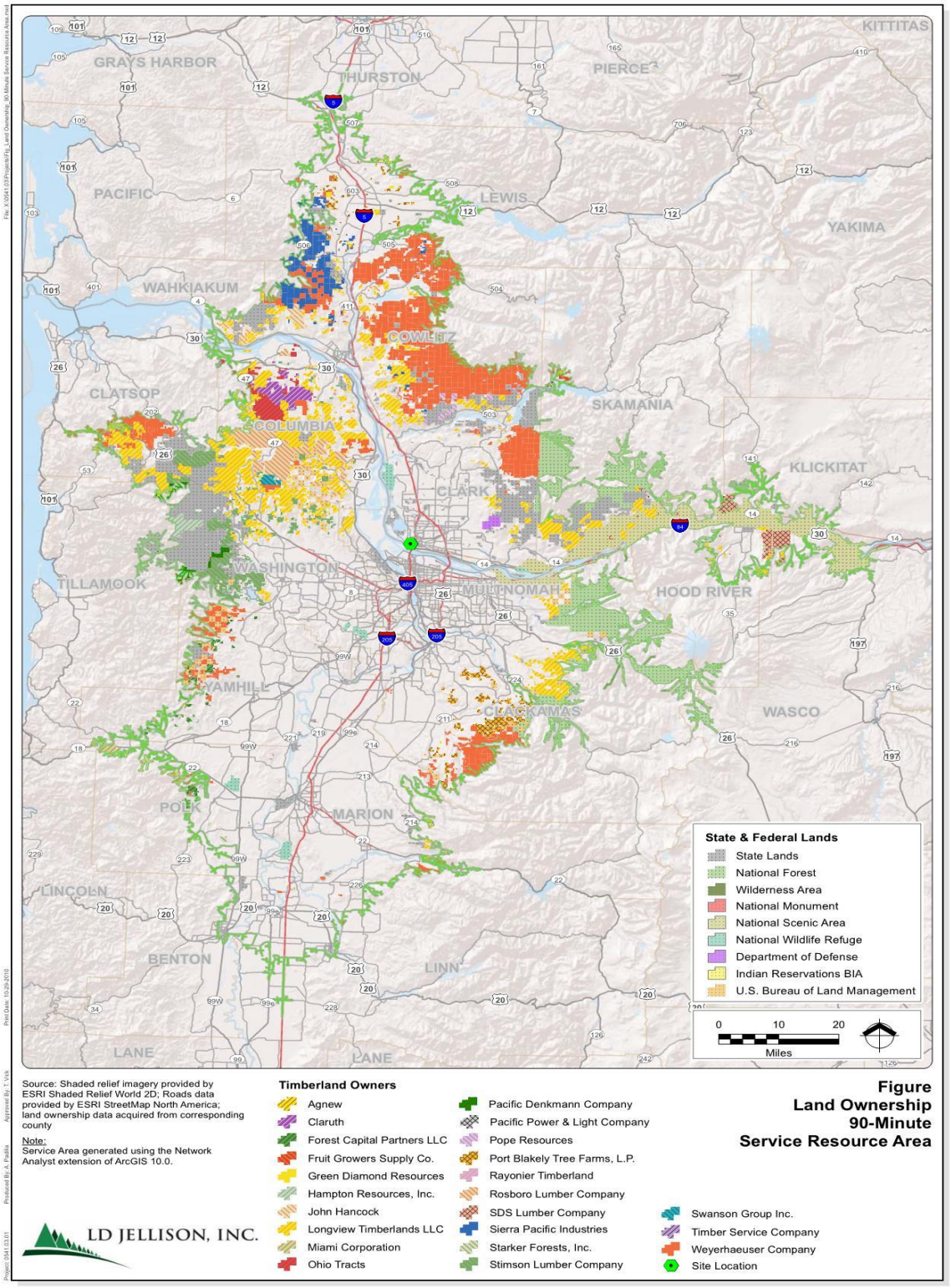


Figure 10: Study Resource Area Timberland Ownership Map. Source: LD Jellison.

Table 1: Study Resource Area Timberland Ownership. Source: LD Jellison.

Public Timberland Owners		
Landowner	**Acreage**	**Percentage**
State	321,777	46.1%
Federal	376,966	53.9%
Total Public Timberland	**698,743**	**100.0%**
Private Timberland Owners		
Landowner	**Acreage**	**Percentage**
Agnew	487	0.0%
Claruth	17,345	1.5%
Forest Capital Partners LLC	8,639	0.8%
Fruit Growers Supply Co.	1,029	0.1%
Green Diamond Resources	881	0.1%
Hampton Resources	12,507	1.1%
John Hancock	12,995	1.2%
Longview Timberlands LLC	377,274	33.4%
Miami Corporation	3,059	0.3%
Ohio Tracts	16,502	1.5%
Pacific Denkmann Company	5,321	0.5%
Pacific Power & Light Company	222	0.0%
Pope Resources	5,878	0.5%
Port Blakely Tree Farms, L.P.	55,832	4.9%
Rayonier Timberland	40	0.0%
Rosboro Lumber Company	86,183	7.6%
SDS Lumber Company	17,106	1.5%
Sierra Pacific Industries	48,703	4.3%
Starker Forests, Inc.	1,096	0.1%
Stimson Lumber Company	99,687	8.8%
Swanson Group Inc.	5,869	0.5%
Timber Service Company	45	0.0%
Weyerhaeuser Company	351,897	31.2%
Total Private Timberland	**1,128,596**	**100.0%**

Figure 11 shows the proportional acreage distribution of public and private timberland within the Study Resource Area in relationship to the total amount of timberland.

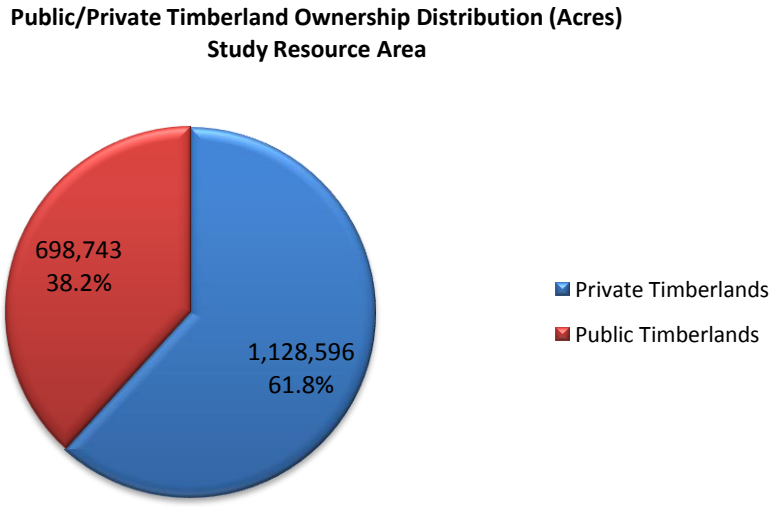


Figure 11: Public/Private Timberland Ownership Distribution for Study Resource Area. Source: USDA Forest Service.

Timberland Analysis

A factor to be considered in estimating the amount of potential woody biomass from private timberland is the diameter of the trees. The diameter at breast height[13] (DBH) is used in conjunction with species type to calculate the volume of potential biomass that could be collected from a stand of trees. DBH is a determining factor in defining merchantable timber. When more merchantable timber exists in a stand of trees, the potential for logging slash increases. Figures 12 and 13 illustrate the distribution of trees on public and private timberland according to diameter class in accordance with USDA Forest Service acreage estimates.

[13] Diameter at Breast Height (DBH) is defined by the USDA Forest Service as being the diameter for the tree stem measured at 4.5 feet above the ground on the uphill side of a tree.

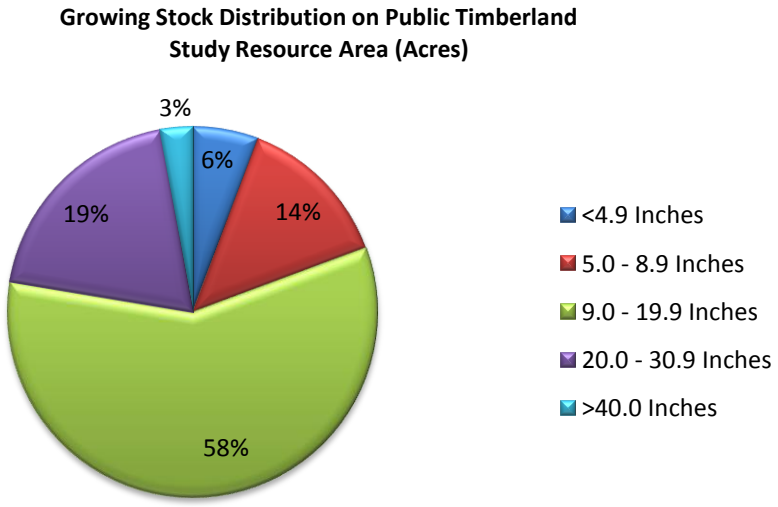


Figure 12: Growing Stock Trees Distribution on Public Timberland for Study Resource Area. Source: USDA Forest Service.

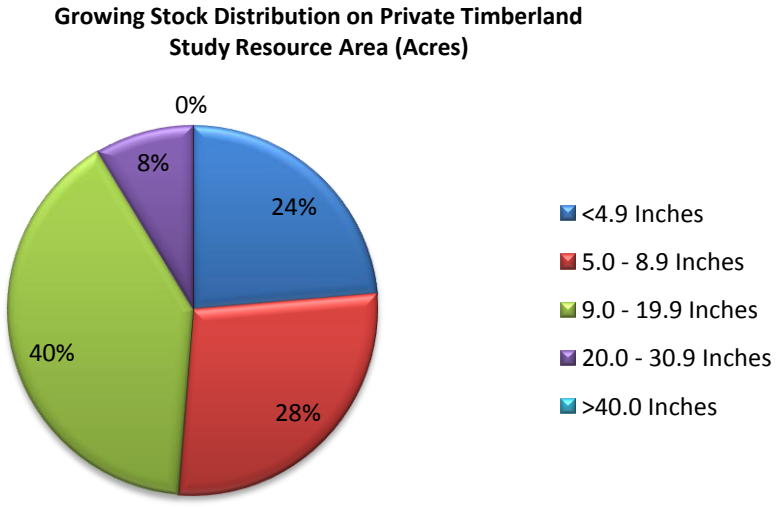


Figure 13: Growing Stock Trees Distribution on Private Timberland for Study Resource Area. Source: USDA Forest Service.

The public and private timberlands within the Study Resource Area can further be divided into separate stocking classes of growing-stock trees. Growing-stock trees, as defined by the USDA Forest Service,[14] are live trees at least 5.0 inches DBH that meet merchantability requirements. The five stocking classes identified by the USDA Forest Service are overstocked, fully stocked, medium stocked, poorly stocked, and nonstocked. Figures 14 and 15 illustrate the dispersal of the stocking classes among the public and private timberland in the Study Resource Area.

[14] FIA Glossary, May 2006.

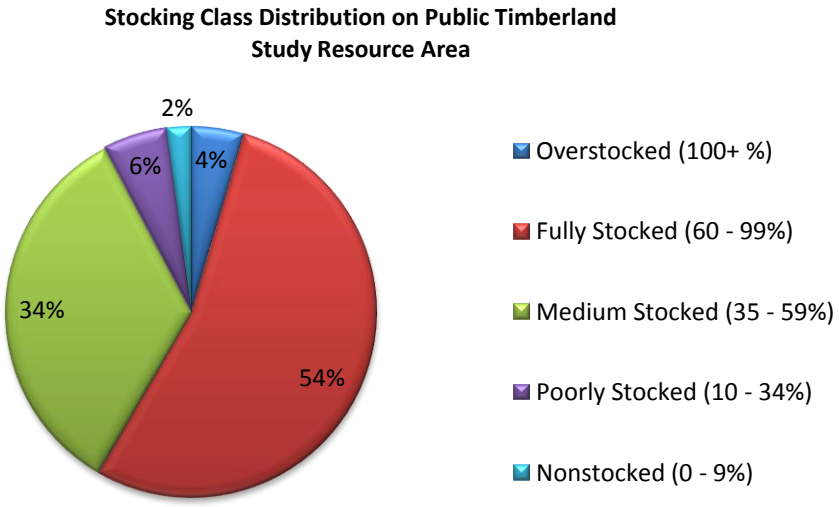


Figure 14: Stocking Class Distribution on Public Timberland for Study Resource Area. Source: USDA Forest Service.

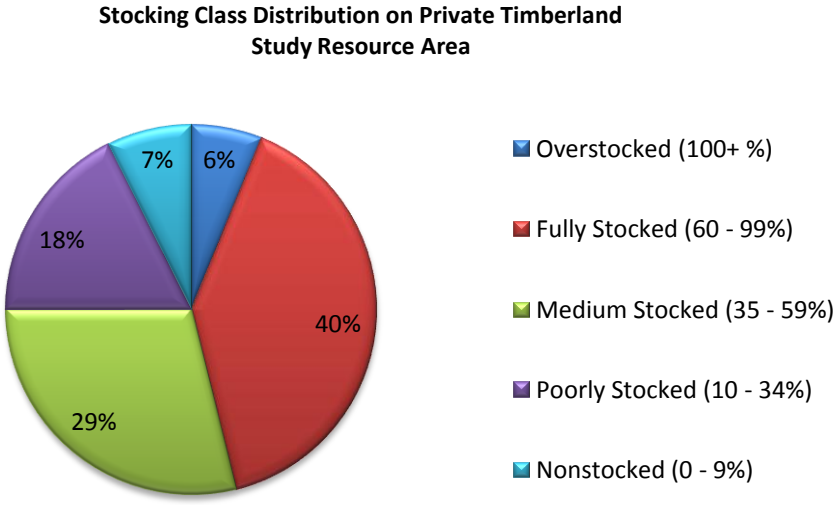


Figure 15: Stocking Class Distribution on Private Timberland for Study Resource Area. Source: USDA Forest Service.

The composition of species types assists in determining the density and volume of the retrievable woody biomass from logging and thinning operations. Figures 16 and 17 present the ratio of hardwoods to softwoods (based on the total number of live trees) in accordance with USDA Forest Service estimates.

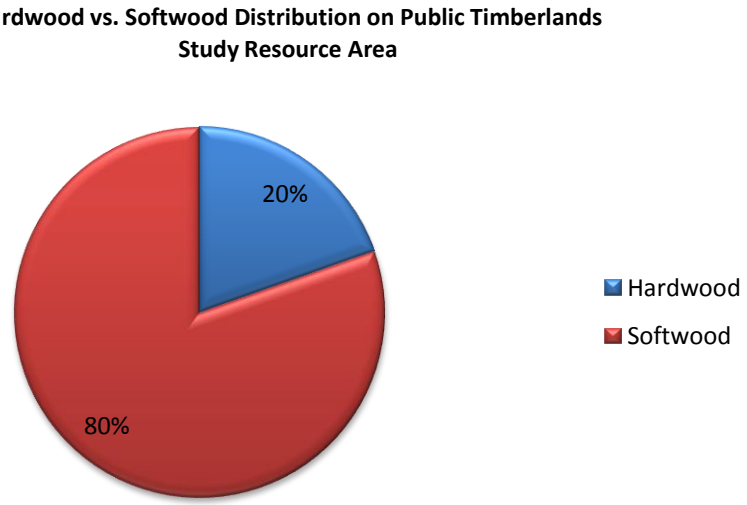


Figure 16: Hardwood vs. Softwood Distribution on Public Timberland for Study Resource Area. Source: USDA Forest Service.

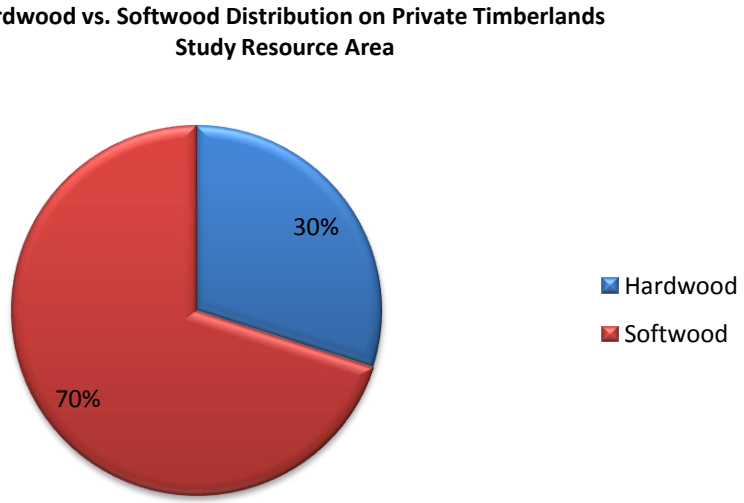


Figure 17: Hardwood vs. Softwood Distribution on Private Timberland for Study Resource Area. Source: USDA Forest Service.

The vast majority of live trees (80% of public timberlands and 70% of private timberlands) are classified as softwoods, which the USDA Forest Service defines as coniferous trees, usually evergreen, and having needles or scale-like leaves.[15]

Figures 18 and 19 display the proportional distributions of the various tree species composing the private timberland located in the Study Resource Area (also based on the total number of live trees) in accordance with USDA Forest Service estimates.

[15] FIA Glossary, May 2006.

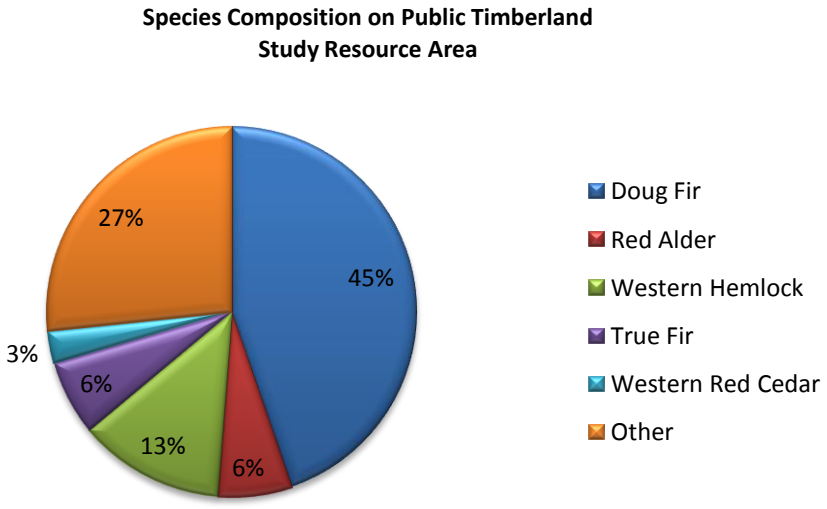


Figure 18: Species Composition on Public Timberland for Study Resource Area. Source: USDA Forest Service.

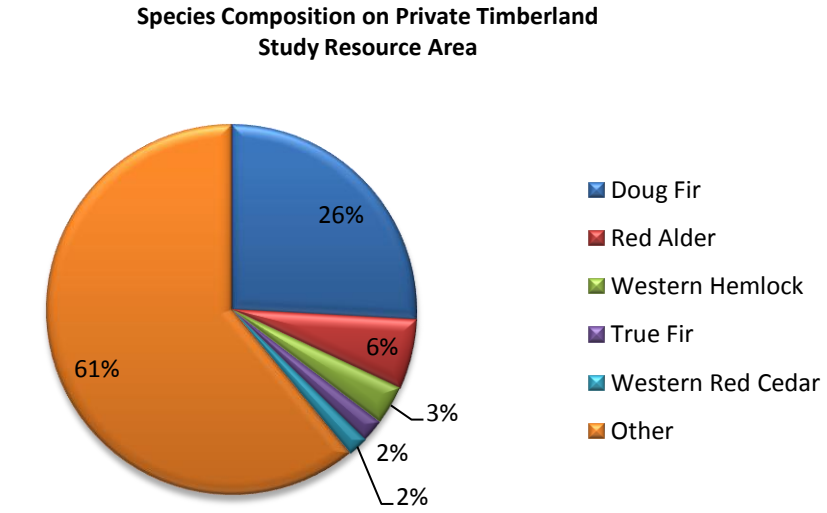


Figure 19: Species Composition on Private Timberland for Study Resource Area. Source: USDA Forest Service.

Of the softwoods growing in the Study Resource Area, approximately 45% of public timberland and 26% of private timberland belong to the Douglas Fir species. According to the California Department of Forestry, the typical heating value for Douglas Fir is approximately 9,000 British thermal units (BTU) per pound, which is slightly higher than the approximately 8,000 BTU/pound heating value for a hardwood such as maple.[16]

This study further analyzed the stand age for the Study Resource Area in order to assess the possibility for classification of private timberland old-growth timber. As seen in Figure 20 and Figure 21 below, an

[16] California Department of Forestry. "Wood Energy in California." 1981.

estimated 18% of all public timberland stands are greater than 100 years old, whereas an estimated 1% of private timberland is in excess of 100 years old using the information analyzed from the USDA Forest Service.

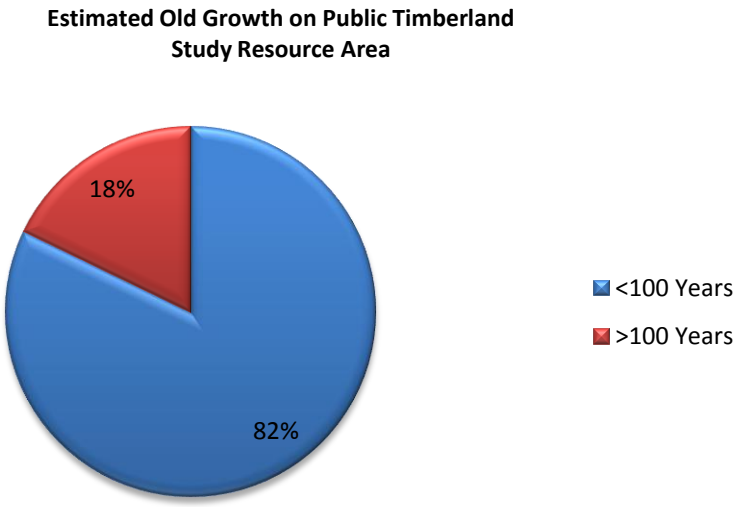


Figure 20: Estimated Old Growth Stands on Public Timberland for Study Resource Area. Source: USDA Forest Service.

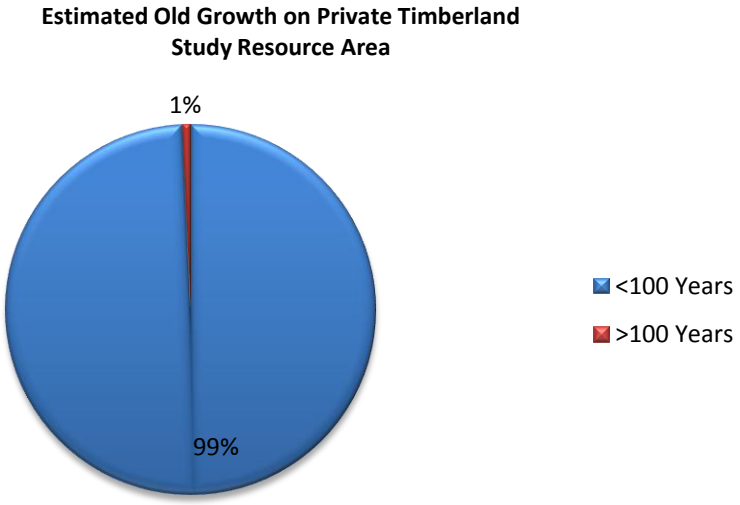


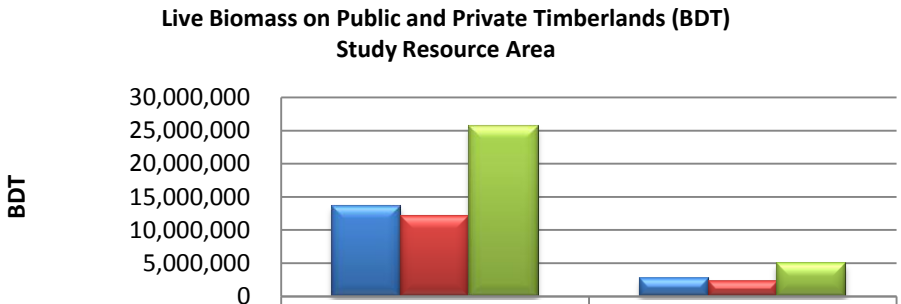
Figure 21: Estimated Old Growth Stands on Private Timberland for Study Resource Area. Source: USDA Forest Service.

According to our analysis of the data obtained by the USDA Forest Service, we estimate that there are 25,609,221 BDT of live forest biomass located on public and private timberland within the Study Resource Area. According to the definition provided by the USDA, this number includes the complete above-ground weight of wood and bark in live trees at least 1.0 inch DBH, not including all foliage.[17] It

[17] FIA Glossary, 2006.

also includes the weight of wood and bark in lateral limbs and secondary limbs and twigs from sapling-size trees but not from poletimber and sawtimber-size trees.

In order to more accurately assess the amount of woody biomass material economically available for recovery, this study first narrowed the amount of woody biomass to that located less than 200 feet from an existing road and on land with less than a 40% slope. Industry standards indicate that this material is too costly to recover at this time. Applying these filters, the amount of total live woody biomass within these economically retrievable areas within the Study Resource Area is estimated to be 4,901,441 BDT in accordance with USDA Forest Service data. Figure 22 below provides a summary of the estimated total live forest biomass and estimated accessible total live forest biomass across the various public and private timberlands.

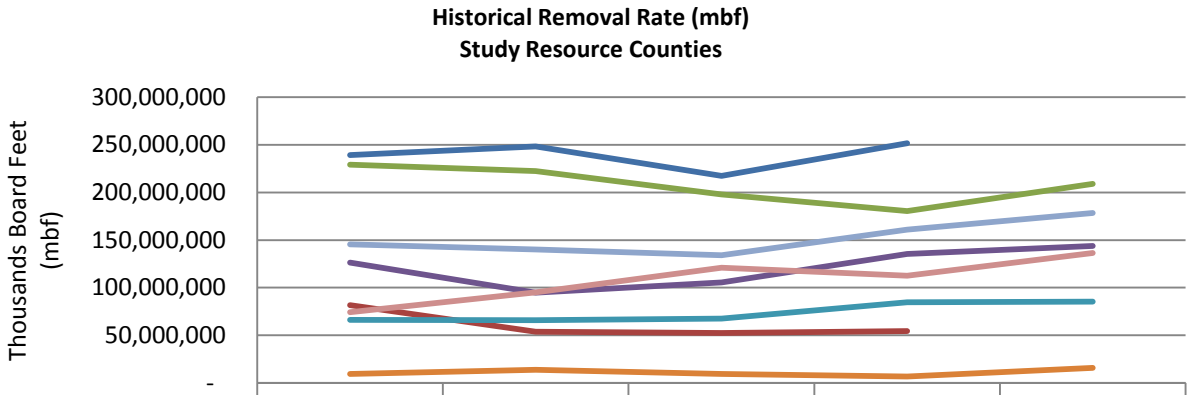


	Total Live Biomass	Accessible Total Live Biomass
Public Timberland	13,616,946	2,652,679
Private Timberland	11,992,275	2,248,761
Total Public & Private Timberland	25,609,221	4,901,441

Figure 22: Live Biomass on Public and Private Timberlands for Study Resource Area. Source: USDA Forest Service.

Historical Harvest Analysis

Historical timber production is an important part of the statistical analysis of the Study Resource Area because it provides insight into the future potential for biomass retrieval. Because some counties have only a small portion of timberland falling within the Study Resource Area, harvest data was narrowed to the eight Study Resource Counties. Figure 23 shows the historical volume of timberland harvesting data for each of the Study Resource Counties in accordance with data obtained from the Washington Department of Natural Resources (Washington DNR) and the Oregon Department of Forestry (ODF).



	2000	2001	2002	2003	2004
Cowlitz	239,098,000	248,132,000	217,327,000	251,547,000	
Clark	81,761,000	53,887,000	52,408,000	54,606,000	
Columbia	228,944,000	222,323,000	198,002,000	180,573,000	208,851,000
Clackamas	126,383,000	94,622,000	105,562,000	135,547,000	143,811,000
Marion	66,234,000	65,883,000	67,724,000	84,588,000	85,252,000
Multnomah	9,638,000	13,803,000	9,441,000	6,667,000	15,840,000
Washington	145,601,000	140,164,000	134,201,000	161,074,000	178,353,000
Yamhill	74,237,000	94,991,000	120,809,000	112,507,000	136,266,000

Figure 23: Historical Removal Rates for Study Resource Counties. Source: Washington Department of Natural Resources, 2008, and Oregon Department of Forestry, 2005. (2009 removal rates data, from Washington Department of Natural Resources, for Washington state counties omitted for comparison purposes – see Table 2 for 2009 data.)

Potential Forest Residues

By analyzing the historical harvest data from Washington DNR and ODF for the Study Resource Counties in conjunction with data from the USDA Forest Service from 2009, this study estimated the total potential amount of forest residues produced from logging operations by dividing the gross weight of merchantable biomass located in the Study Resource Counties by the gross volume of sawtimber located in the Study Resource Area, and multiplying the harvest data from either 2004 or 2009, depending on the availability of data. This number provides an estimated approximation of the resulting total of potentially available biomass from forest residues created by logging slash based upon the 2009 Washington DNR and 2005 ODF historical removal data and for the Study Resource Counties, assuming that all biomass from timber harvesting operations is perfectly utilized. Table 2 provides a summary of these calculations. It is important to note, however, that the creation of this biomass does not necessarily translate to the recoverable amount of biomass, which depends on a variety of factors such as the accessibility of the biomass, harvesting methods used, and efficiency of the biomass recovery operations.

Table 2: Estimated Total Potential Annual Logging Slash for Study Resource Counties. Source: USDA Forest Service, Washington DNR, ODF.

	Weight of Merchantable Biomass	÷	Volume of Merchantable Sawtimber	x	2004 Timber Harvest Data (OR ODF)	OR	2009 Timber Harvest Data (WA DNR)	=	Estimated Total Annual Slash
	(BDT)		(Board Feet)		(Board Feet)		(Board Feet)		(BDT)
Clackamas	57,634,222		21,668,127,804		143,811,000				382,517
Clark	17,373,385		6,552,880,573				44,578,000		118,188
Columbia	15,618,026		5,007,176,920		208,851,000				651,433
Cowlitz	30,671,665		9,661,830,170				134,102,000		425,709
Marion	24,557,975		9,087,673,415		85,252,000				230,380
Multnomah	5,826,694		2,194,177,462		15,840,000				42,064
Washington	20,821,519		7,265,499,041		178,353,000				511,125
Yamhill	21,756,335		7,524,358,689		136,266,000				394,007
Totals:	**194,259,821**		**68,961,724,074**		**768,373,000**		**178,680,000**		**2,755,423**

The estimated 2,755,423 BDT per year includes only forest residues (slash) created from logging operations on public and private commercial timberlands within the eight counties comprising the Study Resource Counties. It does not include forest residuals resulting from thinning operations, land-clearing operations, or fire-reduction treatments. For the purposes of maintaining more conservative estimates, these additional forestry activities were not taken into account in assessing the potentially available forest residues.

The total amount of recoverable forest residues in reality is going to be significantly less than the total potential due to various efficiencies. Based upon our experience in the forest products industry, our experience with fuel resource studies within Western Washington, our analyses of the public and private commercial timberlands within the Study Resource Counties, an October 2009 report by the University of Washington to the Washington State Legislature, and industry standards,[18] this study assumed a recovery rate of 20% of the total estimated annual slash. This places the total estimated economically recoverable forest residues, based on 2005 and 2009 historical harvest rates, at approximately 551,084 BDT annually.

Current Utilization of Forest Residues

From our interviews with private commercial timberland owners, fuel processors and sawmills, this study estimated that there is the equivalent of approximately two full-time grinders engaging in in-woods grinding operations within the Study Resource Counties. Industry standards indicate that one full-time grinder can produce approximately 300 BDT of biomass fuel per day, or 77,000 BDT per year. This equates to an estimated 144,000 BDT annual current utilization of forest residues from the logging slash created by timber harvesting within the Study Resource Counties, resulting in a remaining estimated 407,085 BDT of unutilized forest residues available annually from logging slash created from timber harvesting within the Study Resource Counties.

[18] See Elaine Oneil and Bruce Lippke, *Eastern Washington Biomass Accessibility*, a Report to the Washington State Legislature and Washington Department of Natural Resources, October 2009.

Summary of Available Forest Residues

This study determined from interviews and industry sources that based upon historical and forecasted harvesting of public and private commercial timberlands there is an estimated 407,085 BDT of forest residues from logging slash available annually within the Study Resource Counties, as shown on Figure 24.

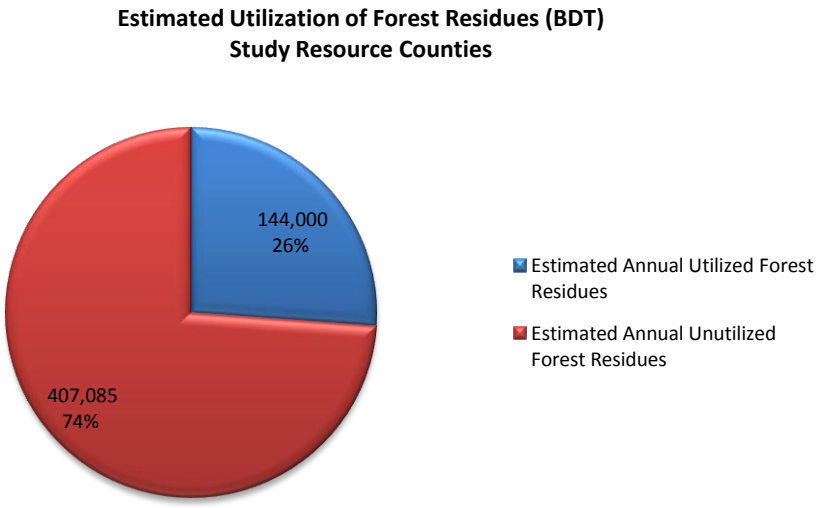


Figure 24: Estimated Utilization of Forest Residues for Study Resource Counties. Source: LD Jellison.

Primary Mill Residues

Available Primary Mill Residues

Reliable assessment of the potential woody biomass in the Study Resource Area that can be used for fuel for the proposed biomass facility must include the sawmill residuals that are part of the current biomass market. This information is summarized in Table 3.

Table 3: Summary of Sawmills within the Study Resource Counties. Source: Random Lengths, 2010.

STUDY RESOURCE COUNTIES SAWMILLS						
Sawmill	Location	County	Approx. Distance from Vancouver (miles)	8 Hour Capacity (mbf)	Estimated Annual Production (mbf)*	Estimated Annual Production (BDT)**
Alder Creek Lumber Co., Inc.	Portland, OR	Multnomah	13	125	60,000	52,800
Arrowhead Timber Co.	Carver, OR	Clackamas	18	90	43,200	38,016
Banks Lumber Co.	Banks, OR	Washington	24	500	240,000	211,200
Columbia Vista Corp.	Vancouver, WA	Clark	0	230	110,400	97,152
Hambleton Lumber Co.	Washougal, WA	Clark	19	96	46,080	40,550
Hampton Lumber Mills, Inc. Willamina Division	Willamina, OR	Yamhill	59	500	240,000	211,200
iLevel by Weyerhaeuser Longview, WA	Longview, WA	Cowlitz	43	440	211,200	185,856
Interfor Molalla Division	Molalla, OR	Clackamas	44	250	120,000	105,600
Maple Grove Trading, LLC	Molalla, OR	Clackamas	44	5	2,400	2,112
RSG Forest Products, Inc. Estacada Lumber Co.	Estacada, OR	Clackamas	39	340	163,200	143,616
RSG Forest Products, Inc. Molalla Division, Precision Mill	Molalla, OR	Clackamas	44	500	240,000	211,200
RSG Forest Products, Inc. Molalla Division/Band Mill	Molalla, OR	Clackamas	44	500	240,000	211,200
RSG Forest Products, Inc. Olympic Forest Products	Mist, OR	Columbia	50	450	216,000	190,080
RSG Forest Products, Inc.	Kalama, WA	Cowlitz	25	450	216,000	190,080
Stimson Lumber Co. Clatskanie Mill	Clatskanie, OR	Columbia	41	140	67,200	59,136
Stimson Lumber Co. Forest Grove Stud & Dimension Mill	Forest Grove, OR	Washington	35	400	192,000	168,960
James Van Loo Lumber Co.	Gales Creek, OR	Washington	31	20	9,600	8,448
Yankee Forest Products	Clatskanie, OR	Columbia	41	2	960	845
TOTAL:						**2,128,051**

*** Annual production estimated at 2 shifts per day, 5 day workweek, 4 weeks per month, 12 months per year.**
**** Assumed 1mbf = .88 BDT of residual material. Source: Alaska Wood Energy Conference, 2005.**
***** 8 hour capacity estimated per LD Jellison.**

Current Utilization of Primary Mill Residues

This study assumed that all primary mill residues currently being produced are being consumed by the market. The reasoning for this assumption is that primary mill residues are more accessible and comparatively more economically retrievable than forest residues.

Secondary Mill Residues

In accordance with the interviews conducted in this study, and taking into account the population density of the Study Resource Counties, this study estimates that the current and historical annual volume of

secondary mill residuals within the Study Resource Counties is minimal and estimated to be approximately 40,000 BDT annually. Furthermore, this study assumed that like primary mill residues, all secondary mill residues are being consumed by the market due to the fact that these residues are comparatively more economically retrievable than forest residues.

Urban Wood Residues

In accordance with the interviews conducted in this study, and taking into account the population density of the Study Resource Counties; this study estimates that the average annual volume of urban wood residues within the Study Resource Counties is 275,000 BDT annually. However, when taking into account the estimated volume of urban wood residues that is likely to meet the final wood fuel air permit requirements for the Clark County facility and the air permit standards of the local Southwest Washington Clean Air Agency (SWCAA) administering the various state and federal regulatory standards, we estimate that the amount of urban wood residues meeting these standards is likely to be approximately 175,000 BDT annually. When taking the population density into account, it is further estimated that 50% of this, 87,500 BDT, within the Study Resource Counties is unutilized and therefore potentially available for use for woody biomass facilities. These findings are summarized in Figure 25.

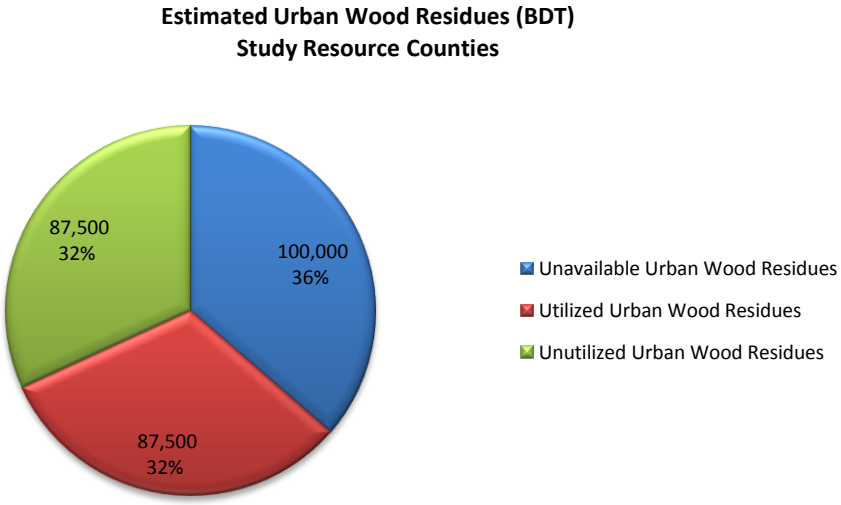


Figure 25: Estimated Urban Wood Residues for Study Resource Counties. Source: LD Jellison.

Summary of Quantitative Analysis

This study concludes that there is an estimated total potential of 2,894,136 BDT of woody biomass available annually within the Study Resource Counties, comprised of the various residues as shown on Figure 26.

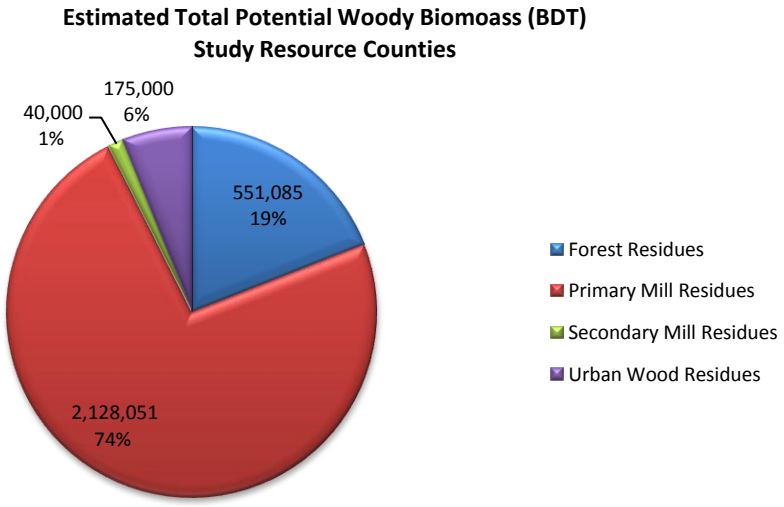


Figure 26: Estimated Total Potential Woody Biomass (BDT) for Study Resource Counties. Source: LD Jellison.

Of this total potential 2,894,136 BDT of woody biomass available annually within the Study Resource Counties, it is further estimated that 2,399,551 BDT is being utilized by various consumers, leaving 489,085 BDT of potentially unutilized woody biomass. Clark County's anticipated annual consumption of 40,000 BDT is 12% of this total potentially unutilized woody biomass, as shown on Figure 27.

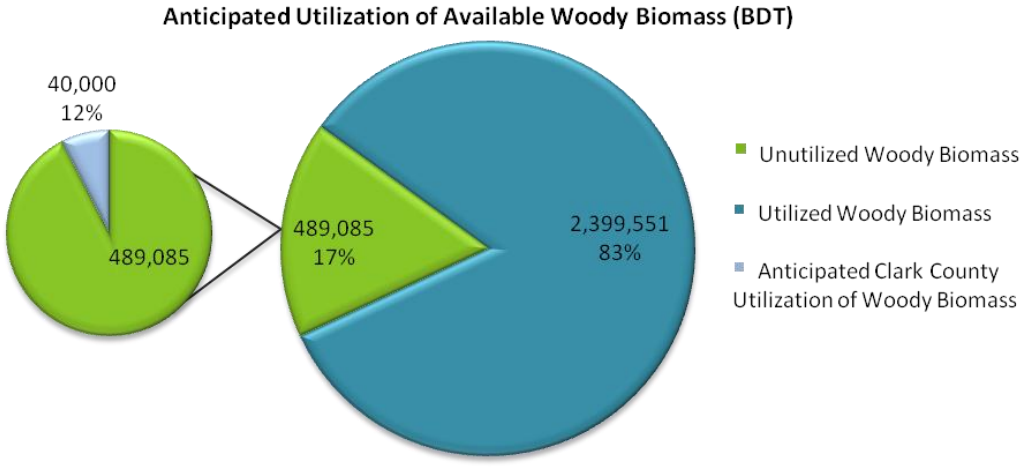


Figure 27: Anticipated Utilization of Available Woody Biomass (BDT) for Study Resource Counties. Source: LD Jellison.

V. ECONOMIC ANALYSIS

The economic analysis of this study involved reviewing regional woody biomass recovery operations and examining past, current, and future regional prices for woody biomass materials. For this analysis, we gathered information from leaders in the regional forest products industry. We further obtained and analyzed information from RISI, Inc. (RISI), generally considered the leader in both the forest products and financial industries in providing economic forecasting for wood products on both national and regional levels.

Biomass Recovery Operations

Logging methods have a significant impact on the availability of forest-sourced woody biomass. Regional logging methods used for harvesting timber can be divided into two general categories: conventional harvesting and whole-tree harvesting.

Conventional harvesting means that after a tree is felled, the tree limbs and top are then removed in-place where the tree is felled. As a result, the tree limbs and tops are scattered across the entire logging area making it difficult to economically retrieve the logging slash created from conventional harvesting methods. The wood waste requires extra handling of the slash to extract it to a landing area or to pile the slash for open burning.

Whole-tree harvesting involves the felling of the tree, which is then transported to a central processing area (landing) where the tree limbs and top are removed. This type of harvesting method concentrates the logging slash in a central landing area where they can be more economically retrieved from a central location.

Historically, the majority of timber was harvested using conventional harvesting methods, which made the collection and utilization of slash created by forest residues difficult. Changing timber harvesting practices, however, have encouraged whole-tree harvesting, which significantly increases the potential availability for forest residues from logging slash created by timber harvesting.

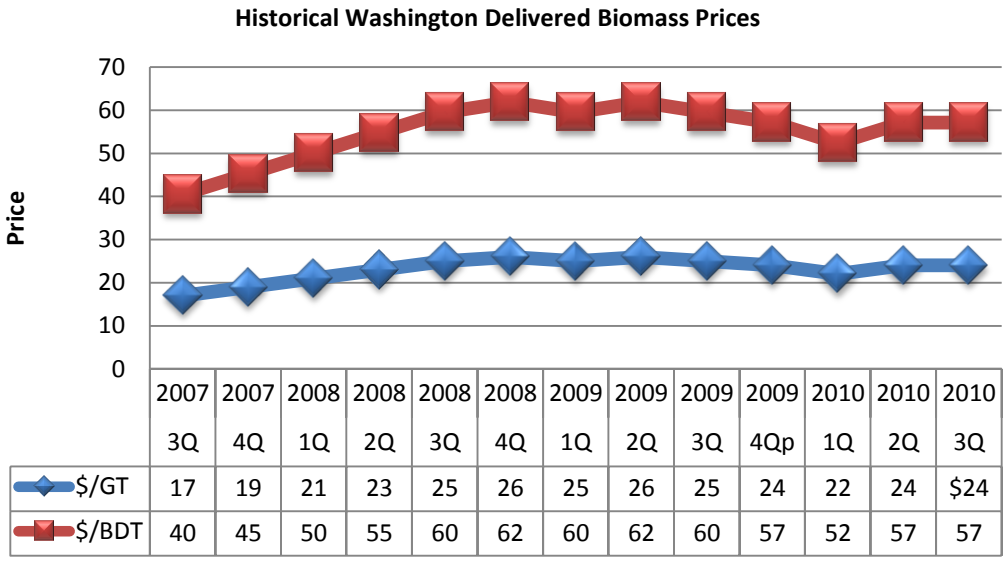
Public and private commercial timberland owners have begun to favor whole-tree harvesting as a more efficient means of harvesting timber, especially since the removal of slash promotes the growth of seedlings and reduces open burning of forest residues. In addition, government incentive programs such as the U.S. Department of Agriculture's Biomass Crop Assistance Program (BCAP), have sought to further increase the incentive for the removal of biomass from timberlands.

It is expected that federal, state, and local regulations will become more restrictive in the future with respect to open burning of forest residues, which would have the likely positive effect of increasing the supply of woody biomass for forest residues from logging operations.

Historical Price

According to RISI,[19] the average delivered price for woody biomass in Washington for the past three years has ranged from a low of $17 per green ton to a high of $26 per green ton, with an average price of $23 per green ton. This study assumed a moisture content of 42% for a green ton, which translates into a low of $40 per BDT, a high of $62 per BDT, and an average of $55 per BDT. These historical prices are shown in Figure 28 below.

[19] RISI Wood Biomass Market Report, 2010.



	2007 3Q	2007 4Q	2008 1Q	2008 2Q	2008 3Q	2008 4Q	2009 1Q	2009 2Q	2009 3Q	2009 4Qp	2010 1Q	2010 2Q	2010 3Q
$/GT	17	19	21	23	25	26	25	26	25	24	22	24	$24
$/BDT	40	45	50	55	60	62	60	62	60	57	52	57	57

Figure 28: Historical Washington Woody Biomass Prices. Source: RISI, 2010.

It is important to note and take into account that the prices provided by RISI include the cost of higher-value sawmill residuals, such as shavings, sawdust, bark, and chips, and are therefore higher than the cost of lower-grade forest residual biomass hogfuel that is expected as the primary source of fuel for the proposed biomass facility. Based on interviews with private commercial timberland owners, fuel processors, sawmills, and woody biomass fuel consumers in the study resource areas, this study estimates that the average historical delivered prices for this lower-grade fuel for the last two years have ranged from approximately $20 to $32 per BDT with a current average delivered price of approximately $24 per BDT. The historical prices from RISI as shown in Figure 28, however, provide a general index for market fluctuation over time.

Current Price

According to RISI,[20] the most recent delivered price index for woody biomass in Washington for 2010 is $107 per green ton ($24 per BDT assuming a moisture content of 42% per green ton). This price includes the higher-value sawmill residuals discussed above and is therefore not an accurate indication of current local forest residual biomass hogfuel market conditions.[21] Furthermore, interviews with regional landowners and biomass hogfuel suppliers and consumers within the study resource areas separately concluded that the current average delivered price for forest residual biomass hogfuel is $25 per BDT.

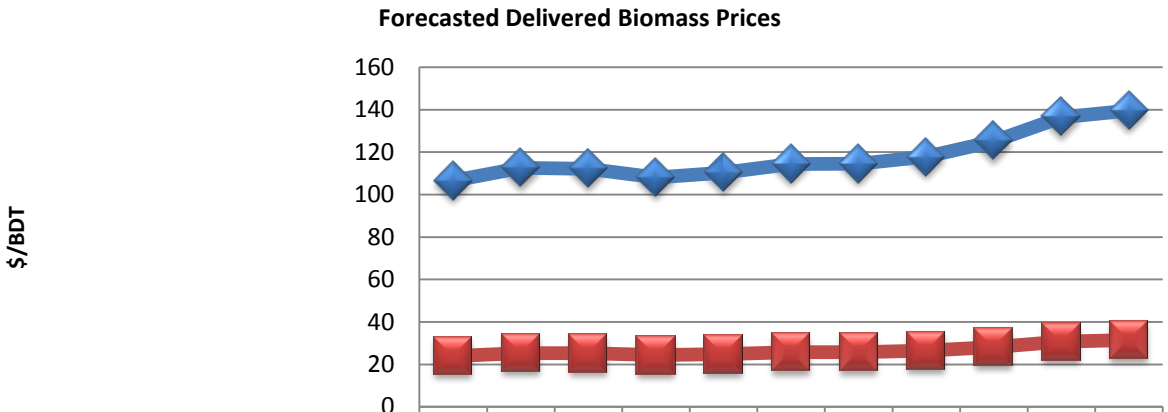
Forecast Price

In accordance with conversations and discussions with some of the senior economists at RISI, this study assumes a 1:1 correlation between RISI's forecast delivered chip prices index and woody biomass prices in order to forecast the delivered forest residual biomass hogfuel prices within the study resource areas for the Clark County facility. Figure 29 illustrates RISI's price forecast for residual chips and the forecast

[20] RISI Wood Biomass Market Report, 2010.

[21] Based upon interviews of timberland owners, fuel processors, sawmills .and biomass consumers, the volume of both forest residues and primary mill residues is sufficient to supply the private and public biomass facilities for the demand price range above the current $24 per BDT at or below the maximum $45 per BDT.

woody biomass price using the foregoing assumptions. As can be seen in Figure 29, using the forecast price for woody biomass in Washington based upon RISI's forecast delivered chip price index and assuming a current woody biomass price of $25 per BDT, the delivered price for woody biomass with the Study Resource Area is not forecasted to exceed $45 per BDT. This study estimates that ten-year long-term fuel supply contracts within the study resource areas with negotiated escalation and hedging indices would currently average between $35 and $45 per BDT.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
National Delivered Chip Prices ($/BDT)	107	113	112	108	110	114	115	118	125	136	140
Study Resource Area Delivered Hogfuel Prices ($/BDT)*	24	25	25	24	25	26	26	27	28	31	31

Figure 29: Forecasted Biomass Prices. Source: RISI, 2010.
***Initial price estimates provided by LD Jellison.**

Summary of Economic Analysis

This study estimates that the current average price for forest residual biomass hogfuel within the Study Resource Area suitable for the Clark County facility is currently $25 per BDT. Both the current and ten-year forecasted prices for forest residual biomass hogfuel within the Study Resource Area are forecasted not to exceed $45 per BDT.

VI. FUEL COMPETITION ANALYSIS

Competition from Existing Large Biomass Power Facilities

According to the Biomass Power Association, there are 14 biomass facilities in Oregon and Washington. These facilities are shown in Figure 30.

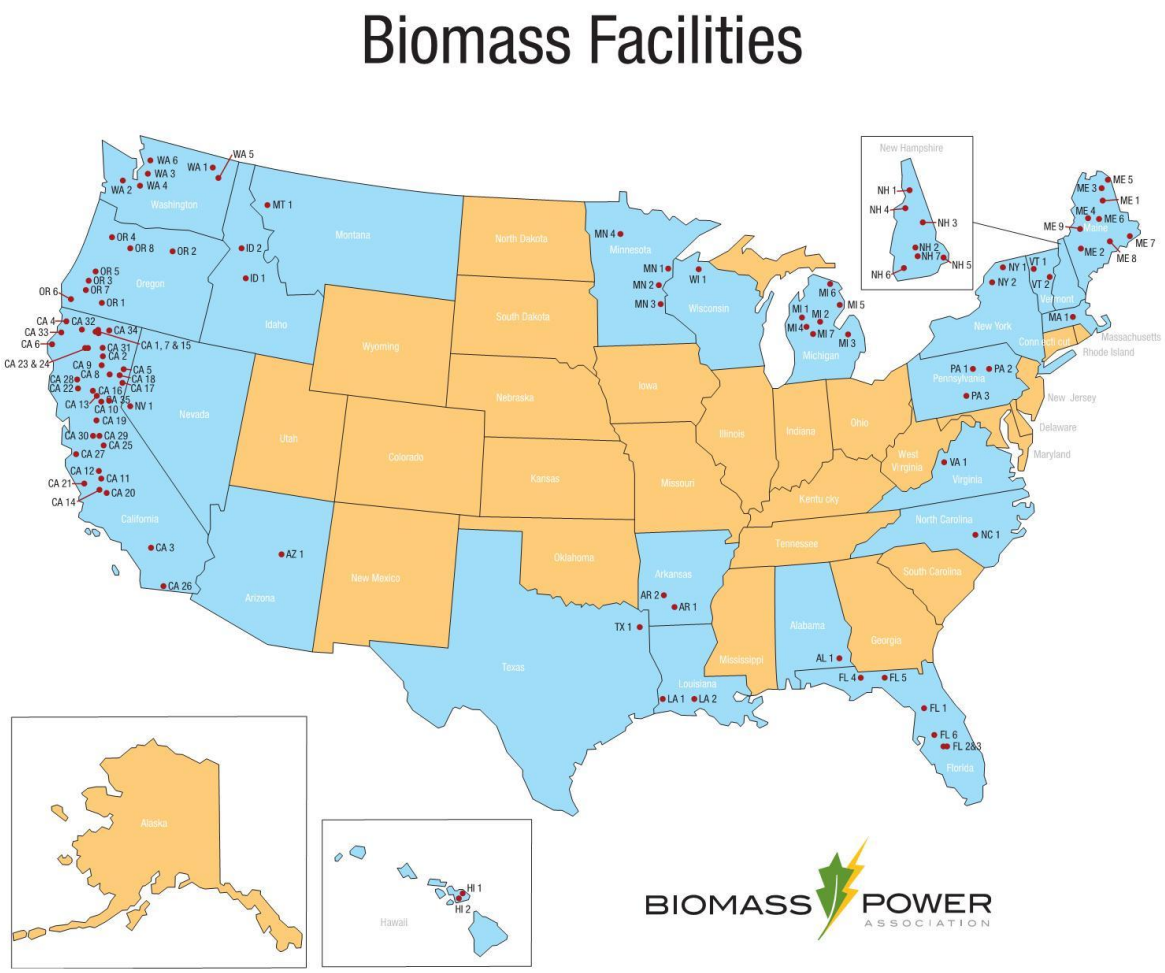


Figure 30: Locations of existing biomass plants in the Pacific Northwest. Source: Biomass Power Association, 2011.

There are four identified biomass facilities currently in operation in the Study Resource Area that could pose competition for the potentially available woody biomass needed for the proposed facility; these facilities are summarized in Table 4 below.

Table 4: Existing Biomass Power Facilities' Draw Upon Study Resource Counties. Source: LD Jellison.

Biomass Power Facility Name	Location	Size* (MW)	Estimated Annual External Consumption (BDT)**	Estimated Study Resource Counties Draw (BDT)	Distance from Vancouver, WA (miles)
Georgia-Pacific (Camas)	Camas, WA	52	260,000	234,000	10
Longview Fibre 1-7 (CR & Pwr Boilers)	Longview, WA	67	335,000	190,950	43
Weyerhaeuser (Longview) TG 4	Longview, WA	18	90,000	51,300	43
Weyerhaeuser (Longview) TG 5	Longview, WA	31.4	157,000	89,490	43
Totals:			**842,000**	**565,740**	

***Source: Northwest Power and Conservation Council, 2010.**
****Consumption estimated assuming 10,000 BDT annual woody biomass fuel consumption per MW of power generation with 50% of woody biomass requirements being supplied from internal sources.**

LD Jellison estimates that these co-generation facilities on average obtain approximately 50% of their required fuel from non-woody biomass, such as black liquor, sludge, etc. Accordingly, the estimated draws on available woody biomass within the study resource areas for the planned biomass facility are estimated to be 565,740 BDT annually based upon LD Jellison's experience and interviews with the various woody biomass suppliers and consumers. For the purposes of this study, the estimated study resource area draw of 565,740 BDT annually by these existing biomass power facilities are included within the current existing demand for woody biomass as discussed in the Quantitative Analysis (Section IV) above.

Summary of Fuel Competition Analysis

Currently, there are four identified competing large biomass facilities within the Study Resource Counties that annually consume an estimated 565,740 BDT of woody biomass within the Study Resource Counties. The draw of these existing facilities upon the Study Resource Area and Study Resource Counties are assumed in the current utilization of the available woody biomass as previously discussed in Section IV above.

VII. SUMMARY AND CONCLUSIONS

In the course of this study, LD Jellison conducted four analyses of woody biomass in the Study Resource Area to determine whether a Level 2 Feasibility Analysis is justified and recommended. The **qualitative analysis** determined that the composition of potentially available woody biomass in the Study Resource Area is composed of not more than 10% of secondary mill residues and urban wood residues. The **quantitative analysis** estimated 489,085 BDT of unutilized woody biomass potentially available annually from public and private commercial timberlands in the Study Resource Counties. The **economic analysis** estimated the current average delivered price for forest residual biomass hogfuel in the study resource areas at $25 per BDT, and the ten-year forecast average price for delivered forest residual biomass hogfuel not to exceed $45 per BDT. Finally, the **competition analysis** determined that the current and proposed competition for potentially available woody biomass in the Study Resource Area is not sufficient to dissuade from the facility being able to contract to meet its total annual fuel requirements. In conclusion, this Fuel Resource Study determines that from the standpoint of the annual fuel requirement of 40,000 BDT, the proposed 44,000 PPH biomass facility at Clark County is economically viable and feasible.

GLOSSARY OF TERMS

BCAP: Biomass Crop Assistance Program.

BDT: A Bone Dry Ton is the equivalent of 2,000 pounds of woody material that contains 0% moisture.

BTU: British Thermal Units.

DBH: Diameter at Breast Height, defined as being the diameter for the tree stem measured at 4.5 feet above the ground on the uphill side of a tree

Forest Residues: Logging residues and other removable material left after carrying out silviculture operations and site conversions.

GIS: Graphical Information Services.

Growing Stock Trees: Live trees at least 5.0 inches DBH that meet merchantability requirements.

Green Ton: The equivalent of 2,000 pounds of woody material, including moisture content.

NREL: National Renewable Energy Laboratories.

ODF: Oregon Department of Forestry.

PPH: Pounds per Hour.

Primary Mill Residues: Wood materials (coarse and fine) and bark generated at manufacturing plants when round wood products are processed into primary wood products such as slabs, edgings, trimmings, sawdust, etc.

RISI: A leading company in the forest industry who provide economic forecasting for wood products on both national and regional levels.

Secondary Mill Residues: Wood scraps and sawdust from woodworking shops, furniture factories, wood container and pallet mills, and wholesale lumberyards.

Study Resource Area: The potential resource areas for available fuel, covering everything within a 90 minute haul-time of the Site.

Study Resource Counties: Clark County, Cowlitz County, Columbia County, Washington County, Multnomah County, Yamhill County, Marion County, and Clackamas County.

SWCAA: Southwest Washington Clean Air Agency.

Urban Wood Residues: Wood residues from municipal solid waste, tree trimmings, and construction and demolition sites.

USDA: United States Department of Agriculture.

WDOE: Washington Department of Ecology.

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