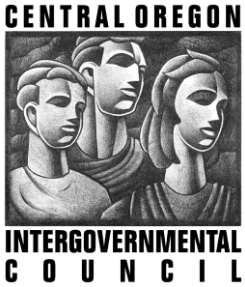
CENTRAL OREGON BIOMASS SUPPLY AVAILABILITY ANALYSIS

Prepared for:
Central Oregon Intergovernmental Council



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June 6, 2016

ACKNOWLEDGMENTS

The authors wish to thank several individuals and organizations for their significant efforts in support of this project. These include, but are not limited to:

Kiley Rucker-Clamons, Central Oregon Intergovernmental Council
Scott Aycock, Central Oregon Intergovernmental Council
Kate Odneal, USFS, Deschutes and Ochoco National Forest
Brian Tandy, USFS, Deschutes and Ochoco National Forest
Chris Johnson, Whitefish Cascade Forest Resource
John Williams, Quicksilver Contracting
Steve Castillo, Bureau of Land Management
Marcus Kauffman, Oregon Department of Forestry
Stu Cook, Oregon Department of Forestry
Ed Keith, Deschutes County
Casey Kump, Crook County Fire
Tom Jaca, Jefferson County Fire
Tom Bennett, Natural Resource Conservation Service
Chris Mundy, Natural Resource Conservation Service
Mark Goodwin, Jefferson County Soil and Water Conservation District
Tim Deboodt, Oregon State University, Crook County Extension
Tim Gammell, Wood Resources International

The TSS Consultants team includes:

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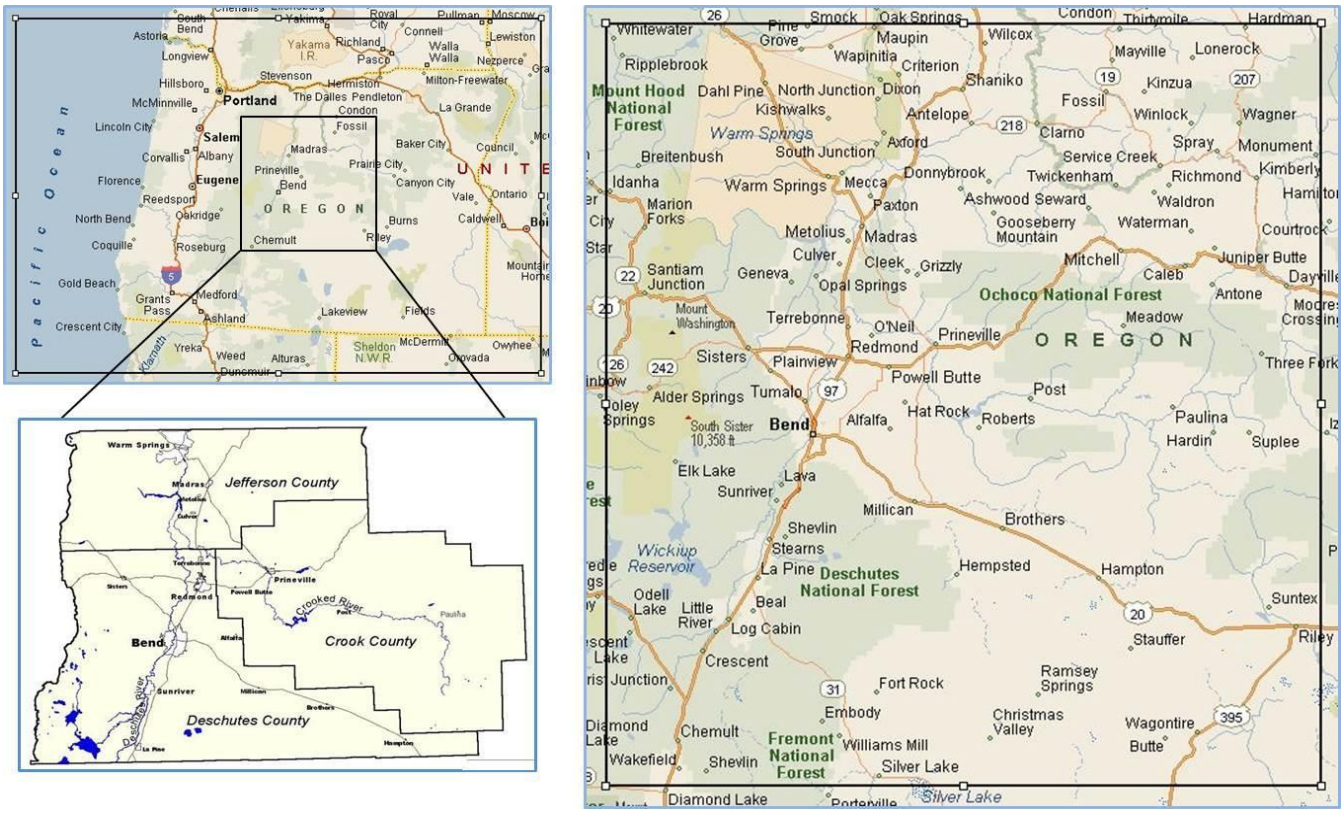
INTRODUCTION

The Central Oregon Intergovernmental Council (COIC) was designated a Council of Governments in 1972 and provides regional collaboration for central Oregon local governments. In 2015, COIC received a USDA Forest Service Wood Innovation grant to support the Central Oregon Biomass Cluster Development Project. Understanding and characterizing the availability of economical woody biomass material is an important first step consideration in the biomass cluster development process. COIC retained the services of TSS Consultants to assess the supply of biomass material available within targeted Central Oregon counties.

The COIC sphere of influence is centered on three counties (Deschutes, Jefferson and Crook), although they have programs and activities beyond that region (Figure 1).

Figure 1. Central Oregon and the COIC Region



FINDINGS

Table 1 provides a summary of woody biomass material available by source produced within the Target Study Area. Note that these estimates are based on interviews and data collected from a variety of sources (see Acknowledgments). Current market demand for biomass within the Target Study Area is very dynamic due to a variety of factors:

- ➢ Pulp chip prices are dropping as a result of recent changes in market conditions (e.g., international chip prices, oversupply of sawmill residual chips).

- ➢ Renewable energy wholesale market prices are forcing existing biomass power plants to reduce generation due to the relatively high cost to produce biomass power.

- ➢ There are emerging markets for biomass developing within the region that may impact biomass availability in the near term, including new commercial-scale facilities:

    - o Red Rock Biofuels, Lakeview
    - o Oregon Torrefaction, Grant County
    - o Quicksilver Contracting, La Pine

Table 1. Biomass Availability Summary

SOURCE	POTENTIALLY AVAILABLE (BDT/YEAR)	TECHNICALLY AVAILABLE (BDT/YEAR)	ECONOMICALLY AVAILABLE (BDT/YEAR)
Timber Harvest Residuals	128,662	97,689	58,939
Forest Restoration and Fuel Treatment Residuals	183,000	134,225	95,475
Western Juniper Treatment Residuals	115,550	46,220	26,220
Forest Products Manufacturing Residuals	0	0	0
Construction and Demolition	7,096	4,612	113
Tree Trimming	2,149	1,397	936
TOTAL	**436,457**	**284,143**	**181,683**

Note that the economically available estimate of 181,683 BDT per year represents a significant volume of biomass material. This volume will support numerous community-scale biomass thermal projects or up to about 22 megawatts of baseload[1] biomass power. In addition to traditional bioenergy uses, other value-added products (bio-chemical, advanced biofuels) may provide alternative cost effective end use markets.

[1] Year round, 24/7 power.

BIOMASS SUPPLY ANALYSIS

Feedstock considered in this analysis includes forest or woodland sourced material, urban wood waste and forest products manufacturing residuals:

- Forest residuals from forest management operations (limbs, tops, small diameter stems typically considered non-commercial)
- Rangeland restoration residuals (western juniper removals)
- Urban wood waste (tree trimmings, pallets, clean construction wood)
- Hazardous fuels and other small diameter material (typically considered non-commercial) from removal projects
- Forest products manufacturing residuals (sawdust, bark, shavings)

The report categorizes the supply of biomass fuel available as potentially available, technically available and economically available. Potential biomass availability is the total amount produced annually with no restrictions; recoverable biomass is judged to be technically available considering physical constraints such as terrain (steep slopes), transport (road systems that do not support removal) or policy constraints (environmental regulation, wilderness); and economical biomass is the amount available considering existing competition for the wood waste.

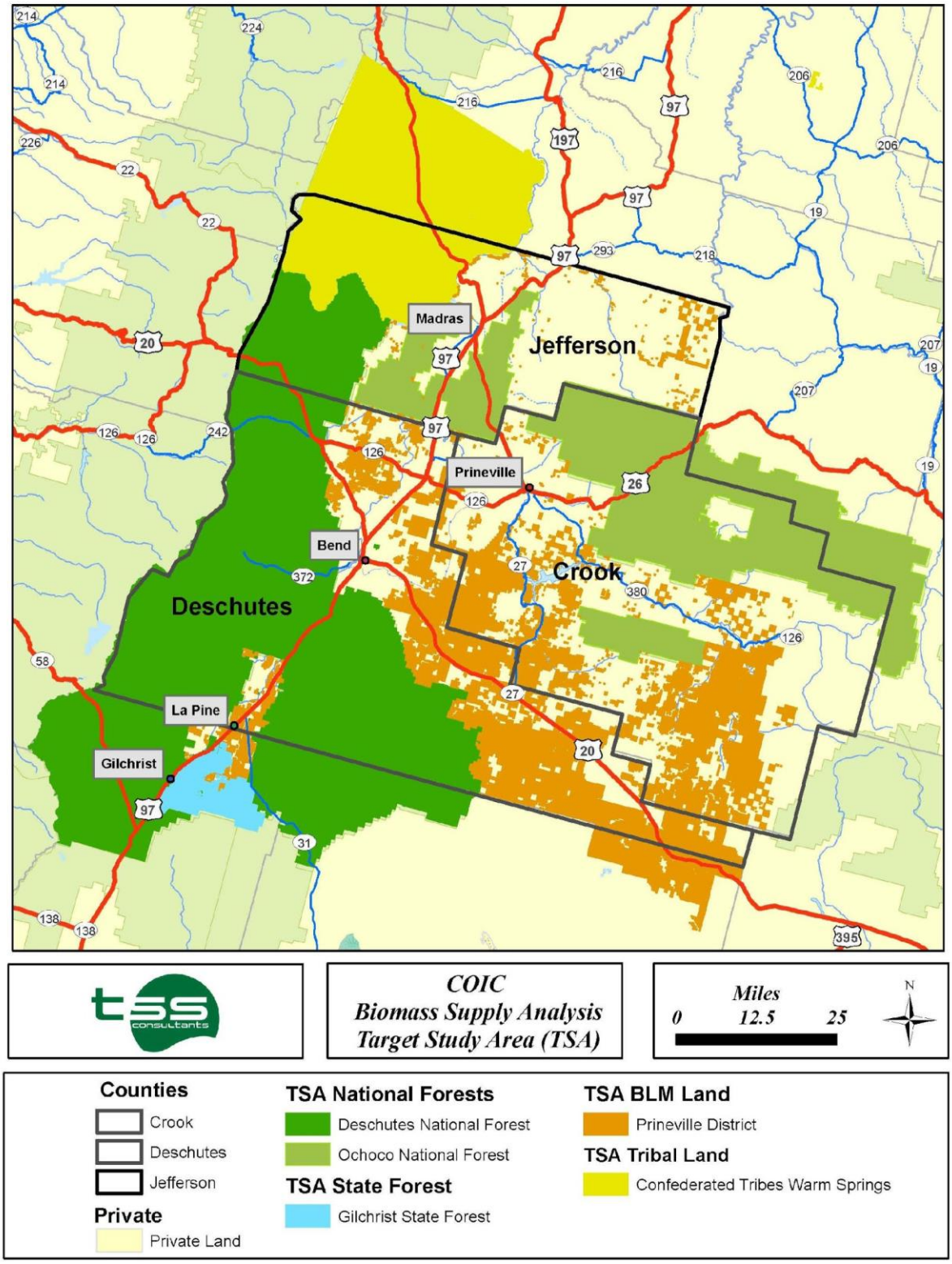
Target Study Area

A target study area (TSA) was defined with significant input from local experts including COIC staff and the project technical advisory committee. Figure 2 maps the TSA selected. Feedstock considered in this analysis includes forest-sourced material from both private and publicly managed lands. The TSA takes in two USDA Forest Service (USFS) national forests, Bureau of Land Management (BLM) rangelands, tribal lands, an Oregon state forest, and privately owned forests and rangeland. The TSA includes the entire area of each entity on the following list, except BLM Prineville District as described (Figure 2):

- Jefferson County
- Crook County
- Deschutes County
- Deschutes National Forest
- Ochoco National Forest
- The Confederated Tribes of Warm Springs Reservation
- Gilchrist State Forest
- BLM Prineville District lands south of the northern border of Jefferson County.[2]

[2] The small sections of Prineville District BLM land that stretch north of Jefferson County to Interstate 84 are scattered, on steep terrain and fairly inaccessible. They were not included in the analysis.

Figure 2. Target Study Area (TSA)



Vegetation Cover

Woody biomass availability for any given region is heavily dependent on vegetation cover, topography, land management objectives, and ownership. Vegetation cover types for the TSA were mapped using US Geological Survey LANDFIRE 2011 datasets.[3] LANDFIRE existing vegetation (EVT) describes species composition currently present, utilizes USGS GAP Analysis Program vegetation classifications, and includes crosswalks for Society of American Foresters (SAF) and Society for Range Management (SRM) vegetation cover classes.[4]

The major land cover classes and vegetation cover types in the TSA are agriculture, conifer forest, juniper woodland, hardwood forest, shrubland, grassland, riparian, water, barren and developed. Barren indicates sparsely vegetated, rocky and ice or snow-covered terrain. Developed includes high and low intensity urban areas and roads. The specific plant communities found within each major vegetation classes are shown in Table 2.
Figure 3 maps the major vegetation cover classes.

Table 2. Vegetation Cover Class Acreage

COVER CATEGORIES AND VEGETATION TYPES		TSA		
		ACRES	ACRES	PERCENT TOTAL
Agriculture			133,795	2.1%
Conifer Forest			2,429,010	38.4%
	California Mixed Evergreen Forest and Woodland	*11,943*		
	Conifer-Oak Forest and Woodland	*4,720*		
	Douglas-fir Forest and Woodland	*29,671*		
	Douglas-fir-Grand Fir-White Fir Forest and Woodland	*279,435*		
	Douglas-fir-Ponderosa Pine-Lodgepole Pine Forest and Woodland	*445,088*		
	Douglas-fir-Western Hemlock Forest and Woodland	*11,032*		
	Lodgepole Pine Forest and Woodland	*173,121*		
	Mountain Hemlock Forest and Woodland	*170,004*		
	Mountain Mahogany Woodland and Shrubland	*8,207*		
	Ponderosa Pine Forest, Woodland and Savanna	*1,103,697*		
	Red Fir Forest and Woodland	*40,476*		
	Spruce-Fir Forest and Woodland	*27,431*		
	Subalpine Woodland and Parkland	*11,008*		
	Western Hemlock-Silver Fir Forest	*113,177*		
Juniper Woodland and Savanna			341,156	5.6%

[3] USGS LANDFIRE: http://www.landfire.gov/index.php
[4] Vegetation units were originally based on NatureServe's Ecological Systems Classification and the National Land Cover Database life form types. Later, USGS GAP analysis classes were added. LANDFIRE data products are created at a 30-meter grid spatial resolution.

COVER CATEGORIES AND VEGETATION TYPES		TSA		
		ACRES	ACRES	PERCENT TOTAL
Hardwood Forest			52,566	0.8%
	Aspen-Mixed Conifer Forest and Woodland	*6,632*		
	Aspen Forest, Woodland, and Parkland	*45,272*		
	Red Alder Forest and Woodland	*84*		
	Western Oak Woodland and Savanna	*578*		
Shrubland			2,352,212	37.1%
	Big Sagebrush Shrubland and Steppe	*1,567,579*		
	Chaparral	*9,185*		
	Deciduous Shrubland	*8,579*		
	Desert Scrub	*7,689*		
	Grassland and Steppe	*140,143*		
	Greasewood Shrubland	*4,505*		
	Low Sagebrush Shrubland and Steppe	*614,503*		
	Salt Desert Scrub	*28*		
Grassland			510,090	8.1%
	Introduced Annual and Biennial Forbland	*2,411*		
	Introduced Annual Grassland	*283,091*		
	Introduced Perennial Grassland and Forbland	*32,025*		
	Alpine Dwarf-Shrubland, Fell-field and Meadow	*59,448*		
	Grassland	*133,114*		
Riparian			148,868	2.4%
	Spruce-Fir Forest and Woodland	*17*		
	Western Herbaceous Wetland	*7,321*		
	Western Red-cedar-Western Hemlock Forest	*10,979*		
	Western Riparian Woodland and Shrubland	*130,551*		
Water			44,466	0.7%
Barren			120,932	1.9%
Developed			199,487	3.2%
TOTAL			**6,332,582**	**100.0%**

Figure 3. Vegetation Cover Map with Steep Slope Exclusion

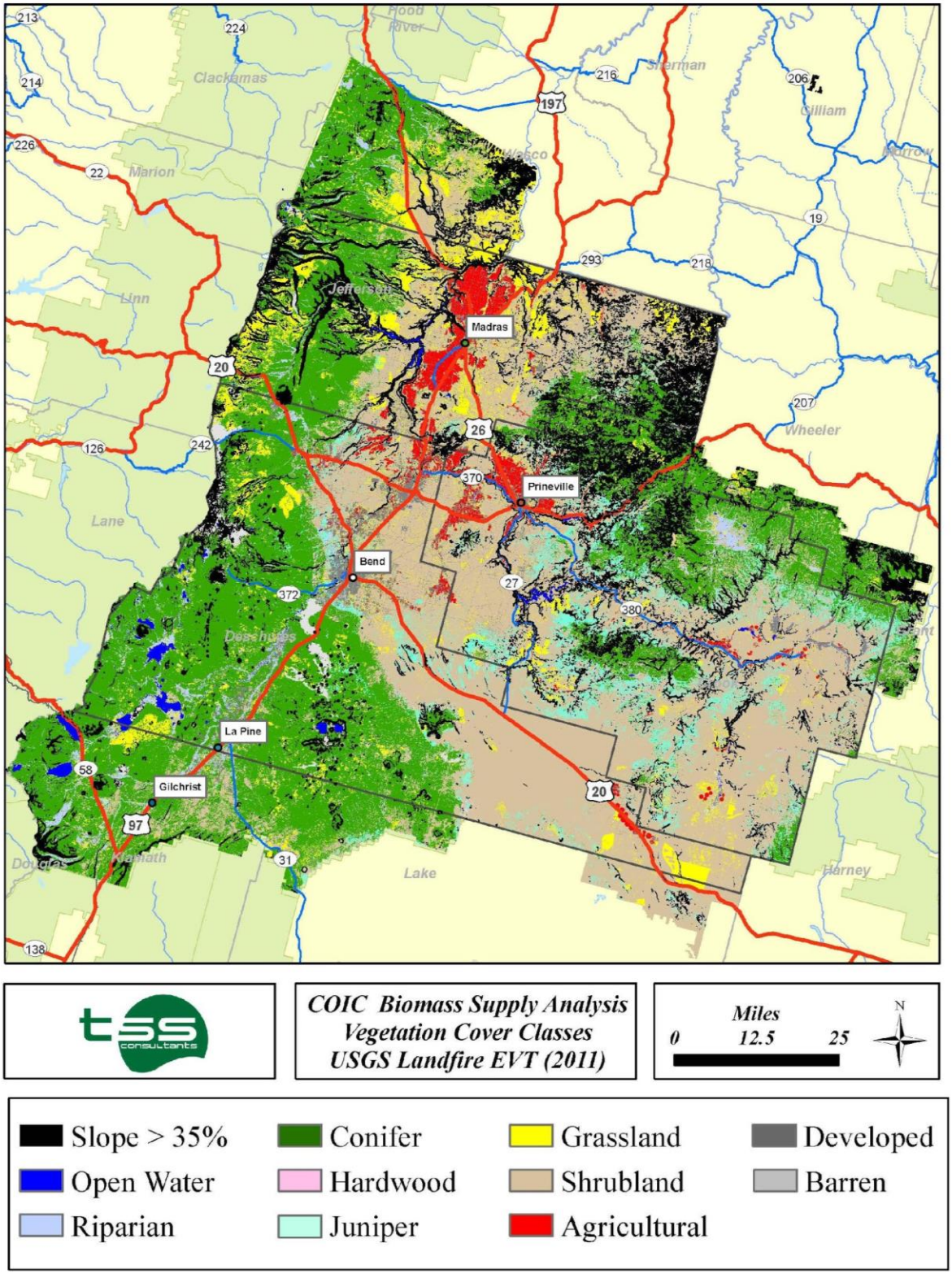
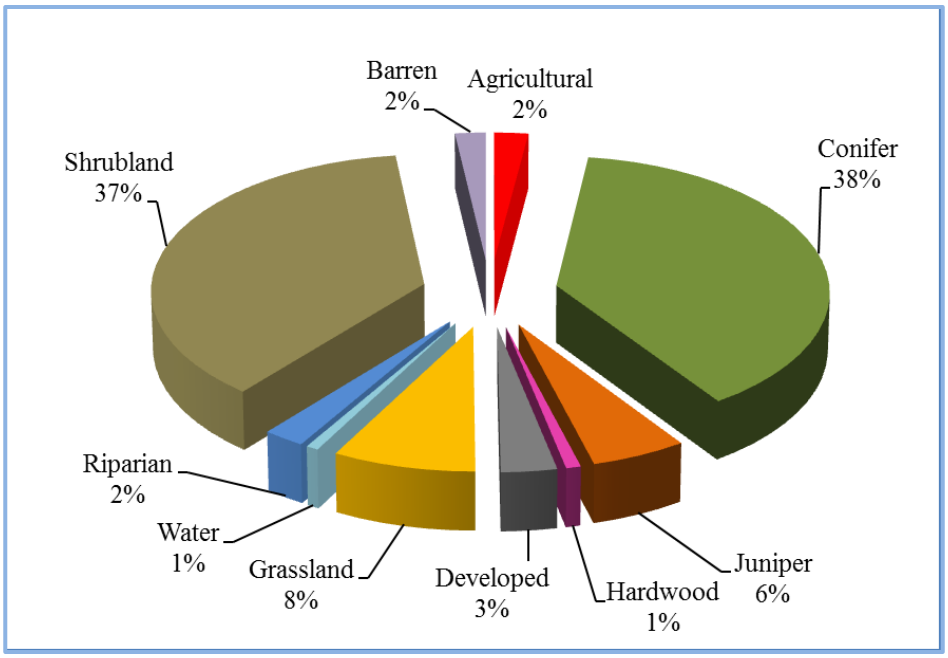


Figure 4. Vegetation Cover Distribution



As shown in Table 2 and Figure 4, the conifer forest cover type accounts for just over 38% of the land area within the TSA. The majority of conifer forest (64%) is either ponderosa pine or Douglas fir-ponderosa pine-lodgepole pine. Approximately 37% of the TSA consists of shrublands, over 90 % of which are either big sagebrush or low sagebrush and steppe. Hardwood forest is mostly aspen parkland and occupies less than 1% of the TSA. Juniper woodlands cover 6% of the TSA. The vegetation cover distribution graphic in Figure 4 illustrates the dominance of conifer forest and shrublands.

Topography

Forest biomass collection activities are generally restricted to topography that will allow ready access for equipment and crew. Steep topography over 35% slope gradient is considered to be the breakoff point for ground-based logging and/or biomass recovery equipment on federally managed lands (USFS and BLM). Private land managers may use ground-based equipment on slopes up to 50% but the cost of operating on sustained slopes above 35% are quite high and often considered prohibitive. Areas with 35% slope or higher are highlighted in Figure 3 (shown in black). Table 3 summarizes the results of the slope gradient analysis within the conifer forest and juniper woodland landscapes.

Table 3. Slope Assessment for Conifer Forest and Juniper Woodland

COVER CATEGORY	TSA	
	≤ 35% SLOPE	> 35% SLOPE
Conifer	91.2%	8.8%
Juniper	89.9%	10.1%
AVERAGE	**90.5%**	**9.5%**

Slope gradient does limit accessibility across approximately 9.5% of the conifer and juniper vegetation cover type within the TSA.

Land Ownership

Land ownership is important as a driver of vegetation management objectives and therefore the potential supply of biomass feedstock. Ownership of landscapes capable of producing biomass is critical to the long-term sustainable availability of feedstock. Ownership and management jurisdiction directly impact policy, regulations, and management with regard to operations. Within forest ecosystems, the level of management activity is typically higher, and operational limitations are less restrictive on privately managed lands. Federal land administration is focused on multiple objectives (e.g., recreation, habitat, fire resiliency) that significantly influence vegetation management and dictate woody biomass availability and quantity.

Table 4 summarizes acreages for the major land ownership categories shown in Figure 2. The ownership analysis was prepared from spatial data obtained from multiple sources and compiled into a single comprehensive ownership database for the TSA. Ownership sources include the USFS,[5] BLM,[6] ODF,[7] and Crook, Deschutes and Jefferson County.[8]

There are over 6.3 million acres within the TSA. The USFS is the largest landowner and manages two national forests within the TSA, the Deschutes National Forest and the Ochoco National Forest. There are 1,869,977 total acres within the Deschutes forest administrative boundary and 912,780 acres within the boundary of the Ochoco. However, national forest boundaries have complex land ownership patterns containing both federal lands, owned and managed by the USFS, and private lands, owned or managed by private landowners. For lands located within a national forest administrative boundary, acreages for federal and private ownership are kept separate for analyses in this report (see Table 4).[9]

The Deschutes forest has two designated national monuments that remove acreage from consideration for feedstock sourcing Lava Lands National Monument and Newberry Volcanic National Monument. In addition Deschutes has five National Wilderness Areas (NWA): Diamond Peak, Mount Jefferson, Mount Thielsen, Mount Washington and Three Sisters. The Ochoco contains three Congressionally-designated wilderness areas: Mill Creek, Bridge Creek and Black Canyon. Table 4 accounts for wilderness acres. Excluding wilderness, the USFS manages over 2.2 million acres within the TSA. The BLM Prineville District has almost 1.8 million acres widely scattered in non-contiguous township and range sections across the TSA. The Prineville district also extends into the southern portion of the Deschutes forest near La Pine and Gilchrist (see Figure 2). The Confederated Tribes of Warm Springs Reservation borders the Deschutes, and with over 640,000 acres of reservation land is the third largest landowner in the TSA.

[5] Ochoco National Forest GIS data library: http://www.fs.fed.us/r6/data-library/gis/ochoco/; Deschutes National Forest GIS data library: http://www.fs.fed.us/r6/data-library/gis/deschutes/
[6] Bureau of Land Management Oregon GIS Data, OR District Boundary: http://www.blm.gov/or/gis/data.php
[7] Oregon Department of Forestry, Ownership of Managed Lands geodatabase (all state managed lands).
[8] Crook County GIS: http://www.co.crook.or.us/gis/Home/tabid/1560/Default.aspx; Deschutes County GIS: http://www.deschutes.org/it/page/gis-data-services; Jefferson County GIS: http://www.co.jefferson.id.us/printable_maps.php
[9] USFS ownership always refers to those lands owned and managed by the Forest Service, not private lands within national forest boundaries.

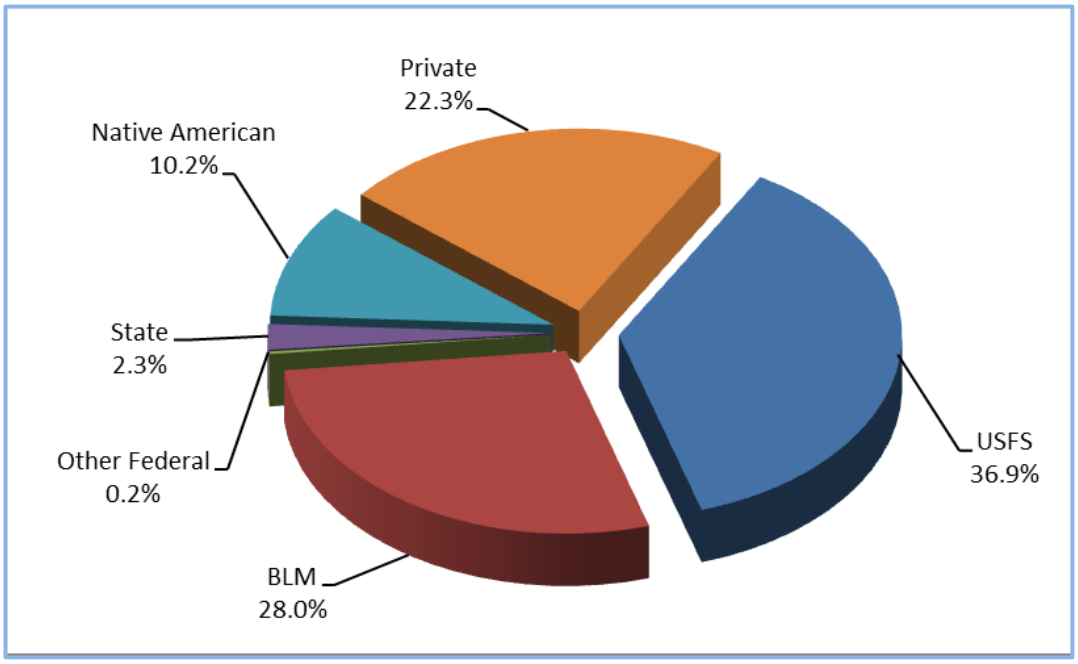
Table 4. Land Ownership Acreage within the TSA

OWNERSHIP		TSA		
		ACRES	ACRES TOTAL	PERCENT TOTAL
US Forest Service*			2,244,741	36.9%
	Deschutes National Forest	*1,613,357*		
	Deschutes Wilderness Exclusion	*(183,087)*		
	Deschutes National Monument Exclusion	*(49,510)*		
	Ochoco National Forest	*726,501*		
	Ochoco Wilderness Exclusion	*(35,429)*		
US Bureau of Land Management			1,774,519	28.0%
	Prineville District	*1,745,332*		
	Badlands Wilderness	*(29,187)*		
Other Federal			15,099	0.2%
	Bureau of Reclamation, FERC	*15,099*		
State of Oregon / Local Government			142,705	2.3%
	Department of State Lands, Parks and Recreation Department, City or County Lands	*70,311*		
	Gilchrist State Forest	*72,394*		
Native American			646,519	10.2%
	Confederated Tribes of Warm Springs	*646,519*		
Private			1,413,881	22.3%
TOTAL			**6,332,582**	**100.0%**

*Acres within the national forest boundary and under USFS management. Private lands within the forest boundary are included under Private.

Land ownership distribution is shown in Figure 6 using the acreage amounts in Table 4. The predominance of federal lands is clear; federal lands cover about 65% of the TSA land base. The USFS has the largest portion of land (36.9%) followed by the BLM (28%). Over 10% of the TSA land base is managed by the Confederated Tribes of Warm Springs. Lands owned and managed by the State of Oregon are not significant as a percent of overall land area (2.3%); however, the Gilchrist State Forest is actively managed and relevant in terms of biomass supply.

Figure 5. Land Ownership Distribution within the TSA



Land Ownership and Vegetation Cover

Table 5 summarizes land ownership by major landowners for the two vegetation types most likely to generate suitable forest biomass feedstock: conifer forest and juniper woodlands. Sagebrush shrublands vegetation cover type does not have the potential to provide viable biomass feedstock suitable for utilization. Riparian forests are often set aside for watershed protection and excluded from active management. Accounting for adverse slopes greater than 35% (see Table 3), 2,155,059 million acres of conifer forest and 337,603 acres of juniper woodlands are potentially available for sourcing biomass material.

Juniper woodlands occur mostly on private land (54%). As is the case throughout the Inland West, juniper woodland is often associated with rangeland managed by the BLM (27%), but Figure 6 shows that there are also significant juniper woodlands on the Ochoco National Forest in Crook County (12%). Conifer forests occur mostly on the USFS national forests with approximately 50% of conifer forest occurring on the Deschutes National Forest and about 19% on the Ochoco. The Confederated Tribes of Warm Springs have over 14% of conifer forest and just 2% of juniper woodland found in the TSA.

Table 5. Conifer Forest and Juniper Woodland Ownership Acreage

OWNERSHIP	CONIFER FOREST		JUNIPER WOODLAND	
	ACRES	PERCENT CONIFER	ACRES	PERCENT JUNIPER
Deschutes National Forest	1,210,855	49.8%	17,737	5.3%
Ochoco National Forest	455,987	18.7%	40,692	12.0%
Prineville District – Bureau of Land Management	35,664	1.5%	92,933	27.2%
Gilchrist State Forest	46,242	1.9%	-	-
Confederated Tribes of Warm Springs	330,346	13.6%	5,549	1.6%
Private	349,916	14.4%	184,425	54.1%
SUBTOTAL	2,429,010	100%	341,156	100%
Wilderness Exclusion	(60,198)		(3,553)	
Slope > 35% Exclusion	(213,753)		(34,457	
TOTAL	**2,155,059**		**337,603**	

Figure 6 below illustrates ownership of conifer forest and juniper woodland, and Figure 7 shows percent distribution by landowner.

Figure 6. Juniper Woodland (Left) and Conifer Forest (Right) Ownership Maps

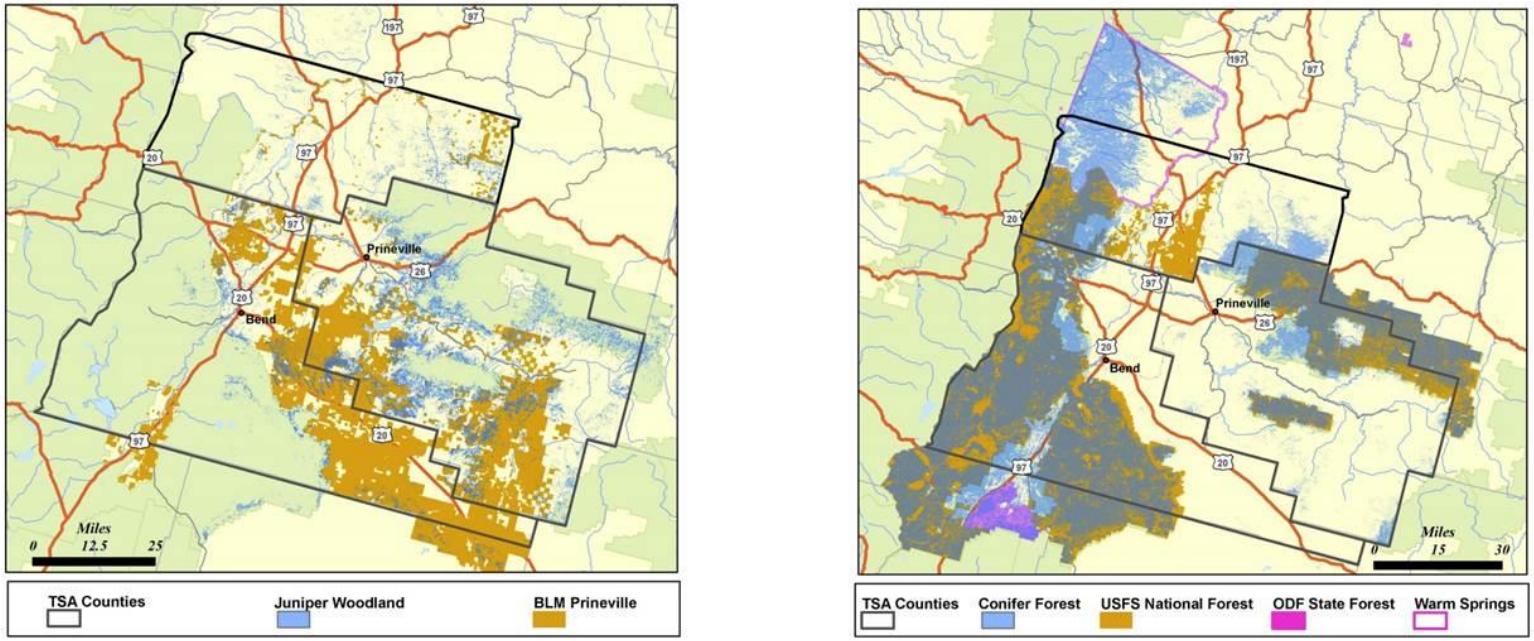
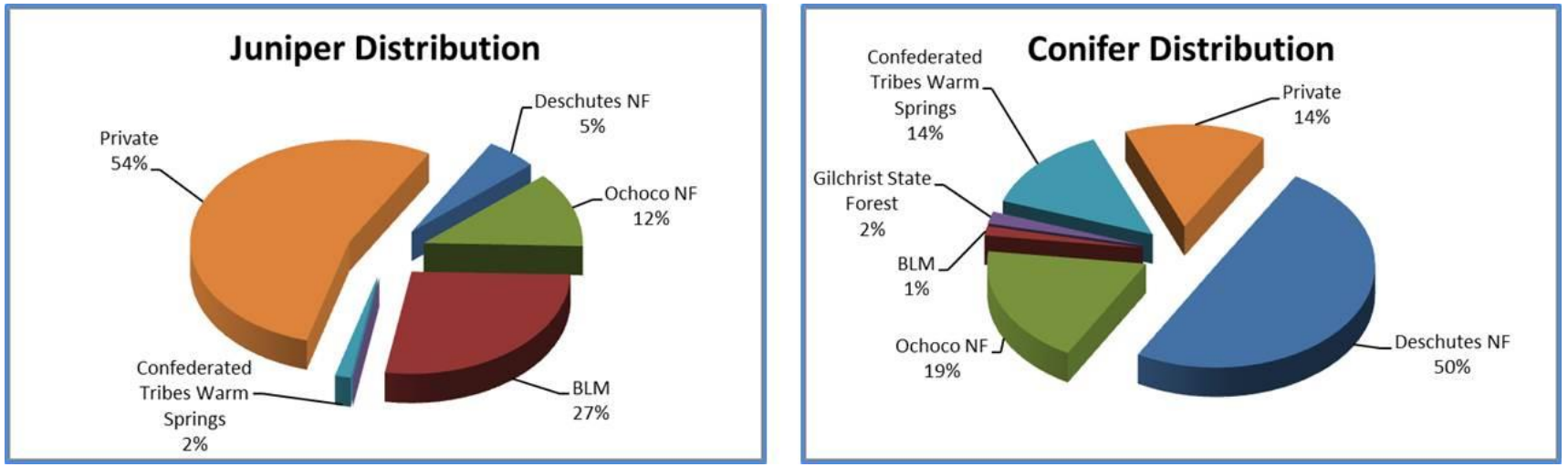


Figure 7. Juniper Woodland and Conifer Forest Ownership Distribution



Forest-Sourced Biomass

Timber Harvest Residuals

Timber harvest residuals can provide significant volumes of woody biomass material. Typically available as limbs, tops and unmerchantable logs,[10] these residuals are byproducts of commercial timber harvest operations. As such, residuals have very limited market value though they can be a relatively economic raw material feedstock source for end uses such as soil amendment (e.g., compost), advanced biofuels (e.g., Red Rock Biofuel) or bioenergy production (e.g., power or thermal energy). In addition, top wood can be utilized as chip logs if the pulp/paper market values support the additional costs to delimb, load and transport.

Timber harvest activity in Oregon is monitored by the Oregon Department of Forestry (ODF). The ODF tracks annual timber harvest levels and makes this data available by year and county. All volumes are reported in thousand board feet (MBF).[11] A review of the 2010 through 2014 ODF timber harvest data was conducted to analyze historic timber harvest activities within the TSA.

The TSA includes all of three counties: Deschutes, Jefferson and Crook. However, historic timber harvest data was also collected for counties surrounding the TSA. Small portions of the Ochoco forest extend into Wheeler and Grant County. The Warm Springs reservation extends into Wasco County, and the Deschutes National Forest extends into Klamath and Lake Counties. These counties were included because a portion of their harvest volumes representative of the TSA will need to be included for analysis. In addition, timber harvest levels of surrounding counties could be of interest for future study.

As discussed above, vegetation management objectives, in addition to terrain and accessibility, vary between public and privately owned lands. The timber harvest residuals analysis separates private and public land owners in order to calculate biomass supply metrics differently for each of the two categories detailed below.

- Private. Ownerships classed as private include industrial private (Industry), nonindustrial private forests (N.I.P.F), and Native American tribes (Tribal).
- Public. Ownerships considered public include United States Department of Agriculture Forest Service (Forest Service), the Bureau of Land Management (BLM), and the Oregon Department of Forestry (State).

Table 6 and Table 7 below show ODF results for private and public timber harvests by county for a five-year period from 2010 to 2014, expressed in MBF per year.

[10] Unmerchantable logs are typically too small or defective (diseased or dead) for manufacturing into lumber.
[11] MBF = thousand board foot measure. One board foot is nominally 12" long by 12" wide and 1" thick.

Table 6. Private Timber Harvest Volume 2010-2014

COUNTY	2010 (MBF/YR)	2011 (MBF/YR)	2012 (MBF/YR)	2013 (MBF/YR)	2014 (MBF/YR)	AVERAGE (MBF/YR)
Crook	938	1,519	3,190	735	2,459	1,768
Deschutes	4,961	5,516	539	1,043	9,062	4,224
Jefferson	7,645	8,985	1,611	19,983	9,939	9,633
Klamath	50,225	59,846	64,545	85,425	59,816	63,971
Lake	18,255	11,326	17,240	4,938	11,039	12,560
Wheeler	908	1,449	2,605	5,551	3,796	2,862
Grant	3,073	4,157	5,802	4,952	4,982	4,593
Wasco	59,742	27,030	33,469	31,962	31,752	36,791
TOTAL	**145,747**	**119,828**	**129,001**	**154,589**	**132,845**	**136,402**

Table 7. Public Timber Harvest Volume 2010-2014

COUNTY	2010 (MBF/YR)	2011 (MBF/YR)	2012 (MBF/YR)	2013 (MBF/YR)	2014 (MBF/YR)	AVERAGE (MBF/YR)
Crook	2,301	10,666	7,245	3,666	6,793	6,134
Deschutes	14,378	17,335	19,536	22,384	18,404	18,407
Jefferson	693	526	59	0	172	290
Klamath	44,122	46,877	42,715	38,216	43,289	43,044
Lake	15,915	26,777	6,461	2,312	13,135	12,920
Wheeler	336	51	3,294	793	910	1,077
Grant	14,724	12,866	14,924	8,470	8,837	11,964
Wasco	6,471	1,984	5,057	255	7,852	4,324
TOTAL	**98,940**	**117,082**	**99,291**	**76,096**	**99,392**	**98,160**

Estimating timber harvest volume and residuals within the TSA requires apportioning the county-wide data shown in Tables 6 and 7 to reflect the private and public lands located within the TSA boundary. Geographic Information System (GIS) spatial analysis calculated acres and determined the percent of the county harvest volume that lies within the TSA. Wasco County includes harvest volume for the Warm Springs reservation. Wheeler and Grant County harvest includes a portion of USFS timber volume from the Ochoco National Forest. Klamath County includes some private and public timber from the Deschutes National Forest, BLM, and Gilchrist State Forest, and Lake County includes public timber from the Deschutes National Forest. A percent weighted average timber harvest figure was calculated for each county.

Table 8 shows the estimated average annual timber harvest volume for the TSA. There is on average an estimated 54,472 MBF annual harvest volume on private lands and 37,430 MBF on public lands within the TSA.

Table 8. Private and Public Timber Harvest Volume Estimates in the TSA by County

COUNTY	PRIVATE PERCENT IN TSA	PRIVATE WEIGHTED AVERAGE (MBF/YR)	PUBLIC PERCENT IN TSA	PUBLIC WEIGHTED AVERAGE (MBF/YR)
Crook	100%	1,768	100%	6,134
Deschutes	100%	4,224	100%	18,407
Jefferson	100%	9,633	100%	290
Klamath	5%	2,152	20%	8,609
Lake	0		20%	2,584
Wheeler	0		75%	808
Grant	0		5%	598
Wasco	100%	36,694	0	0
TOTAL		**54,472**		**37,430**

It is worth noting the decrease in timber harvest volumes shown by the current report compared to a 2002 biomass supply study done by TSS for the COIC for the Prineville area.[12] Although the reports are not directly comparable (for example in the size of the TSA), it is possible to compare the ODF data on timber harvest volumes by county. Table 9 and Table 10[13] show timber harvest volume for the three main counties of Crook, Deschutes and Jefferson for the period 2010-2014 vs. 1996-2000. The average harvest volume per year across the three counties including both private and public lands has decreased to 40,456 MBF from 112,389 MBF.

Table 9. Timber Harvest Volumes for the Three Central Counties 2010-2014

COUNTY	2010 (MBF/YR)	2011 (MBF/YR)	2012 (MBF/YR)	2013 (MBF/YR)	2014 (MBF/YR)	AVERAGE (MBF/YR)
Crook-Public	2,301	10,666	7,245	3,666	6,793	6,134
Deschutes-Public	14,378	17,335	19,536	22,384	18,404	18,407
Jefferson-Public	693	526	59	0	172	290
Crook-Private	938	1,519	3,190	735	2,459	1,768
Deschutes-Private	4,961	5,516	539	1,043	9,062	4,224
Jefferson-Private	7,645	8,985	1,611	19,983	9,939	9,633
TOTAL	**30,916**	**44,547**	**32,180**	**47,811**	**46,829**	**40,456**

[12] Prineville, Oregon Market Area Wood Fuel Availability Assessment, prepared for COIC by TSS Consultants, December 2002.
[13] Ibid. Page 4.

Table 10. Timber Harvest Volumes for the Three Central Counties 1996-2000

COUNTY	1996 (MBF/YR)	1997 (MBF/YR)	1998 (MBF/YR)	1999 (MBF/YR)	2000 (MBF/YR)	AVERAGE (MBF/YR)
All Counties: Public and Private	87,115	130,196	155,473	122,273	66,889	112,389
TOTAL	**87,115**	**130,196**	**155,473**	**122,273**	**66,889**	**112,389**

Note: Data from 2002 Wood Fuel Availability Assessment

TSS' experience with forest biomass recovery confirms that a recovery factor of 1.4 bone dry tons (BDT)[14] per MBF of sawlogs harvested would apply for commercial timber harvests in mixed conifer and ponderosa/lodgepole pine stands across the TSA. Table 11 applies this recovery factor to the timber harvest volume estimates shown in Table 8 and calculates timber harvest residuals in BDT/year.

For all biomass sources, TSS has estimated a potentially, technically and economically available volume. The potentially available volume is the total amount of biomass estimated to be produced annually. However, because of limitations in the ability to gather, process, or transport all that is produced, TSS adjusts for recovery to estimate the volume technically available. Not all road systems will accommodate biomass recovery operations. Slope gradient has a significant impact on forest road layout. Slope analysis (see Table 3) confirms that on average, 9.5% of the forested (conifer and juniper) acreage in the TSA is over 35% slope gradient. For the purposes of this feedstock analysis, 70% of the timber harvest operations on publicly managed forest lands and 80% of operations on private forests are located on road systems that will support biomass feedstock transport using conventional chip vans.[15]

Table 11 shows the timber harvest residuals considered technically and economically available on an annual basis. Adjusting for existing uses (see Existing Competition section) within the TSA, approximately 38,750 BDT per year of timber harvest residuals are currently utilized, resulting in about 58,939 BDT per year considered economically available.

[14] One bone dry ton equals 2,000 dry pounds (no moisture content).

[15] Per interviews with land managers operating within the TSA.

Table 11. Total Timber Harvest Residuals Technically and Economically Available

COUNTY	PRIVATE (BDT/YEAR)	PUBLIC (BDT/YEAR)
Crook	2,475	8,588
Deschutes	5,914	25,770
Jefferson	13,486	406
Klamath	3,013	12,052
Lake	0	3,618
Wheeler	0	1,131
Grant	0	837
Wasco	51,372	0
POTENTIALLY AVAILABLE	76,260	52,402
ADJUSTMENT FOR RECOVERY	15,252	15,720
TECHNICALLY AVAILABLE	61,008	36,680
ADJUSTMENT FOR COMPETING USES	38,750	
ECONOMICALLY AVAILABLE	58,939	
TOTAL PRIVATE AND PUBLIC ECONOMICALLY AVAILABLE	**58,939**	

Forest Restoration and Fuels Treatments

Due to high fire danger conditions and overstocked forests, there are concerted efforts across all forest ownerships within the TSA to proactively reduce hazardous forest fuels in support of fire resilient forest ecosystems. Forest landowners are conducting forest thinning activities to achieve fuels treatment and stocking control (reduce the number of trees per acre as plantations or wild stands age over time and tree size increases).

TSS' experience with forest restoration and fuels treatment operations confirms a recovery factor of approximately 12.5 BDT per acre applies for pre-commercial forest thinning operations in ponderosa pine and mixed conifer ponderosa/lodgepole pine/Douglas fir stands within the TSA on private lands and on the Gilchrist State Forest. Federal lands have a lower recovery factor of approximately 5 BDT per acre, due to multiple land management objectives and down woody material retention standards. Table 12 shows results for potential feedstock availability from forest restoration and fuels reduction material on both private and public lands. There is a potential availability of 183,000 BDT per year from within the TSA.

As discussed earlier, slope conditions and terrain will define landscapes that are technically available for forest biomass removal operations. In addition to slope adjustment, an adjustment is also made to account for the fact that not all available forest biomass is recoverable (e.g., road access for chip trucks). For this analysis, TSS assumed an 80% recovery factor on private lands. However, the recovery factor on federal lands was reduced to 70% due to a variety of accessibility issues including road systems that will not accommodate chip trucks. A total of 134,225 BDT per year is technically available.

Adjusting for existing uses (see Existing Competition section) within the TSA, approximately 38,750 BDT per year of forest restoration and fuels treatment residuals are currently utilized, resulting in about 95,475 BDT per year considered economically available.

Table 12. Forest Restoration and Fuels Treatment Activities and Residuals

SOURCE	FOREST TREATMENT ACTIVITIES		AVERAGE (ACRES/YR)	BIOMASS FEEDSTOCK (BDT/YEAR)
	LOW RANGE (ACRES/YR)	HIGH RANGE (ACRES/YR)		
Private (Including Tribal)	1,600	3,200	2,400	30,000
Oregon Department of Forestry, Gilchrist	2,000	3,000	2,500	31,250
Deschutes NF	17,000	19,000	18,000	90,000
Ochoco NF	5,000	6,500	5,750	28,750
BLM (La Pine tract)	500	700	600	3,000
SUBTOTAL	**26,100**	**32,400**	**29,250**	**183,000**
POTENTIALLY AVAILABLE				**183,000**
ADJUSTMENT FOR RECOVERY				**48,775**
TECHNICALLY AVAILABLE				**134,225**
ADJUSTMENT FOR COMPETING USES				**38,750**
ECONOMICALLY AVAILABLE				**95,475**

Western Juniper Removals

Due to successful wildfire suppression activities in the Inland West, invasive plant species such as western juniper (juniper) have proliferated. Primarily impacting wildlife habitat and water availability, the presence of juniper in unnaturally high concentrations is a major resource management challenge facing land managers in the west. In recent years, both federal and state agencies[16] have allocated resources (funding and staff) focused on the removal of excessive concentrations of juniper. Current techniques deployed range from cutting and removing juniper stems, fall and lop juniper stems on site, to fall, pile and burn on site. Occasionally, where juniper stands are located near roads and communities, some firewood, chip material or stem wood will be harvested for value-added uses.[17] Most of the juniper wood that is removed is utilized as firewood.[18] Federal, state and private land managers confirmed that removal of

[16] Natural Resources Conservation Service, Bureau of Land Management, US Forest Service, Oregon Watershed Enhancement Board, US Fish and Wildlife Service and County Conservation Districts.
[17] Uses including animal bedding, landscape timbers, posts, firewood and some solid wood products (tables, mantles).
[18] Discussions with firewood contractors and land managers.

juniper for off-site value-added use is a much more preferable outcome but is relatively rare (only about 10% of the volume treated). Piling and burning of juniper material has clear liabilities (potential for wildfire, impacts to wildlife habitat) and issues (air quality, regional haze, contribution to greenhouse gases). Federal and state funding is available to private land managers to offset the costs associated with treatment of juniper in order to improve watersheds and wildlife habitat.[19] Based on interviews with federal, state and private land managers, TSS found on privately managed rangelands, between 12,000 and 14,000 acres are treated per year within the TSA (primarily in Crook County).[20] Acres treated per year on federal lands range from 3,200 to 4,500 acres within the TSA. Unlike treatment of conifer vegetation types, once juniper landscapes are treated, return maintenance activities are focused on conserving shrub-steppe or old juniper woodland/savanna vegetation cover types. Most maintenance treatments in juniper woodlands target treatment of young juniper reproduction (before it attains merchantable size – 8 to 10 inch diameter).

TSS' experience with juniper removal operations confirms that an average yield of 8 BDT per acre is consistent with juniper stands in south central Oregon on private lands. A lower average yield of 3 BDT per acre was applied to federal lands due to treatment objectives that tend to retain some juniper stems (typically larger, older stems) and include treatment of relatively low density stands.

On private lands, 104,000 BDT per year is potentially available and 11,550 BDT per year from federally managed lands within the TSA.

Slope conditions and terrain will define landscapes that are technically available for juniper removal, processing and transport. In addition to slope adjustment, an adjustment is also made to account for the fact that not all juniper material available will be recovered, primarily due to road access. For this analysis, TSS assumed a 40% recovery factor on private lands and a 40% recovery factor on federal lands.[21] This results in technical availability of juniper residuals of 46,220 BDT per year within the TSA. Between personal-use and commercially harvested firewood, landscape timbers and posts, TSS estimates about 20,000 BDT per year of juniper material is already utilized within the TSA resulting in an economically available estimate of 26,220 BDT per year within the TSA. These figures are summarized in Table 13.

[19] Natural Resource Conservation Service, Oregon Watershed Enhancement Board.
[20] Per discussions with Natural Resource Conservation Service, Crook County office.
[21] Federal land managers interviewed cited a number of issues that impact road access including concerns regarding the limited number of existing roads, rocky landscapes, and sensitive soil conditions.

Table 13. Western Juniper Treatment Activities and Residuals

SOURCE	FOREST TREATMENT ACTIVITIES		AVERAGE (ACRES/YR)	BIOMASS FEEDSTOCK (BDT/YEAR)
	LOW RANGE (ACRES/YR)	HIGH RANGE (ACRES/YR)		
Private	12,000	14,000	13,000	104,000
BLM - High Desert	2,000	3,000	2,500	7,500
BLM - WUI	400	500	450	1,350
Ochoco NF	800	1,000	900	2,700
SUBTOTALS	**15,200**	**18,500**	**16,850**	**115,550**
POTENTIALLY AVAILABLE				**115,550**
ADJUSTMENT FOR RECOVERY				**69,330**
TECHNICALLY AVAILABLE				**46,220**
ADJUSTMENT FOR COMPETING USES				**20,000**
ECONOMICALLY AVAILABLE				**26,220**

Forest Products Manufacturing Residuals

The Central Oregon region is home to a relatively small number of commercial-scale forest products manufacturing operations. With the recent closure of Warm Springs Forest Products, the only remaining sawmill within the TSA is Interfor Corporation's facility at Gilchrist. Facilities such as Interfor's Gilchrist operation generate byproducts in the form of sawdust, bark, hogfuel, chips and shavings. Traditionally these residuals are utilized for fuel or feedstock to support value-added end uses such as production of process steam (to dry lumber or veneer), power, landscape cover, composite panels (hardboard and particleboard), fuel pellets and/or pulp and paper. These end uses represent well-developed markets, with much of the residuals committed under long-term purchase agreements. For the purpose of this feedstock availability analysis, TSS found that forest products manufacturing within the TSA are already committed to well established markets and are not considered economically available.

Summary of Forest and Juniper Woodland Biomass Availability

Table 14 summarizes forest and juniper woodland biomass availability within the TSA.

Table 14. Forest and Juniper Woodland Sourced Biomass Availability

SOURCE	POTENTIALLY AVAILABLE (BDT/YEAR)	TECHNICALLY AVAILABLE (BDT/YEAR)	ECONOMICALLY AVAILABLE (BDT/YEAR)
Timber Harvest Residuals	128,662	97,689	58,939
Forest Restoration and Fuel Treatment Residuals	183,000	134,225	95,475
Western Juniper Treatment Residuals	115,550	46,220	26,220
Forest Products Manufacturing Residuals	0	0	0
TOTAL	**524,901**	**375,823**	**180,634**

Urban-Sourced Biomass

Construction and Demolition Wood

Local residents, businesses, and construction projects within the TSA regularly produce wood waste in the form of construction debris, demolition wood and industrial byproducts (e.g., wood pallets). The Oregon Department of Environmental Quality (DEQ), Land Quality Division, conducted the Oregon Statewide Waste Composition Study in 2009.[22] DEQ estimates approximately 1,300 pounds per capita of solid waste are generated annually. Usable wood waste (hog fuel, clean lumber, wood pallets) constitute 7.1% of the solid waste stream.[23] Urban wood feedstock is assumed to have a 20% moisture content factor.[24] TSS experience indicates approximately 65% of the potential volume is recoverable as clean wood feedstock and considered technically available.

Table 15 uses 2015 county population data and identifies clean urban wood waste considered economically available in the TSA. Due to the relatively low market value of clean processed construction and demolition wood, most is sold to biomass power plants as fuel and almost completely utilized, resulting in very little being considered economically available.

[22] Oregon Department of Environmental Quality, Waste Composition Study: http://www.deq.state.or.us/lq/sw/disposal/wastecompstudy2009.htm
[23] Waste Composition Study Downstate (all but Metro) waste composition table.
[24] From TSS' experience procuring urban wood waste feedstocks.

Table 15. Construction and Demolition Wood Waste

COUNTY	POPULATION 2015	WOOD WASTE VOLUME (LBS)	WOOD WASTE DRY VOLUME (LBS)	WOOD WASTE FEEDSTOCK (BDT)
Jefferson	22,192	2,048,322	1,638,657	737
Deschutes	170,388	15,726,812	12,581,450	5,662
Crook	20,998	1,938,115	1,550,492	698
POTENTIALLY AVAILABLE		19,713,249	15,770,600	7,096
ADJUSTMENT FOR RECOVERY				2,483
TECHNICALLY AVAILABLE				4,612
ADJUSTMENT FOR COMPETING USES				4,500
ECONOMICALLY AVAILABLE				**113**

Residential Tree Trimming Material

Yard debris also generates usable feedstock in the form of tree trimmings, pruning's, and stumps. Based on the Oregon DEQ Waste Composition Study, these materials constitute 1.59% of the solid waste stream. TSS assumes approximately 65% of this wood waste is recoverable as feedstock. However, based on TSS' experience, many homeowners in small towns and rural areas are utilizing tree trimming material as compost or firewood.[25] In addition, other competing uses such as hog fuel for bioenergy typically utilize most of this material. TSS assumes that most of the tree trimming material is not available due to these competing uses.

In addition to tree trimmings, residents of the TSA generate wood waste as a result of county sponsored fire safe programs conducted annually. Known as the Fire Free program in Jefferson and Deschutes County, and Free Debris Day in Crook County, local residents are encouraged by county fire and solid waste departments to deliver brush, limbs and small stems to local transfer stations and landfills. Tip fees are waived for the duration of the program (typically 10 days for the Knott Landfill and one or two weekends per year at the transfer stations). Interviews with County personnel confirmed that about 1,950 BDT of wood waste per year are delivered to transfer stations and landfills within the TSA during the Fire Free/Free Debris programs. Interviews with solid waste department personnel and local fire marshal confirmed that most of this wood waste is processed using grinders with end uses such as compost and alternative daily cover.[26] Compost markets are considered inconsistent, with most of this material (67%) currently being utilized as alternative daily cover at local landfills.

Table 16 calculates tree trimming material considered economically available within the TSA, indicating there is approximately 936 BDT per year economically available.

[25] Ibid.
[26] Chad Cintola, Operations Manager, Solid Waste Department, Deschutes County, Casey Kump Fire Marshal, Crook County and Melanie Widmer, Madras Sanitary.

Table 16. Tree Trimming and Fire Safe Material

COUNTY	POPULATION 2015	TREE TRIMMING WASTE VOLUME (LBS)	TREE TRIMMING WASTE FEEDSTOCK (BDT)
Jefferson	22,192	45,871	21
Deschutes	170,388	352,192	158
Crook	20,998	43,403	20
Fire Free and Free Debris (all counties)			1,950
POTENTIALLY AVAILABLE			2,149
ADJUSTMENT FOR RECOVERY			752
TECHNICALLY AVAILABLE			1,397
ADJUSTMENT FOR COMPETING USES			461
ECONOMICALLY AVAILABLE			**936**

Table 17 summarizes urban-sourced biomass feedstock available within the TSA.

Table 17. Urban-Sourced Biomass Feedstock Available

SOURCE	POTENTIALLY AVAILABLE (BDT/YR)	TECHNICALLY AVAILABLE (BDT/YR)	ECONOMICALLY AVAILABLE (BDT/YR)
Construction and Demolition	7,096	4,612	113
Tree Trimming	2,149	1,397	936
TOTALS	**9,245**	**6,009**	**1,049**

FEEDSTOCK COMPETITION ANALYSIS

Existing Competition

There are approximately 10 commercial-scale facilities currently sourcing woody biomass material from within the TSA. Three are biomass power generation facilities, one composite panel operation, one charcoal production facility, four pulp/paper facilities (three in Washington), and one animal bedding facility. Several log yards located within the TSA procure chip logs when pulp chip prices support processing, and transport of paper grade chips to pulp mills. One of the logyards is collocated with a recently installed post and pole operation. A fuel pellet manufacturing facility[27] is operating within the TSA, but they declined to provide data regarding their operations. It is believed that the fuel pellet operation procures primarily sawmill residuals (dry Douglas fir shavings).

In addition to the commercial-scale facilities, there are commercial firewood operations located within the TSA that utilize conifer and/or juniper roundwood as raw material.[28]

As for juniper log utilization, there are two commercial-scale sawmill operations (one sawmill is collocated with a post peeling facility) sourcing juniper feedstock from within the TSA.[29] TSS is not aware of any whole stem recovery of juniper that is being processed into hog fuel for delivery to biomass power plants.

The biomass power generation sector has procured forest biomass fuel from the TSA for decades. In recent years this sector has been severely impacted by a general downturn in the market value of renewable power. In addition, fossil fuel prices (natural gas) have dropped significantly, and this has caused energy prices in general to drop. Some Oregon facilities (e.g., Biomass One, White City) are now being compensated to curtail operations (pay for curtailment). The market for hog fuel material within the TSA is somewhat inconsistent.

There are two biomass thermal facilities operating within the TSA, and both are utilizing fuel pellets as their primary fuel source.[30] Several biomass thermal facilities are in the design stage (see Potential Competition section).

Potential and Emerging Competition

<u>Biomass Power Generation</u>

Within the last 10 years, there have been repeated attempts to develop commercial-scale biomass power plants in central and southern Oregon at Warm Springs, La Pine, Klamath Falls, and Lakeview. Due to the significant drop in renewable power prices in recent years, all of these initiatives have been curtailed. TSS is aware of only one commercial-scale bioenergy facility being planned that might source biomass fuel from the TSA – the BioGreen Sustainable Energy

[27] Pacific Pellet, Redmond, Oregon.
[28] Sisters Forest Products, Intermountain Wood Energy, and Dean Innovations.
[29] Per discussions with Oregon State University Crook County Extension.
[30] Sisters High School and Deschutes National Forest – Supervisor's Office.

facility planned for the Finley Butte Industrial Park at La Pine. In the planning phase since 2009, this 24.9 megawatt facility just renewed a lease option for a 20 acre site at the industrial park.[31]

Biomass Thermal

The recent downturn in the cost of natural gas and propane has been a deterrent to the expanded use of forest biomass thermal heating systems. TSS is aware of several biomass thermal heating projects being considered, including a 2.8 million Btu[32]/hour system at Mt. Bachelor and a 14 million Btu/hour system at the Oregon State University Cascade Campus in Bend. Together, these two systems may utilize a total of 3,500 BDT of wood waste fuel annually.[33] In addition there are other biomass thermal projects under consideration in Prineville and Bend.[34] All of these new installations are targeting biomass boiler technology that would facilitate use of biomass in chip form (hog fuel), similar to the system being installed at Burns, Oregon.

Advanced Biofuels

Red Rock Biofuels is planning to commence construction on a 15 million gallon per year advanced biofuels facility Q3 of 2016. Commercial operation should start Q2/Q3 of 2018. Primary products produced include renewable jet fuel and renewable diesel. Forest feedstock utilized includes timber harvest residuals, pre-commercial thinning material and juniper material. Total volume of woody biomass utilized is forecast at 140,000 BDT per year with 10% to 15% sourced from within the TSA.

Torrefied Fuel

Oregon Torrefaction is a new venture that is planning to convert forest biomass into torrefied fuel as a replacement for coal. Their website[35] suggests that the public-private partnership plans to develop a biomass torrefaction facility in Grant County. The primary market for the torrefied fuel produced appears to be the Portland General Electric (PGE) coal-fired power generation facility at Boardman. PGE has plans to stop utilizing coal as a primary fuel by 2020. It is likely that a torrefied fuel manufacturing facility in Grant County would source woody biomass material from the TSA. The project is the recipient of a 2016 Wood Innovation Grant from the US Forest Service.

Biochar

Cascade Carbon, LLC is operating a small-scale biochar conversion facility at Prineville. Currently rated at about ½ ton per hour woody feedstock usage, the facility is being operated intermittently as they test various feedstocks and produce custom biochar on a contractual basis. The facility has the ability to utilize a wide range of feedstocks. There are discussions to ramp up utilization to 2 tons per hour of feedstock usage. Should this occur, the facility could utilize 2,000 to 3,000 BDT of woody biomass per year.

[31] Per Jane Burton, LaPine Area Economic Development Manager.
[32] Btu = British thermal unit.
[33] Per discussions with Wisewood.
[34] Per discussions with Central Oregon Intergovernmental Council staff.
[35] http://www.oregontorrefaction.com/about.html

Post and Pole

Quicksilver Contracting has developed a commercial-scale post and pole operation at La Pine that will utilize small logs. Products produced include posts, poles, and pulp chips. The facility is currently in startup but should be in full commercial operation Q2 2016.

Other post and pole operations in the TSA include:

- Round Tree Lodgepole Products, La Pine
- All American Timber Company, La Pine
- Ketchum Wood Products, Bend

Western Juniper Utilization Integrated Campus

Forest Energy Group, LLC is in the process of conducting a siting analysis for the location of an integrated biomass utilization campus likely in northern Klamath or Lake County.[36] Plans are to target western juniper as the primary feedstock with a variety of products produced including densified fire logs. The project is the recipient of a 2016 Wood Innovation Grant from the US Forest Service.

[36] Per discussions with Stephen Lawn, Forest Energy Group, LLC.

BIOMASS SUPPLY AVAILABILITY FINDINGS

Table 18 provides a summary of woody biomass material available by source produced within the TSA. Note that these estimates are based on interviews and data collected from a variety of sources (see Acknowledgments). Current market demand for biomass within the TSA is very dynamic due to a variety of factors.

- ➢ Pulp chip prices are dropping as a result of recent changes in market conditions (e.g., international chip prices, oversupply of sawmill residual chips).

- ➢ Renewable energy wholesale market prices are forcing existing biomass power plants to reduce generation due to the relatively high cost to produce biomass power.

- ➢ There are new emerging markets for biomass developing within the region that may impact biomass availability[37] within the TSA in the near term. The Oregon Torrefaction and Forest Energy Group projects are in very early stage development:

    - o Quicksilver Contracting, La Pine
    - o Red Rock Biofuels, Lakeview
    - o Oregon Torrefaction, John Day
    - o Forest Energy Group, Northern Klamath or Lake County

Table 18. Biomass Availability Summary

SOURCE	POTENTIALLY AVAILABLE (BDT/YEAR)	TECHNICALLY AVAILABLE (BDT/YEAR)	ECONOMICALLY AVAILABLE (BDT/YEAR)
Timber Harvest Residuals	128,662	97,689	58,939
Forest Restoration and Fuel Treatment Residuals	183,000	134,225	95,475
Western Juniper Treatment Residuals	115,550	46,220	26,220
Forest Products Manufacturing Residuals	0	0	0
Construction and Demolition	7,096	4,612	113
Tree Trimming	2,149	1,397	936
TOTAL	**436,457**	**284,143**	**181,683**

[37] Note that several of these projects are in very early phase development and may not achieve commercial operation.

BIOMASS PRICE ANALYSIS

Current Market Prices

Summarized in Table 19 are current market prices paid by end users for forest biomass sourced from wood operations within the TSA. Some end user market data was not available (e.g., fuel pellet raw material).

Table 19. Current Biomass Wood Waste Market Prices[38]

END USER	DELIVERED PRICES TO EXISTING COMMERCIAL USERS	
	LOW RANGE	HIGH RANGE
Biomass Power	$22/BDT	$42/BDT
Pulp/Paper	$105/BDT	$120/BDT
Chip Logs (small logs for pulp/paper or animal bedding)	$18/GT	$32/GT
Composite Panels	$75/BDT	$85/BDT

Delivered Cost Forecast

The cost to collect, process and transport woody biomass material within the TSA is dependent on a number of factors, including capital expense of equipment and labor, but a major driver is the cost of diesel fuel. Depending on the equipment deployed and the haul distance to market, between two and four gallons per BDT of diesel fuel can be required.[39] For the purposes of this delivered cost forecast, TSS assumed a one-way haul distance of 50 miles, 16 BDT per delivered load, and $85 per hour transport cost. Table 20 shows the delivered cost forecast.

Table 20. Biomass Collection, Processing, and Transport Costs

BIOMASS SOURCE	LOW RANGE ($/BDT)	HIGH RANGE ($/BDT)
Timber Harvest Residuals	$42	$48
Forest Restoration and Fuel Treatment Residuals	$48	$58
Western Juniper Treatment Residuals	$60	$80

Note: Cost assumes no cost share arrangement with NRCS, USFS, OWEB and BLM.

[38] Based on May 2016 market data.
[39] Based on interviews with contractors and landowners within the TSA.

OBSERVATIONS

Biomass Availability – 2016 compared to 2002

Biomass availability analysis tools have improved considerably since 2002. GIS data is more accurate, land managers have more experience tracking forest and woodland residual recovery, and agencies (e.g., USFS, BLM) are accounting for treatment activities in more detail. Funding for vegetation treatment has improved and evolved over time to address wildlife habitat (e.g., sage grouse habitat improvement) in addition to overall forest or woodland health and fuels reduction. Perhaps the most significant difference is the drop in commercial sawlog harvest (see tables 9 and 10). Unfortunately, with the recent closure of Warm Springs Forest Products Industries, the market demand for sawlogs is trending lower in the region. Discussions with logging contractors and land managers operating within the TSA confirm a drop in sawlog prices.

The 2002 biomass availability analysis found between 162,000 and 324,000 BDT per year potentially available, while the 2016 analysis found between 181,683 and 436,457 BDT per year available.

Key Barriers to Value-Added Biomass Market Development

Posted below are TSS observations regarding barriers to value-added utilization of excess biomass generated within the TSA.

- The cost to collect, process and transport woody biomass material is significant. This severely limits transport opportunities to key urban markets like Portland.

- Wholesale market prices for renewable power have dropped considerably in recent years, limiting opportunities for existing facilities to operate at capacity (utilities seeking pay for curtailment arrangements) or new biomass power generation projects to be developed.

- Fossil fuel prices such as natural gas and propane have dropped precipitously in the last five years thus impacting the financial viability of alternative thermal energy projects using waste wood as the primary fuel source.

- The capital expenses associated with a commercial-scale value added utilization enterprise can be considerable. In order to secure financing, product offtake agreements for products produced are required (e.g., posts, poles, power, compost, advanced biofuels). Offtake agreements can be challenging to secure, for example, power purchase agreements for renewable power are not readily available at price levels that allow for financially viable operation.

- The economically available biomass estimate (181,683 BDT per year) is a conservative figure as it assumes that existing competition (inside and outside the TSA) will continue to be price competitive. New biomass utilization ventures

within the TSA, if price competitive could outcompete existing users and have ready access to biomass volume exceeding 181,683 per year.

Biomass Currently Burned

Approximately 181,683 BDT per year is estimated to be economically available within the TSA. Interviews with land managers in the region indicate that between one fifth and one quarter of this volume (36,336 to 35,420 BDT per year) is targeted for burning with prescribed fire or pile and burn techniques. These figures vary considerably as a result of limited opportunities to burn due to regional concerns regarding air emissions, regional haze and weather conditions (resulting in narrow burn windows). In recent years, land managers have been very motivated to limit biomass burning due to a variety of concerns weighted heavily due to liability (fire escape), and greenhouse gas release.

Timber Sale and Service Contracts on Federal Lands

Both the USFS and BLM conduct land management activities using a variety of contracting mechanisms: stewardship contracts, timber sale contracts, service contracts and force accounts (in-house agency crews). Both agencies maintain U.S. Small Business Administration (SBA) protocols to set aside a certain percentage of projects for contracting with small businesses.

For the USFS, approximately 33% of projects are set aside for small businesses in the Deschutes Market Area (Deschutes NF) and 69% of projects are set aside in the Prineville Market Area (Ochoco NF). To qualify as a small business, firms must have less than $11 million dollars in annual revenue or less than 500 employees.

For BLM projects, the SBA set aside is administered on a state-wide basis (not district-wide). As with the USFS small business standard, firms must have less than $11 million dollars in annual revenue or less than 500 employees. In addition, the USFS and BLM administers fuels management services contracts that have a small business threshold with firms have less than $19 million in annual revenue. If the agency is administering forest health/stand improvement activities (including pre-commercial thinning) a separate category known as Support Activities for Forestry applies targeting small businesses with less than $7.5 million in annual revenue.

Biomass Supply Overview

Note that the economically available estimate of 181,683 BDT per year represents a significant volume of biomass material. This volume will support numerous community-scale biomass thermal projects or up to about 22 megawatts of baseload[40] biomass power. In addition to traditional bioenergy uses, other value-added products (bio-chemical, advanced biofuels) may provide alternative cost effective end use markets.

[40] Year round, 24/7 power.