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Technical and Economic Considerations for Utilizing Industrial and Urban Wood Wastes as Wood Fiber Extenders in Oregon's Panelboard Plants

Agricultural Experiment Station
Oregon State University

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A Research Study supported by
Oregon Department of Agriculture
Oregon Department of Energy
Oregon Agricultural Experiment Station
and
Contributing Panelboard Firms:
Timber Products
Weyerhaeuser Co.
Dee Forest Products

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by

International Resources Unlimited

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PREFACE

This study emerged from a number of sources concerned about availability of fiber raw materials used to produce pulp/paper products, panelboard, pellet/log fuels, and fuel for power plants. Dwindling traditional supplies of wood fiber has Oregon's users of these raw materials searching for alternative fiber sources. Willamette Valley's major grass seed industry also is searching, but markets for its grass straw, a by-product of grass seed production, have been limited.

In the case of pulp/paper manufacture, a number of research efforts are underway to assess the technical and economic requirements for utilizing grass straw as a fiber extender to produce pulp and paper products.

In the case of reconstituted panelboard manufacture, industrial and urban wood waste now going into Oregon landfills looked like a potentially viable source of wood fiber. Yet little was known about the nature of this fiber source. Concern that agricultural straw fibers might require modification of existing plant and equipment, utilization of an unknown and perhaps costly factor, prompted this investigation to look at industrial and urban wood waste ahead of agricultural fibers.

Funding for the study was provided by the Oregon Department of Agriculture (ODA), the Oregon Department of Energy (ODE), the Agricultural Experiment Station, Oregon State University, and three Oregon panelboard manufacturers. The contributing panelboard companies are Dee Forest Products, Timber Products, and Weyerhaeuser.

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EXECUTIVE SUMMARY

Oregon Department of Agriculture (ODA), with assistance from the Oregon Department of Energy (ODE), three Oregon panelboard manufacturers, and the Agricultural Experiment Station, Oregon State University funded the first statewide attempt to determine the volumes of Oregon wood waste currently burned and landfilled that could be converted into a raw material for the manufacture of reconstituted panelboard. By-products of sawmills and plywood plants historically have been the source of virgin wood material used by the panelboard industry.

Under present and pending constraints on public timberland harvests, availability of virgin wood residual has been severely restricted and this is expected to continue in the foreseeable future. Slow economic recovery in the U.S. has dampened wood residue demand, thus buying time for the Oregon panelboard industry to search for alternative fiber sources. Reclamation of wood waste now going into landfills is perceived by the industry as the best substitute for virgin wood fiber, at least as a fiber extender. Yet, little is known about landfills as a source of wood waste, their number and location in the state, the make-up of their waste stream, the tonnage and quality of their wood waste, and reclamation (processing) requirements and costs for wood wastes to be utilized from that source. Preliminary EPA and Portland Metro estimates in 1992 indicated that nearly 400,000 tons of wood waste annually were being reclaimed.

The study surveyed 126 public and private landfills in Oregon with some two-thirds responding. Additionally, all 27 wood-waste recovery firms surrounding the Portland metropolitan area were interviewed and site visits were performed.

Perhaps the most significant observation from the study was the nearly universal lack of knowledge--by both the waste management industry as potential suppliers of wood waste and the panelboard industry as potential users--concerning the nature and extent of wood entering the waste stream, its potential for reclaiming, and the economics of doing so. If anything, this study serves as a "wake-up call" on urban and industrial wood waste utilization.

When the study was initiated in early 1993, wood waste was recovered from construction, demolition, urban, and industrial sites only in Portland, Salem, Eugene, and Medford metropolitan areas. Only the Portland Metro area had an aggressive wood-waste reclamation program in place and it was relatively new, with several of its wood-waste processors having come on-line only recently. Now several communities, particularly those with strong growth pressures, are investigating the value of reclaiming wood waste.

Also, at study inception only three of 16 panelboard producers in Oregon were using waste wood as a raw material. Since then, all Oregon panelboard producers have initiated use of wood-waste material as extenders to their traditional supplies of virgin wood raw material, an important economic indicator of the economic viability of this raw material source. One company has announced plans to use cereal straw as a wood fiber extender.

Historically, wood waste, some 6 to 12 percent of the total waste stream in Oregon, has been burned or sent to landfills to be burned or buried. Near-zero cost of site burning and low disposal (tipping) fees at landfills encourage such disposal practices rather than reclamation. A number of areas along the coast and in eastern Oregon continue such practices. In the more densely populated metropolitan areas, concerns with high waste volumes, high land values, and high transportation costs contribute to the desire to remove materials from the waste stream, including wood waste, for reclamation.

The urban areas in western Oregon, covering eight counties and containing two-thirds of Oregon's population, generate most of the wood-waste stream. In 1992, nearly 400,000 tons of wood waste from landfills in Oregon were utilized, principally as hog fuel for power generation. Three urban centers have wood-waste recovery programs. A fourth center is being considered for central Oregon. While an additional 100,000 tons annually are known to go into landfills, this figure is much lower than actual, but unknown, amounts. The reasons for this include:

- Limited knowledge of wood wastes going into Oregon landfills by landfill operators,
- Significant under-reporting of wood-waste volumes entering reclamation streams in the Portland Metro region in 1993 when Metro announced higher fees for wood reclamation at the time of the study,
- Ten counties initiating or investigating potential wood-waste management programs, principally by private firms or timber products mills rather than landfill operations.

Wood-waste processing for separation into a full range of use categories is in infancy and, to date, limited principally to the three regional centers. Little is known about the alternative process requirements and their costs for separating various wood wastes, other than the preferred low-cost choice of site separation of wood materials to minimize contamination with non-wood materials. Much wood waste has contaminants (metal, paint, chemicals, pesticides, and chemical resins) that, unless removed or separated from clean wood at source site, are costly to separate and degrade wood to low-valued hog fuel. Market demand for wood fiber is highest in production of the higher-valued products that also have the most stringent wood furnish requirements. Pulp and paper production ranks highest, followed by panelboard, pellet/log fuels, and finally hog fuel for power plants.

The amount of landfill wood waste available may represent no more than 5 or 6 percent of the estimated total volume of wood residues currently used in the Pacific Northwest. However, it appears to be at least a partial offset for the large residue supply reductions from lumber mill closures and major timber harvest reductions on public lands.

Substantial volumes of virgin wood from timber slash and agricultural orchard prunings appear to be additional potential wood fiber sources. Some 3 to 6 million tons annually from slash have been estimated. Access to such wood fiber on public lands, however, is in the courts. The economics of recovery on private lands is being investigated, and pilot recovery operations are underway. The volume of orchard prunings is estimated at a quarter to three-quarters of a million tons annually and located in The Dalles/Hood River, Willamette Valley,

and southern Oregon regions. If the economics of recovery, while unknown, are not prohibitive from these sources, the strongest demand is likely to come from pulp/paper followed by panelboard mills where high-quality virgin wood fiber is a necessary and significant proportion of the raw materials mix.

Grain straw and grass straw in Oregon, totalling some 4 million tons annually, provide a large potential fiber source. With exception of a small market for grass straw in Japan, very little of such straw is utilized currently. Low bulk density contributing to high densification and transportation costs, sensitivity to degradation by weather, and technical qualities somewhat different from wood fiber that may require some plant modification for it to be utilized, have been contributing factors in panelboard industry preference for wood fiber. Marked increases in wood fiber prices recently and limited supply of wood fiber from industrial and urban wood waste are spurring interest and investigation by pulp/paper and panelboard plants into these alternative fiber sources.

CHAPTER 1: INTRODUCTION AND BACKGROUND

The forest products industry in the Pacific Northwest is facing a severe virgin timber supply shortage. Some 163 forest products mills have closed in the four-year period since 1990 in Oregon, Washington, Idaho, and California. In Oregon alone, 178 mills have closed since 1980. The number of mills remaining in Oregon total 199 (Ehinger). Reduced availability of timber from public forest lands is a major factor. Forest product mills provide a by-product of wood residuals largely in the form of wood chips, mill ends, sawdust, shavings, and plywood trimmings that serve as raw material for firms that produce paper products, panelboard products, compost, pellet/log fuels, and feedstock (fuel) for power plants. Overall supply of these traditional wood residuals has declined markedly and is not expected to increase.

On the demand side, the market for wood residuals is increasing. An upturn in the U.S. economy with enhanced new housing starts is strengthening markets for wood and paper products. The increased demand, combined with reduced supply of wood residuals, is resulting in a marked increase in their price. This condition provides a favorable climate to search and utilize alternative, and heretofore unused, or underutilized, sources of fiber materials to offset or extend the traditional source of virgin wood fiber.

Alternative fiber sources that have not been economic to utilize until now may become feasible for utilization. These fiber sources include:

- Urban wood waste (currently landfilled or burned)
- Industrial wood waste (currently landfilled or burned)
- Logging residues (currently left to rot or slash burned)
- Agricultural residues
  - grass and grain straws
  - orchard and vineyard prunings
  - food processing residues (including nut shells and cannery waste)

Industrial and urban wood wastes are being considered by panelboard firms in Oregon as possible extenders for traditional virgin wood fiber sources. Firms in the pulp and paper industry are looking at grass straw as an extender in production of corrugating medium. Wood residual compost users are looking for alternative composting sources as bark dust and chip prices rise. Reclamation of logging slash in the woods is beginning to be investigated.

The panelboard industry of Oregon perceives that reclamation of wood waste now going into landfills may provide the best substitute for virgin wood fiber, at least as a fiber extender. However, little is known about landfills as a source of industrial and urban wood waste, their number and location in the state, the make-up of their waste stream, the tonnage and quality of their wood waste, and reclamation (processing) requirements for wood wastes to be utilized by panelboard plants.

Agricultural fibers, principally grain and grass straws, may also be potential wood fiber extenders for the panelboard industry. A critical look at agricultural fiber sources has not yet been undertaken because of technical concerns that existing processes might require significant capital modification of existing plant and equipment to accommodate agricultural fibers. This perceived situation is a factor in the panelboard industry preference for investigating industrial and urban wood wastes and forest slash potentials before looking at agricultural fiber sources.

This study addresses the role and potential of urban and industrial wood waste as wood fiber extenders in Oregon's panelboard industry. A preliminary review of the availability of forest slash and agricultural fiber sources also will be undertaken.

CHAPTER 2: NATURE OF THE STUDY

Specific objectives of the study are:

1. To determine if industrial and urban wood wastes represent the most economic supplement to virgin wood fiber for Oregon's panelboard industry and, if so, to ascertain the technical and economic basis for such preference.
2. To estimate the volume of urban and industrial wood waste generated in Oregon and their locations.
3. To determine the extent and nature of wood fiber reclamation underway in Oregon.
4. To assess the demand for reclaimed wood residuals including feedstock (fuel) for power plants and wood products uses and the processed forms desired.
5. To provide a preliminary assessment of the economic factors influencing wood waste utilization, including materials separation, processing, tipping fees, & transportation components.
6. To compare projected virgin timber harvest and wood products production forecasts to determine total wood fiber demand and the potential role of industrial and urban wood waste recovery as a supply source.

This study is the first known effort at identifying the nature and importance of industrial and urban wood waste going into landfills in Oregon.

To conduct the study, a survey of public and private landfills and wood-waste processors in Oregon was undertaken. This includes the facilities on Oregon's Department of Environmental Quality (DEQ) Solid Waste Permit List Shown in **Appendix C**, some 126 private and public landfills around the state and 27 wood-waste processors in the Portland Metro area. A survey questionnaire was sent to each landfill. Follow-up phone calls and FAX letters were sent to non-respondents. A copy of the survey document with accompanying explanatory letter is shown in **Appendix D**. On-site interviews were conducted with each of the 27 wood-waste processors.

Results of the study are reported in the following manner. CHAPTER 3 reviews the forest products industry in the Pacific Northwest. CHAPTER 4 reports the results of the survey of Oregon landfills. This includes availability of wood waste by region and county, reclaiming practices, and economic forces influencing wood-waste reclamation. CHAPTER 5 specifies the sources of market demand for wood fibers. This includes pulp and paper, reconstituted panelboard, fuel, and compost markets. CHAPTER 6 provides a general overview of forest slash and agricultural residues available as potential sources of fiber. CHAPTER 7 provides study conclusions.

Literature is cited in **Appendix A**. A Glossary is provided as **Appendix B** to define technical terms used in the study.

CHAPTER 3: THE PACIFIC NORTHWEST FOREST PRODUCTS INDUSTRY

The Pacific Northwest has encountered major reductions in timber harvests in recent years. Environmental concerns and endangered species acts have reduced dramatically the acreage of land on which timber can be harvested, particularly on public lands. Nowhere is this more pronounced than in Oregon. **Table 1** shows Oregon timber harvest for the most recent 5-year period from 1988 through 1992. During that period, total timber harvest from both public and private lands declined from 8.6 billion board feet to 5.7 billion board feet, a 34 percent reduction. Timber harvest on public lands, however, declined from 5.1 to 2.2 billion board feet, a 58 percent reduction. Timber sales on public lands represented 62 percent of total timber sales in 1988. This declined to less than 40 percent in 1992. Volume of timber sales on private lands have been steady or increased slightly during the same time period. Those harvest levels are expected to increase even more on private lands in the near future in anticipation of more stringent harvest rules being enacted there as well (*The Oregonian*, 1994).

The substantial decrease in supply of virgin fiber will continue into the future, both on public and private lands. Decreased harvest levels directly impact the quantity of virgin wood residuals available for use by the secondary wood products industry which includes pulp and paper, panelboard, power generating, and compost firms.

Table 1. Oregon Timber Harvest by Ownership, 1988-1992
(Millions of Board Feet) [a]

Year	Private Lands	Public Lands					Public Lands as % of total	Total
		State	NF [b]	BLM [c]	BIA [d]	Other [e]		
1988	3259	270	3487	1439	121	39	62.2	8615
1989	3721	198	3307	1026	124	44	55.8	8420
1990	3229	137	2014	704	98	37	48.1	6219
1991	3312	91	2068	486	87	36	45.5	6080
1992	3570	135	1403	483	111	29	37.6	5731

[a] An approximation of current timber grade out is as follows. Some 4.87 board feet of timber, Scribner scale, converts to 1 cubic foot of volume of the following products:

0.67	cu. ft.	lumber
0.18	" "	wood chips
0.09	" "	hog fuel
.06	" "	sawdust
1.00		

[b] National Forest Lands; [c] Bureau of Land Management Lands; [d] Bureau of Indian Affairs Lands;
[e] County Lands, all in Western Oregon

Source: Oregon State Department of Revenue, U.S. Forest Service, Bureau of Land Management, Oregon State Department of Forestry, U.S. Bureau of Indian Affairs and compiled by Bob Bourhill of the Oregon State Forestry Department.

Table 2 provides a projection of expected timber harvest levels and resulting lumber and plywood production in Oregon throughout the decade of the 1990's developed for Clinton's Timber Conference in 1993 under the Option 9 Plan.

Table 2. Oregon Production Levels and Projections of Timber Harvest, Lumber, and Plywood, 1985-2000

Year	Timber Harvest of all Lands (Millions of Board Feet)		Structural Panel
	Standing Timber (Log Scale)	Lumber Products (Lumber Scale) [a]	(Million sq. ft. 3/8" basis)
1985 - 1989	8.424 (ave.)	8.264	5.500
1990	6.219	7.511	5.500
1991	6.080	6.595	4.040
1992	5.731	6.199	4.308
1993	5.100	5.780	3.349
1994	4.700	5.202	2.523
1995	4.200	4.682	2.610
1996 - 2000	4.200	4.214	N/A

[a] Board foot measurement of lumber products in the table exceeds that shown for standing timber in a number of instances. This is due to differences in board foot measurement scales used at each stage of lumber processing. Board foot (log scale) is measured once a tree has been felled and cut into log lengths for transport. Board foot (lumber scale) is measured after as log has been processed into lumber products. Further, each additional time that wood is handled and/or processed, another form of measurement is used. No attempt has been made to reconcile measurement discrepancies in the study.

Source: Prepared for President Clinton's 1993 Timber Conference in Oregon under Plan 9 Option. Contributors included Oregon Economic Development Department, U.S. Forest Service, American Plywood Association, and the IRU Group.

With adoption of the Clinton Administration's proposed Option 9 for management of Pacific Northwest public forest lands, timber harvest levels and resulting lumber and structural panel production through 1996 are expected to be approximately half of the 1985-1989 average. This represents record low timber harvests. This shortage is the economic force driving the price of virgin fiber, finished wood products, wood residuals for by-products, and fuel feedstock to higher levels. To survive in this environment, forest products companies (mills) as primary wood fiber users are becoming more efficient in reducing fiber loss through recovery methods and enhanced manufacturing processes. These improvements impact the secondary wood products industry by reducing the quantity and availability of wood waste as raw material (furnish) in manufacture of pulp/paper and panelboard, hog fuel as feedstock for power plants, and compost generation with resulting increases in market prices of these materials.

Since 1990, structural panelboard producers of plywood in Oregon and Washington have lost ground to southern mills in terms of production and production capacity. Information provided by the American Plywood Association in **Appendix E** shows that western structural

panelboard producers have a declining percentage of the U.S. market and the lowest production/capacity ratio of any region in the U.S. The significance is that western plants are operating at levels far below their plant capacity, limited by the shortage of available fiber. This trend is expected to continue until 1997, by which time production efficiency is expected to improve through attrition in the number of operating mills and enhanced production capacity of surviving mills.

As of May 1993, there were 208 primary forest products manufacturers in Oregon. This includes sawmills, plywood manufacturers, veneer plants, panelboard plants, and pulp mills. The majority of these facilities are located west of the Cascades. The number of secondary manufacturers of wood products, which includes millworks, molding, door, sash, window, truss/beam, and remanufactured lumber firms is estimated at between 800 and 1,200 (OEDD, 1993).

The 208 primary forest products manufacturers convert timber into products through debarking, chipping, sawing, peeling, planing, shaving, chipping, trimming, and sanding. The by-products of those processes are bark, chips, sawdust, sander dust, shavings, and trim. High-quality residues (largely trim, shavings, and sawdust) are ground in a chipper for sale to paper and panelboard manufacturers. The remaining lower-quality residues are usually ground in a machine called a hog and shipped as "hog fuel" for burning as feedstock for process steam and electricity generation in lumber mills, wood fiber manufacturing plants, and power plants or used as compost. Hog fuel is generally a mix of bark, fines, and sawdust. Two decades ago, wood waste was disposed of by burning in "tepee" burners at the millsite.

Table 3 shows historical sawmill and plywood/veneer mill waste production data up to 1985. Neither the Funk nor the Howard and Ward reports have been updated. Mill residues are a fairly clean and convenient source of furnish for panelboard production or to supply a boiler or power plant. **Table 4** provides sawmill residue volume by size class and county for 1985. A comparison with **Table 3** indicates that sawmills generated almost two-thirds of the total residue from the combined source of sawmills and plywood/veneer mills.

Table 3. Sawmill and Plywood/Veneer Residue Generated in Oregon, 1968 - 1985
(Thousands of oven dry tons)

Year	Generated	Unused	Percent
1968	15,463	2,900	19.3
1972	17,122	1,463	8.5
1976	15,383	530	3.4
1982	8,991	23	0.3
1985	13,481	75	0.5

Sources: Funk, 1986; Howard & Ward, 1988

Little residue is now unused, compared with historic levels. Three factors account for this trend:

- First, fewer mills operate today than in the past. Since 1990, 163 forest products mills closed in the Pacific Northwest. The remaining mills, while producing at about the same total output as in the past, are more efficient than before with less waste per cubic foot of product generated.
- Second, the waste generated by solid wood producers is nearly all utilized. Paper producers, reconstituted board manufacturers, and wood energy users (power plants) all have increased their use of wood waste in the last decade to the point that they now use an estimated 99 percent of all primary mill residues.
- Third, increased regulation of solid waste disposal and higher tipping fees discourage or prevent mills from landfilling their wood wastes. Such regulation encourages market utilization of the residue rather than dumping.

In Oregon, in recent years, mill residue use as a raw material input has been:

51% - as high-quality chips for pulp/paper & reconstituted panelboard,
41% - as feedstock in power generation,
7% - as compost for gardening, landscaping and mulching,
1% - unused (Howard & Ward, 1988).

Supplies of mill residues change with both location and time. Generally, there is an increasing shortage of available mill residues on the market. Remote areas which landfilled their unused residues in the past are realizing improved markets, with price increases now more than compensating for longer distance hauls. In some areas of the state, landfills are being "mined" to recover previously discarded mill residue.

Wood products companies are becoming increasingly active in search of wood waste for recycling. Some companies have distributed "mass mailers" in search of additional fiber. Others have established recycling facilities to supplement their shortage of virgin fiber. For example, Lane Forest Products in Eugene accepts clean wood waste from industries in the Willamette Valley at no charge. Lane then processes the wood waste to Willamette Industries specifications and sells the furnish to them as raw material fiber for particleboard production.

Changes in market conditions for wood residues since 1987 can be traced by looking at the prices of these residues during that time period. Record lumber production in 1987 resulted in hog fuel available in some areas for the price of hauling. Hog fuel price was as low as $3.00 per unit in Eugene (Lewis, 1987). **Table 5** shows the rapid increase in hog fuel prices from 1988 to 1993 for selected Oregon markets. Prices are from individual sources within each area. Note Roseburg, once a premiere forest products district in Oregon, has been greatly affected by the continued virgin timber shortage and shows the greatest change in the price range of all locations in the state.

Today, hog fuel prices in Oregon range from $18 to $30 per bone dry unit (BDU), reflecting the virgin timber shortage and subsequent mill closures and low lumber production in the area.

During the same time period, from 1988 to 1993, chip or hogged wood prices for panelboard furnish fluctuated from $25 to $45/BDU. Chips for pulp/paper furnish fluctuated between $60 and $140/BDU with current price near $90/BDU. While neither of these two chip markets are directly influenced by national economic conditions, they both have experienced definite increases since 1988.

Table 4. Sawmill Residue Produced by Size Class and County in Oregon, 1985.

	Residue Size Class				
County	Coarse	Shavings	Fine	Bark	Total
	Thousand Oven Dry Tons				
Baker/Wallowa	85	24	44	38	191
Benton/Lincoln	134	46	55	66	301
Clackamas	283	73	116	138	610
Clatsop	56	21	23	28	128
Columbia	83	14	34	41	172
Coos/Curry	173	43	71	84	371
Crook	70	23	36	31	160
Deschutes/Jefferson	103	37	53	45	238
Douglas	480	166	197	235	1,078
Grant/Harney	158	55	81	70	364
Hood River/Multnomah	100	40	41	42	223
Jackson	292	106	120	131	649
Josephine	105	26	43	52	226
Klamath	199	70	102	88	459
Lake	47	10	24	21	102
Lane	639	174	261	307	1,381
Linn	162	63	68	60	353
Marion	87	34	36	43	200
Morrow/Umatilla	58	21	30	26	135
Polk	119	28	49	56	252

County	Residue Size Class				
	Coarse	Shavings	Fine	Bark	Total
	Thousand Oven Dry Tons				
Tillamook	72	27	29	36	164
Union	86	32	44	38	200
Wasco	52	17	27	23	119
Washington	147	50	60	72	329
Yamhill	128	48	53	63	292
Totals	**3,918**	**1,248**	**1,697**	**1,834**	**8,697**

Source: Howard and Ward, 1988. No current update is available. The U.S. Forest Service, Portland Forestry Sciences Laboratory will be updating this information in a new study which began in 1993 and is expected to be completed by 1994-1995 (McKay,USFS).

Table 5. Oregon Hog Fuel Prices - Per Bone Dry Unit, 1988 and 1993

Location	1988 Price	1993 Price
Albany/Lebanon/Sweet Home	$9.00 - 20.00	$9.00 - 20.00
Coos Bay/Gardiner	8.00 - 18.00	8.00 - 18.00
Dillard/Roseburg/Riddle	5.00 - 8.00	25.00 - 40.00
Eugene/Springfield	3.00 - 5.00	18.00 - 26.00
Klamath Falls	8.00 - 12.00	24.00 - 30.00
LaGrande	10.00 - 20.00	10.00 - 20.00
Medford	5.00 - 15.00	17.00 - 20.00
Newberg/Oregon City	10.00 - 17.00	28.00 - 35.00
Pendleton/Pilot Rock/Long Creek	10.00 - 30.00	23.00 - 29.00
Philomath	10.00 - 15.00	20.00 - 28.00
Portland	12.00 - 36.00	15.00 - 30.00
Toledo	12.00 - 15.00	30.00 - 35.00
Average Range	**$8.50 - $17.60**	**$18.90 - $27.60**

Source: 1993 Prices obtained were quotations for August 1993 from individual sources.

CHAPTER 4: SEARCH FOR WOOD FIBER IN OREGON LANDFILLS

The Environmental Protection Agency (EPA) estimates that each person in the U.S. generates 4.5 pounds of waste per day, or 1,642 pounds per year. Of that amount, 6.3 percent or 103 pounds per year per person are estimated to be wood waste. The most recent EPA estimates of household waste components are shown in **Table 6** for the U.S. Such figures do not include industrial waste estimates, and therefore understate total waste generation by unknown but likely significant amounts. Using the EPA estimates and a 1992 Oregon population of 2.979 million, total waste in Oregon is estimated at 2.446 million tons per year.

Table 6. Composition of Trash in the U.S.

Products	Percent
Paper & Paperboard	37.5%
Yard Waste	17.9%
Plastics	8.3%
Food Waste	6.7%
Glass	6.7%
Metal	6.3%
Wood	6.3%
Miscellaneous	3.7%
Textiles	2.8%
Rubber & Leather	2.4%
Aluminum	1.4%

Source: Franklin Associates for U.S. Environmental Protection Agency.
Consumer Reports, February, 1994.

Reports by Oregon landfills to Oregon's Department of Environmental Quality (DEQ) estimate total municipal waste in 1992 of 3.23 million tons or 5.94 pounds of waste per day per capita. Using the EPA estimate of wood waste in the waste stream of 6.3 percent, Oregonians in 1992 generated some 166,000 tons of wood waste per year. By examining areas in Oregon which have maintained waste stream records, such as the Metro region around Portland, the wood waste volume becomes more apparent.

In 1992, Metro generated 1.135 million tons of municipal solid waste from a regional population of some 1.22 million people. This translates to 5.09 pounds per person per day. Also in 1992, Metro reused or recycled almost 99,000 tons of wood waste. This includes construction lumber, packaging lumber used in pallets and crates, and demolition and land clearing debris. This wood waste, if estimates are at all accurate, represents 12.1 percent of the total waste generated in the Metro region, nearly double the national average of 6.3 percent. Using the 12.1 percent rate and a 3.23 million ton waste stream in Oregon, the wood

waste reclamation potential would appear to exceed 390,000 tons annually. This may be conservative as Oregon landfills receive materials from Washington and Idaho as well.

Survey Results - Availability & Reclamation of Wood Waste

All 126 public and private landfills in Oregon monitored and regulated by Oregon's Department of Environmental Quality (DEQ), shown in **Appendix C**, were sent a mail-in questionnaire. A copy of the questionnaire and accompanying letter are shown in **Appendix D**. Telephone and FAX letter follow-ups were conducted with non-respondents. On-site visits and interviews were conducted with the 27 wood-waste recovery firms in the METRO area surrounding Portland and Vancouver.

An incident, unrelated to the study, occurred during the time that information was being obtained and compiled from the 27 wood-waste recovery firms within the Portland Metro Waste Management region. This incident, described below, reduced the extent of data that could be reported from the waste recovery firms. Individual site visits were made to each facility by IRU and Metro Waste Management staff. Just as the collection and compiling phase was being completed, Metro proposed a rate levy increase on the waste processors. The figures obtained through the study indicated increased processing and higher reclamation volumes than previously published data Metro had from those sources. Data from the study was viewed by processors as a potential basis for assessing a "penalty" rate increase, given the increased value gained by processors in recycling and reusing the materials. Subsequently, each wood-waste processor contacted the study team and demanded that information they had provided for the study be withdrawn. Their demands were honored.

Wood-waste recycling efforts vary greatly from county to county. Recycling efforts are greatest in the more densely populated and industrialized areas of the state. These areas, almost exclusively west of the Cascades, are where the largest quantities of waste materials are generated. These areas typically experience higher costs and greater restrictions concerning operations, expansion capabilities, and life expectancy of their landfills. High land values impact the cost of expanding or siting landfills. It is in these areas where wood waste recycling programs have been, or are being, initiated as it is in their best economic interest to do so.

Several regional waste recycling capabilities exist, all in western Oregon (IRU/Metro, 1993). It is the regional reclamation activities which keep waste stream records, and from which some insight into quantities of wood-waste material that may be available in other regions of Oregon might be estimated. With few exceptions, most landfills in Oregon have not maintained records reflecting the make-up of their waste stream, including wood waste.

Survey results are reported first on a regional basis, followed by individual county briefs. A tabular summary of regional and county wood-waste recovery information obtained from the survey is presented in **Table 7**.

Table 7. Summary of Wood Waste Recovery by Region and County From Study Survey

Region and County	1992 Population	Present Handling of Wood Waste	Annual Volume of Wood Waste (tons) Reported			Regional Wood Waste Recycling Focus [a]	Wood Waste Management Plan? [b]
			Landfilled	Recycled	No Response		
Willamette Valley							
Clackamas, Multnomah, Washington Co.	1,221,400	Panelboard hogfuel		99,000 [c]		Yes	Yes
Central Valley Benton-Linn	500,000	Panelboard hogfuel		10,250		Yes	Yes
Jackson, Josephine, Klamath Region	277,700	Hogfuel Landfill		260,000		Yes	Yes
Douglas	96,300	Hogfuel Compost			X	No	Yes
Lane	293,700				X		Future
Marion	241,500	Burn			X	No	Yes
Polk	53,000	Landfill			X	No	None
Yamhill	69,200	Landfill	30,000			No	None
Coastal Oregon							
Clatsop	33,100	Landfill/Burn			X	No	None
Columbia	38,800				X		N/R
Coos	62,100				X		N/R
Curry	21,400	Burn/Landfill			X	No	Future Plans
Lincoln	39,600				X		N/R
Tillamook	22,500				X		N/R
Eastern Oregon							
Baker	15,800	Burn/Landfill			X	No	None
Crook	15,000	Wood Products Landfill/Burn	250	390		No	Yes
Deschutes	82,600	Panelboard/hog fuel/Landfill	5,000			No	Yes
Gilliam	1,750	Landfill			X	No	None
Grant	8,000				X		N/R
Harney	6,950	Landfill	9,000			No	None

Region and County	1992 Population	Present Handling of Wood Waste	Annual Volume of Wood Waste (tons) Reported			Regional Wood Waste Recycling Focus [a]	Wood Waste Management Plan? [b]
			Landfilled	Recycled	No Response		
Hood River	17,600	Landfill	11,000			No	None
Jefferson	14,600	Landfill/Burn	1,200			No	Future
Lake	7,350				X		N/R
Malheur	26,800				X		N/R
Morrow	8,100				X		N/R
Sherman	1,800				X		N/R
Umatilla	61,100	Landfill			X	No	Future
Union	25,000	Landfill			X	No	Future
Wallowa	7,150	Landfill/Burn			X	No	None
Wasco	22,600	Landfill	9,000			No	Future
Wheeler	1,500						N/R
TOTAL REPORTED			**66,000**	**370,000**			

[a] Regional Focus refers to cooperative wood waste recycling with surrounding counties.

[b] As of September, 1993. Response by Counties of whether they have present, future, or no plans for a wood waste utilization program. No response is identified as N/R.

[c] Reported volume for 1992.

Regional Reclamation

Regional recycling is occurring in three areas of Oregon, all on the west side of the Cascade mountain range where the state's largest population is concentrated. The first involves the metropolitan region, called **Metro** in this study, including Portland and the urban areas of Clackamas, Multnomah, and Washington counties. **Valley Landfills** at Albany serves the central Willamette Valley region, predominantly Linn and Benton counties. **Biomass I** serves Jackson, Josephine, and portions of Klamath counties.

The **Metro** area, with a population of 1.22 million, contains some 41 percent of Oregon's population. It has received considerable attention for understanding and capitalizing on recycling waste, including wood waste. In 1992, Metro recycled 99,000 tons of wood waste, 25,000 tons into new wood products and 74,000 tons converted to hog fuel for burning. Recycling included salvage lumber, panel products, bridge timbers, and furnish. A total of 27 firms were identified as involved in recycling woody materials. The list of firms is shown in **Appendix F**. A number of the processors are new, having begun operations since 1991. All of the facilities were visited to observe their operations, their raw material procurement sources, their recycling processes, and the market outlets for their processed materials. Most

of the processing is for two markets. The largest, but lowest-valued, market is for hog fuel. A more highly valued, but lower-volume market is furnish for panelboard production. At the time of this study, the Oregon pulp/paper firms still had adequate supplies of traditional high-grade wood chips and old corrugated cardboard as raw materials.

One such facility, the Wood Exchange, is a privately owned and operated non-franchised wood recovery and recycling facility located in North Portland. The Wood Exchange accepts clean wood waste that has been separated from non-wood waste materials at the construction or demolition site and converts it to reusable pallets or furnish at its conversion site for use by panelboard producers. All material recovered is either reused of recycled. In 1991, the Wood Exchange recycled about 7,500 tons and reused some 1,000 tons of wood materials. In 1992, this facility recycled 17,000 tons, 5,000 tons converted into pallets and 12,000 tons chipped for hog fuel and furnish for panelboard firms.

The Washington County landfill facility received 200,000 tons of waste in 1992. It currently recovers pallets, yard debris, and wood waste, the actual tonnage of which is not known. The facility is considering opening a material recovery facility in 1994 to further increase recovery of waste materials. The county wants to sell some wood waste to Willamette Industries for particleboard. A test run with Willamette Industries was successful, but greater refining to remove contaminants is needed. It is estimated that the facility can generate a truckload/day (30 units) and receive $35/BDU, a value of $1,050/day/truckload.

Valley Landfills is a private waste recovery center which serves the central Willamette Valley region of 500,000 people, approximately 17 percent of Oregon's population. Valley Landfills sold 32,000 cubic yards of processed wood waste in 1992. As of July of 1993, sales had increased to 41,000 cubic yards. At 500 pounds/cubic yard, this translates to 10,250 tons of recycled wood waste.[1]

Valley Landfills processes wood waste into particleboard specification chips which it sells to Weyerhaeuser Springfield, Dura Flake, and Smurfit. There is no tipping fee for wood waste delivered to the site from within the five to six county area. Reject wood waste, which cannot be processed to meet particleboard specifications, is processed for hog fuel. This includes wood debris from furniture manufacturing, formica covered plywood, painted wood, etc. Separation of such materials at its source is preferred, if possible. Valley offers an incentive to have the wood waste source separated before delivery. Source separation is done manually.

Albany-Lebanon Sanitation, as well as other sanitation companies in the region, haul all wood waste to Valley Landfills for recycling. Albany-Lebanon Sanitation uses drop boxes at

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[1] The conversion used was 500 pounds/per cubic yard of wood chips from the National Recycling Coalition Measurement Standards and Reporting Guidelines, Clean Washington Center, Seattle Washington.

construction sites, charging only a haul fee and no tipping (dumping) fee. Future plans include targeting smaller construction sites that have smaller volumes of wood waste and initiating a wood-waste route to remove pallets and other wood waste free of charge.

Biomass I is a co-generation power plant located at White City in Jackson County. It utilizes wood waste from Jackson, Josephine, and Klamath counties. The area serves some 277,000 people representing 9.5 percent of Oregon's population. County sanitation haulers, industry, and homeowners deliver wood waste to Biomass I. Recent statistics for this facility have plant operations consuming 260,000 tons of wood waste as hog fuel. The plant burns the wood waste and generates steam used by several veneer mills for drying and sends the balance of its energy into the region's electrical grid. County recycling managers indicate that virtually no woody material ends up in landfills, all of it being utilized by the Biomass I facility.

County Reclamation

County-level wood-waste reclamation activities obtained from the survey are discussed in this section. This includes existing and future plans for wood-waste reclamation. Several of the counties have no plans in place and none for the future. Others are aware of their opportunities and are planning to take advantage of them.

Table 7 provides a summary on a county by county basis of existing wood-waste reclamation activities, future plans, and estimated volume of wood-waste recycling reported. Some counties failed to respond to the survey or follow-up phone calls. In those instances, no information is provided and is identified with a no response (N/R) designator. County-level contacts and their phone numbers are listed in **Appendix G**.

It must be noted that, for the most part, the percentages and quantities of material estimates at Oregon's landfills are extremely rough. Of the survey respondents, fewer than 23 percent had scales. Of those that had scales, few used them on a regular basis. The remainder assessed fees on visual estimates. Most Oregon counties lack equipment necessary to process wood waste at landfill sites.

Baker

In the Baker City area most wood waste comes from residential areas. All of it is landfilled. Yard debris and brush are burned four times a year at the county landfill under permit from DEQ. No restriction on ability to burn in the future is foreseen. Wood waste consists of pallets, wood, lumber, panelboard, and other construction debris. There is no estimate of the quantity of wood waste generated.

A new recycling facility has opened that recycles paper, boxes, newsprint, glass, tin, aluminum, and oil. Wood waste is not included. Mills in the area are handling and reusing their own wood waste. While there is good wood going into the landfill, no discussion has occurred with area mills to recover and divert wood waste from the landfill for their use.

Clatsop
The Clatsop County landfill is closed. The county does not handle wood waste. Yard debris and woody materials are burned. The county is searching for wood-waste disposal alternatives.

Columbia
The county does not have much wood waste and no regulations on its disposal.

Coos N/R

Crook
Clear Pine Mouldings, a mill in Prineville, collects an estimated 1,560 cubic yards, or 390 tons, of wood waste annually from private companies in the county for hog fuel. An additional 1,040 cubic yards, or 250 tons, annually are estimated to go into the Prineville Disposal landfill. The public goes to a transfer station to dispose of their wood waste. There is no arrangement at the landfill for wood recycling. The wood waste is piled and burned several times a year. Prineville Disposal plans to recycle the wood waste for hog fuel within two years.

Curry
No wood waste is recycled in the county. Most wood waste is from residential remodels and construction. Essentially all of it is burned on site with a county burn permit. This provides an extremely cheap method of disposal. There is no industrial wood waste.

Curry Transfer & Recycling is interested in processing wood waste for resale if large enough quantities are available to make the effort feasible. Materials received at the transfer station are sorted. Burnable materials are separated and stacked for burning while the non-burnable material goes into the landfill. The nearest wood-waste market is more than 100 miles away, so utilizing wood waste in that market is questionable. Curry Transfer is talking with area mills about processing wood waste for them. Weyerhaeuser offered roughly $15 a ton for the material. For recycling to occur, a ban would need to be levied on open burning of wood waste and yard debris so there would be sufficient quantities to justify installation of a processing unit.

Deschutes
A local mill is site-sourcing wood-waste material. A county demolition landfill in the Bend area chips clean wood for hog fuel. The 1992 estimates indicated that Deschutes County generated some 5,000 tons of wood waste in the form of pallets, miscellaneous wood, and construction/demolition debris which went into a landfill. In Redmond, the Opportunity Center (handicap/working center) is shredding wood waste and selling it as hog fuel to a plywood company in Roseburg. It previously was sold to a local Bend mill, but the Roseburg mill offered a better price.

The county is hoping to go after wood waste more aggressively in 1994. A plywood mill in the area has offered to provide a site for wood-waste collection and processing into hog fuel for the mill.

A study has been commissioned by Deschutes County to investigate the feasibility of a regional landfill to serve Deschutes, Crook, Klamath, and Jefferson counties.

Douglas
Douglas County offers drop-off locations for wood waste at nine transfer sites and two landfills. Residents drop off wood waste and yard debris at no charge. Yard debris is diverted for compost. All wood waste collected is chipped and sold for hog fuel to Roseburg Forest Products.

Gilliam
No timber of significant quantity exists in Gilliam County. Dryland wheat farming is the dominant industry. County population is only 1,700. What little wood construction and demolition debris exists is taken to the county landfill. The county has no plans to utilize wood waste. Until antiquated grain elevators are torn down, there will be no significant quantity of wood waste.

Grant N/R

Harney
Two lumber mills, Snow Mountain Pine and Tecton Laminants, operate in the county. The French Glen Millworks recently closed. The estimated amount of urban and industrial wood waste landfilled per day is 120 cubic yards of loose waste. This amounts to some 9,000 tons per year. No plans exist to recycle local wood waste due to low volumes and long distances to markets.

Hood River
The county, with a population of 17,600, does not recycle wood waste. Dee Forest Products and Hanel Lumber recycle their own wood waste. All landfilled material is buried, not burned. Estimated total of all landfilled materials is approximately 3,000-4,000 cubic yards per month, or 9,000-12,000 tons annually. All wood waste from demolition, building, and construction is shipped to the Wasco County landfill and buried. There are no plans to improve recycling /collection of wood waste and orchard prunings in the future. Preliminary discussions have been initiated for considering a joint wood-waste recovery program with Wasco County.

Jefferson
Jefferson County is not recycling wood waste. It has a DEQ permit to burn yard waste four times per year, but very little tonnage is involved. Industrial wood waste is landfilled. Industrial wood waste is estimated at 3-4 tons per day, or 1,200 tons per year, mostly cut window stock debris from Brite Wood Corporation. The county will soon close its landfill

and go to a transfer station. When it does, the county likely will transfer its waste to the Roosevelt landfill in Washington as it is the lowest-cost alternative that they have found to date. The county has no equipment to process material.

A study has been commissioned by Deschutes County to investigate the feasibility of a regional landfill to serve Deschutes, Crook, Klamath, and Jefferson counties.

Josephine
Before 1993, most wood waste was landfilled. Now, most wood waste collected is hauled to the Biomass I facility in White City. The material must be separated at its source before pick-up for transfer to Biomass I. What cannot be chipped for hog fuel goes to the landfill for disposal.

Klamath N/R

Lake N/R

Lane
Lane County Solid Waste Management is exploring options for future wood-waste utilization.

Lincoln N/R

Malheur N/R

Marion
Marion County operates the only municipal solid-waste incinerator in Oregon. All wastes, including wood waste, are burned as feedstock for power generation. The county, under current contract agreement with the municipal solid-waste incinerator, cannot divert wood-waste materials for recycling.

Morrow N/R

Polk
Very little industrial or urban wood waste is collected. Wood debris goes to the landfill unless special arrangements are made to transfer it to Valley Landfills.

Sherman N/R

Tillamook N/R

Umatilla
The county has no policy to recycle wood waste. Mills in Pilot Rock utilize their own wood wastes. The only manufacturer in the Pendleton area that generates small quantities of wood waste is a trailer company. Construction/demolition debris is estimated to constitute

10 percent of total waste generated. Pendleton Sanitary Service has commissioned a study on waste-disposal opportunities for Umatilla County, including wood wastes.

Union
The county, with 25,000 population, has little wood waste. All waste is landfilled. The county has no plans for collection of wood waste. City Garbage Service, a private hauler in Baker City, is considering installing a facility to recover wood waste. Wood material collected consists mainly of packaging pallets.

Wallowa
Wallowa County burns wood waste at its landfill. They burn four times a year, predominantly demolition and woody materials. The quantity burned is unknown. The county has no plans for future recycling of wood debris. Burning is the cheapest means of disposal. There are three sawmills in the area that utilize their own wood waste.

Wasco
Northern Wasco County landfill is the last operating landfill in the county. An estimated 50,000 tons per year of solid waste is received at the site. Approximately 15 to 20 percent, or 7,500-10,000 tons, are wood waste and yard debris. A local hauler is considering a wood-waste program.

Preliminary discussions are underway for a joint wood-waste recovery program between Wasco and Hood River counties.

Wheeler N/R

Yamhill
No form of wood waste or yard debris reclamation program exists in the county. The county estimates that 15 percent of the 200,000 tons/year of total municipal solid waste, or 30,000 tons/year, is wood waste. The majority is mixed wood waste consisting of household, construction, and demolition debris. All of this is buried in the landfill. No equipment is available on-site to process wood waste or yard debris.

Smurfit Newsprint in Newberg receives wood waste and woody material from private sources but has not approached the landfill, nor has any other company, to reclaim wood waste.

Reclamation Practices

The physical and chemical make-up of the wood-waste stream are important elements in determining separation and processing requirements, their cost, and the potential markets into which the various processed forms can move. Much of the industrial and urban wood-waste stream contains non-wood materials or "contaminants." Wood-waste materials containing these contaminants include:

1. Pallets and wood shipping containers--may contain metals, pesticides, preservatives, and glue resins.
2. Painted wood--contains lead-based paint in old demolition material and acrylic-based paints and metallic pigments in newer materials.
3. Structural and non-structural panels--contain glue resins, fire retardant chemicals, and PVC laminates.
4. Treated wood--contains predominantly chemical and creosote-coal tar preservatives.

A more detailed specification of the contaminant content of the above-named categories of wood wastes are presented in **Appendix H**.

A recent Metro study of waste generated from the construction of three single-family homes indicated that wood comprises 40 to 80 percent (2 to 4 tons) of all waste from homebuilding sites. When such wastes are separated at the homebuilding site, the wood waste portion can be collected at the site then hauled to and unloaded at a recycling facility for $10 to $20 per ton. If that same wood is mixed with other construction wastes, the disposal cost can be as high as $150 to $300 per ton (Metro).

In the Metro area, at the time the study began, only one processor of wood waste was set up to provide furnish to the panelboard industry. That company, Wood Exchange, is partially owned by a hardboard plant. One other processor, Bredl Saw, came on line shortly after the study began. Hogged fuel was being processed by a number of the Metro wood-waste converting facilities.

Structure Dismantles

Home remodeling is on the rise. High cost of new forest products materials is initiating searches for alternative materials. Old homes and other structures are more and more often being dismantled instead of demolished. Doors, windows, timbers, flat panels, and other wood materials from these buildings are now beginning to be moved into a used lumber products market and sold as is. Significantly higher value can be realized with dismantling efforts. Demolition techniques, due to high contamination rates, tend to reduce the value of reclaimed materials to low-grade hog fuel, valued at about $13/ton, or be reduced to the point where the material can be disposed of only in a landfill. Metro is currently reviewing several dismantling projects in the Portland area.

Economic Practices Influencing Utilization

Quantity of woody material received is a direct function of the landfill's location, regional population, economic activity, and disposal rules and regulations. For example, Washington County's daily landfill volume consists of nearly 50 percent construction/demolition and woody material. In Grant County, wood waste comprises only 1 or 2 percent of the total waste stream. In Gilliam County, where dryland wheat farming is the primary industry,

almost no wood waste is generated. It may, however be a potential supplier of agricultural waste in the form of grain and grass straw in the future.

Disposal alternatives available to a county are an important economic variable.

- **Open burning** by permit is the least costly choice. This option provides a convenient and essentially zero cost alternative for handling wood waste. Open burning by permit is allowed in Curry County. As no large quantities of industrial wood waste are generated in Curry County, and all waste generated from construction and demolition can be burned on site, there is no potential wood waste of significant quantity to enter a waste stream.

- **Open burning permits at landfills** also deter wood-waste generators from implementing recycling efforts if the tipping fee is very low. Landfills in Clatsop, Baker, Crook, and Jefferson counties stockpile and burn wood waste and construction/demolition debris several times a year. Low volume of wood waste, low cost, and lack of local markets are contributing factors.

- **Tipping fees** are the fees charged at landfills for the right to dump waste materials. These fees range from $35 to $85 per ton in Oregon. At the low end of the range, tipping fees work against wood-waste reclamation practices by becoming the least-cost or lower-cost alternative for wood-waste disposal. At the high end of the tipping fee range, wood-waste producers may search for alternatives to landfilling for those materials.

  In the Portland Metro area, up to the time of the study, the tipping fees charged by the wood processors ranged from minus $10/ton to $75/ton. The negative tipping fee or incentive payment of up to $10/ton paid by the wood processors was for clean waste wood delivered to the processor's recycling site.

- **Transport costs** of wood waste to market areas is important for some coastal and eastern Oregon counties where mills and other users of wood waste do not exist. In these cases, transportation costs to ship wood waste can outrun profitability of wood waste recycling.

- **Lack of equipment to process wood waste** is a factor deterring most of the landfills surveyed. The general trend of landfills that recycle is to contract an independent operator or have a contractual agreement with a local mill that has proper processing equipment to handle wood waste recycling operations.

- **Raw Material Specifications** are different for different market outlets. Markets for processed wood waste include panelboard, pulp/paper, compost, and fuel markets. Specifications range from a high degree of specification in panelboard and pulp/paper markets to a much lower level in compost and fuel markets. Raw material specification requirements for wood fiber in each of these markets is discussed in some detail in CHAPTER 6.

Raw material specifications also vary among firms producing similar materials. The most stringent specifications are for pulp/paper manufacture. Less stringent are for panelboard production. Here specifications can vary from extremely restrictive to few specifications. For example, with structural panelboard, specifications are stringent. With non-structural panelboard and fiberboard, the raw material may have few specifications when serving as a core component of panelboard. Markets with the fewest specifications are the fuel and compost markets.

As a consequence, it is important to check with each potential buyer of processed wood waste to ascertain specification requirements.

Some buyers will arrange for pickup or provide a dumpster for wood-waste collection. Payment method varies also. Some will pay based on the moisture content of the load. Some buyers penalize suppliers for poor-quality material or failure to conform to their specifications. Some buyers track supplier shipments, compute monthly averages, and apply penalties based upon this composite information. Penalties usually range from refusal to accept a load to a percentage reduction of the predetermined price.

- **Insufficient information** of the market for recycled wood waste both by potential users and by potential suppliers of such material has been, until very recently, a deterrent. Potential users, facing major raw material shortage, are now reaching out to wood-waste sources. The question of cost and profitability of wood-waste recycling continues as a major factor.

The Bonneville Power Administration (BPA) publishes a book, called Biomass Guidebook, that provides a comprehensive list of the considerations and concerns that should be addressed in the recovery of virgin wood residuals, including transportation costs. This document also provides copies of purchase agreements and contracts supporting development of businesses geared towards virgin wood residual recovery. Copies of this document can be obtained through local BPA offices (BPA).

CHAPTER 5: MARKET DEMAND FOR WOOD FIBER

Potential markets for wood-waste fiber include:

- Furnish for pulp/paper plants,
- Furnish for panelboard plants,
- Pellet/log fuels
- Compost/bedding (for poultry operations, roadside embankments, landscaping, and nursery operations), and
- Hog fuel for power generation.

The highest value, with most restrictive process specifications, is for pulp and paper.
The lowest value, with least restrictive process specifications, and highest-volume use is wood fiber as hog fuel in power plants and manufacturing facilities to generate electrical energy and produce process steam for plywood, veneer, and lumber mills.

Pulp and Paper Markets

Pulp and paper producers are experiencing difficulty in obtaining suitable clean virgin wood fiber for paper production. More pulp/paper manufacturers are seeking and utilizing alternatives to virgin fiber. Expensive plant modifications are being undertaken by the industry to accommodate recycled paper, corrugated cardboard, and even phone books in their pulping processes. Some percentage of clean wood chips, however, must be included with the recycled paper to insure integrity of the finished product.

This industry is looking for good alternative fiber sources just as the panelboard, compost, and fuel markets are doing. Weyerhaeuser in Springfield currently is investigating the feasibility of incorporating grass straw fiber in its paper making processes for corrugating medium, the fluted center portion of cardboard boxes.

Pulp and Paper Mills located in the Western U.S. are listed in **Appendix I.**

Kraft pulp mills, makers of brown paper materials, would most likely be the first pulp and paper users locally to consider using recycled wood materials. Their processes and standards allow for some variation in fiber specifications that a "fancy" paper manufacturer could not accept.

Thermochemical and mechanical pulp mills that manufacture various white paper products and facial or body tissue products, have very high standards for the wood chips they purchase. Meeting the standards of these mills may be difficult with recycled wood materials except in some very specific instances.

- Typical Pulp and Paper Specifications:
  Species Accepted: Pine, White Fir, Douglas Fir, and Cedar
  Not Accepted: Hardwoods.
  Chip Specifications:

Over-Length: +45mm (1 percent maximum in the entire load may be over 45mm)
Over-Thick: +10mm (5 percent maximum may be over 10mm)
Accepts: -45mm to +7mm
Pin Chips: -7mm to +3mm
Pan Chips: -3mm
Contaminants: The material must be free of soil, rocks, metal, rubber, plastics, silicon, hazardous wastes, and other foreign materials; there are percentages per load for various rot contents ("white-pecky" or "brown cubicle" rot for example) as well as the rigid chip-size requirements.

Clean wood furnish that meets pulp and paper specifications is selling for $60 to $125 per bone dry unit (2,400 pounds). The price paid for this furnish is the highest of all forms of wood chips, reflecting the strict chip standards required for pulping and the higher-valued end product for the industry.

Panelboard Markets

The panelboard market in the U.S. is made up of two distinct sub-markets. The first is structural panelboard. Structural panelboard consists of plywood and oriented strandboard, both of which meet distinct specifications for structural purposes. The other is non-structural reconstituted panelboard. Reconstituted panelboards are not tested for structural use. This group includes particleboard, hardboard, and medium-density fiberboard (MDF). Loss of virgin fiber has provided the opportunity for recycled wood materials to become a feedstock for particleboard, hardboard, and medium-density fiberboard.

Processed wood waste is an emerging market as furnish for the reconstituted panelboard industry. This alternative offers higher market price for wood waste if processed to meet industry specifications. The quantity of material processed and sold as hog fuel may continue to be greater than that sold for other markets, but the value added is greater for wood waste processed to panelboard specifications.

Clean wood furnish which meets reconstituted panelboard industry specifications currently is selling for $35-$55 per bone-dry unit.

The listing of panelboard plants in Oregon is presented in **Appendix J**.

Particleboard is made principally from finely ground virgin wood, bonded together under heat and pressure with a urea formaldehyde adhesive. The board can be laminated and embossed easily. The predominant market is in manufacture of furniture, doors, cabinets, and fixtures. Other uses include floor underlayment and mobile home decking.

U.S. production in 1992 was an estimated 6.9 million cubic feet.

- Typical particleboard specifications:
  Species Accepted: Pine, White Fir, Douglas Fir and others
  Chip Specifications: Approximately 1-7/8" to sawdust.
  Not Accepted: Cedar, which creates excessive dust and potential for government regulation. There are potential manufacturing problems due to fibrous nature of cedar.
  Contaminants: All raw material must be free from soil, rocks, metal, rubber, plastics, silicon, hazardous wastes, and other foreign materials, and contain less than 3 percent bark.

Hardboard is made from finely ground wood fibers, consolidated under high temperature and pressure. Unlike particleboard, hardboard uses only a small amount of resin, with the high temperature and pressure providing the bonding role. The predominant market for hardboard is the construction industry, primarily for exterior applications such as siding. Other uses include furniture, cabinets, and fixture manufacture.

U.S. production in 1992 was an estimated 1.5 million cubic feet.

- Typical hardboard Specifications:
  Species Accepted: All except cedar; one manufacturer accepts only Douglas Fir as raw material in wet or dry form.
  Chip Specifications: 3" or less; not more than 10-15 percent of any load may be less than 1/16".
  Contaminants: All raw material must be free from soil, rocks, metal, rubber, plastics, silicon, hazardous wastes, other foreign materials, and contain less than 3 percent bark.

Medium-Density Fiberboard is manufactured in a dry form from lignin and cellulose fibers combined with a synthetic resin or suitable binder. It can be laminated and embossed. Its industrial use is mostly in furniture, cabinet, and fixture manufacture.

Production in 1992 was 1.7 million cubic feet.

- Typical medium-density fiberboard specifications:
  Species Accepted: All.
  Chip Specifications: 1-7/8" to sawdust.
  Contaminants: All raw material must be free from soil, rocks, metal, rubber, plastics, silicon, hazardous waste, other foreign materials, and contain less than 3 percent bark.

Composting Markets

Commercial compost is largely yard debris and includes leaves, grass, brush, prunings, and other woody materials. Composting of such materials has increased in the Northwest and across the nation as restrictions to landfilling such materials are imposed. This trend will continue as additional landfills reach capacity or close due to the cost of complying with

federal landfill management regulations. Counties are restricting the flow of yard debris to their landfills and redirecting this material to composting facilities.

The nursery and landscape industries are the major users of compost for residential and commercial applications. It is also used for trail covering, erosion control applications, storm water filtration, beautification projects along interstate highways, and bedding for livestock and poultry operations. Typically, fine-grade, uniform compost materials are the most appealing to buyers. Oversized and dark colored material are less marketable.

The compost market for wood waste is growing in Oregon. Those processors that mix selected wood waste, yard debris, and tree prunings appear to have a quality product for residential and commercial markets.

Composted material sells for $5-$30 per cubic yard. At an approximate weight of 500#/cu.yd., the value ranges from $20 to $120/ton.

Specifications: None. Metro is developing yard debris compost product standards.

Compost was not investigated in this study.

Fuel Markets

The largest market for processed wood waste is for fuel. This includes hog fuel as a raw material for power plants and manufactured densified fuels for general public use. Densified fuels comprise several forms of solid-wood fuels, the most common being briquettes, fuel logs such as the Pres-To-Log, and pellet fuels. Increased emission regulations for wood stoves have spawned development of clean-burning pellet fuels.

Pellet fuels generally are manufactured from dry planer shavings and sawdust. The pellet is clean burning. Original standards were set high to meet stringent EPA emission requirements for wood-burning stoves and heating systems.

Densified fuels can be manufactured from construction/demolition wood, bark, limb stock, old corrugated paper, mixed waste paper, and old newsprint. Timber slash, woodland thinning debris, brush-clearing and logging debris, and other woody materials including juniper and sage brush are possible feedstock for densified fuels.

Pellet fuels that meet biofuel specifications sell for $80 to $160/ ton.

The number of densified wood fuel manufacturers in Oregon has increased from 6 to 14 facilities since 1988. **Appendix K** lists the densified-wood fuel mills in Oregon.

Hog Fuel is wood residue processed through a hog or chipper to produce coarse chips for fuel. It consists predominantly of bark, a small amount of white wood, and fines. The bark

component is more friable and porous than wood, so burns more easily. As moisture content is inversely related to the heat units produced in hog fuel, buyers pay on the basis of bone dry units (BDU) or bone dry ton (BDT).

Typical hog fuel specifications include:

Acceptable Material: Hogged bark and white wood. Minimum of 80 percent bark and maximum of 20 percent white wood.

Chip Specifications: Maximum 4" with 90 percent 2 inches or less.

Weight Measurement: Bone Dry Ton (BDT) or Bone Dry Unit (BDU).

Volume Measurement: One unit of hogged fuel is 200 cubic feet of material and contains approximately 2,200 pounds of oven-dry material.

Moisture Content: 50 percent by weight on wet basis and not exceeding 60 percent.

Contaminants: All raw material must be free from soil, rocks, metal, rubber, plastics, silicon, hazardous waste, and other foreign materials.

Mixed wood furnish that currently meets hog fuel specifications sells for $15-$30/ BDU.

A listing of wood combustion facilities in Oregon is shown in **Appendix L**. These facilities, while using hog fuel primarily, also use shavings and mill residue.

Indirect Demand For Wood Waste

Solid-wood manufacturing operations produce substantial wood waste and often use much of the wood waste that they produce. This includes lumber mills, softwood veneer and plywood mills, hardwood veneer and plywood mills, planing mills, re-manufacturing lumber mills, milling and molding plants, door and window frame and sash manufacturers, and flat panel producers. Much of this wood waste is destined as hog fuel for their own power generation.

Some of these producers/users will influence the availability of wood waste for other uses, depending on the quantity of virgin timber processed and the efficiency of those operations. Lumber production, for example, directly influences wood-waste availability in Oregon in the form of bark, mill scraps, and shavings that can be reclaimed for use as panelboard furnish, pulp chips, and hog fuel. Production and efficiency of milling and molding operations will in some instances decrease the availability of wood waste by reclaiming more of lumber production fall-down and reducing the waste in their own mills. The strength of these products in the retail markets will affect production levels in the mills.

These solid-wood manufacturing producers, in the future, may well buy low-grade hog fuel from landfills and other wood-waste sites instead of using their own virgin fiber for that purpose, and sell their virgin fiber as a high-value furnish to pulp/paper and panelboard plants.

CHAPTER 6: ALTERNATIVE SOURCES OF FIBER

Logging Residues

Logging slash left behind in the woods after timber harvest is a potential source of virgin wood residue. Most of this material is piled and slash burned. Little of it currently is salvaged. Timber shortage and its secondary effect of wood residue shortage has placed increased value on alternative wood residue sources by forest product mills demanding wood residue as a raw material. Large quantities of logging residue remain in western Oregon after timber harvest. A significant quantity could be available in eastern Oregon due to beetle kill and allied poor health conditions of some of those forests.

A relatively small volume of logging residue is collected as firewood for residential use. Some 750,000 cords, representing only 8 percent by weight of the total logging slash available, is used for firewood (Rasbach, Preston, and Cook). Firewood sales on public lands in Oregon declined significantly, from 440,000 to 181,000 cords, during the most recent five-year period from 1987 to 1992 as shown in **Table 8**. Contributing factors to the decline appear to be stricter environmental standards for new woodstoves, access restrictions to slash from fire risks under drought conditions, and low cost of natural gas as a home heating source.

Table 8. Firewood Removed From Public Lands in 1987 & 1992.

Land Manager	Cords Removed	
	1987	1992
U. S. Forest Service	409,200	170,000
Bureau of Land Management (BLM)	25,394	8,052
Oregon Department of Forestry (ODF)	5,691	2,886
Total	440,255	180,938

Source: Rasbach, Preston and Cook, 1993.

Timber harvest from logging results in tree tops, limbs, shatter, rot, and cull material being left behind in the forest as unused wood residue. The type of timber harvest method used, clearcut or partial cut, dramatically affects the amount of wood residue left behind. Clearcuts leave much more residue per acre than partial cuts (Howard, cited in Funck, 1986). Species and age also determine residue amount. Old-growth timber harvest leaves large amounts of residue when cut, estimated as much as 120 tons per acre at 50 percent moisture content. Very little of such harvest is expected in the future. However, large tracts of land on which clear-cut operations have already occurred may provide a major source of usable timber slash. Second-growth timber, although more abundant, is estimated to produce only 20 to 30 tons per acre (IRU/SCEDC/USEDA). Regardless of harvest method, some residue now must be left on the ground to meet wildlife and soil nutrient requirements.

Small amounts of logging residues were salvaged in the past when chip prices were high in the furnish and fuel markets. In those instances the cost of collecting or yarding logging slash to an accessible site was included in the price paid for merchantable timber and often was higher than the market value for furnish or fuel.

The most recent estimates prepared by the U.S. Forest Service for logging slash and mill residues from lumber, plywood, and strandboard mills were in 1988. At that time, their combined total was estimated at about 5.1 million oven-dry tons from the Oregon timber harvest of 8.6 billion board feet (**Table 1**). With the 1993 Federal timber harvest established at 1.2 billion board feet in the Northwest, some 163 mill closures in Oregon since 1990, and increased efficiency of the remaining mills, logging and mill residues from current timber harvests have declined substantially. A study by the U.S. Forest Service is underway to update logging and mill residue volumes generated in Oregon since 1988.[2] Until completed, our best timber slash and mill residue estimates come from the 1988 data.

Using the 1988 relationships, the 1992 harvest levels of 5.7 billion board feet are estimated to have produced some 3.3 million bone dry tons of logging residue and an additional 3.3 million bone dry tons of mill residue in Oregon. With an assumption that 60 percent of the logging residue could be removed and still allow for new-growth regeneration requirements, an estimated 1.9 million bone dry tons of slash are available for salvage. Of that removable amount, some 10 percent is bark and 20 percent is limbstock which can be chipped as hog fuel feedstock or compost. Subtracting the 8 percent used for firewood leaves about 1 million tons annually as potential furnish for the panelboard and pulp/paper industry.

The U.S. Forest Service estimates the amount of residue left when timber is cut. These residue-to-lumber ratios have been calculated for species, land ownership type, and terrains in Oregon. From this, one can estimate logging residues based on timber harvest plans. Using the USFS approach, the Oregon Department of Energy estimated the amount of logging residue by county from 1990-91 timber harvest levels (ODOE). These results are shown in **Table 9**. The estimated total amount is in excess of 3 million tons annually.

The Bonneville Power Administration estimated logging residue on private and public timberlands in Oregon for 1989. **Table 10** presents those estimates, upwards of 7 million tons, some two-thirds of the total from western Oregon and largely from private lands.

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[2] Study to be completed by the U.S. Forest Service, Portland Forestry Sciences Laboratory. For information contact Neil McKay at (503) 321-5848.

Table 9. Estimated Logging Residue Volume by County in Oregon, 1991
(Bone Dry Tons)

County	Bone Dry Tons
Baker	43,680
Benton	36,484
Clackamas	119,140
Clatsop	81,676
Columbia	66,472
Coos	140,588
Crook	44,100
Curry	52,962
Deschutes	78,946
Douglas	413,546
Gilliam	N/A
Grant	114,982
Harney	33,376
Hood River	21,952
Jackson	128,716
Jefferson	48,832
Josephine	46,066
Klamath	272,678
Lake	115,220
Lane	421,204
Lincoln	89,390
Linn	233,604
Malheur	N/A
Marion	36,988
Morrow	N/A
Multnomah	11,690
Polk	39,340
Sherman	N/A
Tillamook	80,346
Umatilla	52,934
Union	73,276
Wallowa	66,976
Wasco	98,210
Washington	N/A
Wheeler	15,624
Yamhill	28,784
Total	3,107,782

Source: Oregon Department of Energy. Oregon Bioenergy Guidebook. 1993.

USFS estimates indicate that substantial volumes of usable furnish of some 217,000 oven-dry tons per year for up to 10 years could be obtained from salvage and thinning operations on public timberlands in eastern Oregon for use by panelboard and pulp/paper producers. Actual utilization is unknown as recovery of bug-and burn-damaged timber is tied up in the courts.

Conflicting demands, environmental concerns, and risks associated with wood-waste collection complicate access to this fiber. However, it is viewed that furnish, compost, and fuel markets are choices for this material once it is separated into clean chip and hog fuel components.

Table 10. Logging Residue by Area and Ownership in Oregon, 1989
(Thousands of Bone Dry Tons)

Area and Ownership	Total Available	Total Usable
Western Oregon		
National Forests	2,469	1,517
Other Public	1,794	1,035
Private	3,862	2,385
Sub-Total	8,125	4,937
Eastern Oregon		
Public	2,571	1,416
Private	756	473
Sub-Total	3,327	1,889
Total	11,452	6,826

Source: Bonneville Power Administration, 1990.

In addition to increased mill efficiencies and conservation practices, the timber crisis has also promoted recovery and utilization of non-traditional wood species in the Pacific Northwest. Shortage of select softwood species, particularly fir and pine, is generating interest in utilizing some hardwoods. Veneer and plywood companies are peeling hardwood species--including cottonwood, alder, and oak--for use as core material in their products. Composite board producers are experimenting with blends of hardwood fibers and straw fibers to mix with their traditional fir and pine furnishes.

Wood-products manufacturers geographically are reaching out farther for raw materials. Fort Vancouver Plywood, the nation's oldest soft plywood manufacturer, is currently receiving cottonwood from as far away as Montana. Willamette Industries imports logs from the Midwest.

In the future we can expect higher levels of utilization during harvest that will result in less available residue. Until this occurs, large quantities of logging residue will be available for reclamation. Other considerations, including environmental considerations, wildlife, and fuel loading conflicts, will impact accessibility of these residues. (Biomass Estimates for Five Western States, BPA 1990)

Collection costs will vary widely with the site. As typical logging and yarding equipment are not well-suited to collect logging residue, reclamation of logging residue will likely occur sometime after logging is completed. Logging residue reclamation has begun in a limited way both in western and eastern Oregon on private timberlands (Tanaka, Miller). Several

National Forests in Oregon and Washington have recently conducted sales for recovery of logging residue. (IRU/SCEDC/USEDA)

Accessing logging residue as a fiber source for wood fiber users will require several changes. First, slash burning would have to be banned. Currently, there is no disincentive to slash burning. As environmental pressures for enhanced air quality increases, slash burning is likely to be terminated or greatly curtailed. Second, the continued shortage of virgin fiber and an increase in conventional fuel prices will induce the search and acquisition of alternative fiber sources such as logging slash that heretofore had not been cost-effective to reclaim. Third, improved efficiency in obtaining logging residue from the field may be needed. Improved yarding machinery and an expanded fuel/fiber sales network are important elements. (IRU/SCEDC/USEDA)

Agricultural Residues

Three types of agricultural residues are available in Oregon as potential fiber sources. They are:
- straw residue from grain and grass seed crops,
- tree limb prunings from orchards and vineyards, and
- residue by-products from food-processing plants. These range from dry shells in walnut and hazelnut processing to high-moisture cannery waste from corn, beet, carrot, and bean processing.

Most agricultural-and food-processing residues are not utilized. With the exception of wheat and barley straws, most field and vegetable crop residues are left in the field and plowed down. Historically, grass straw residues were burned after harvest to control insects and disease. Orchard prunings are sometimes shredded or chipped in the field and spread over or disked into the soil. Usually, they are piled and burned. Very little food processing (cannery) wastes have been utilized. Dry walnut and hazelnut shells are being used for hog fuel.

Straw Residues in Oregon form the largest class of agricultural residues. **Table 11** provides the acreage of small-grain and grass-seed production in Oregon with an estimate of the tonnage of grass and grain straws potentially available as raw material for panelboard and pulp/paper production.

The largest potential annual straw volume is from grain straws, predominantly in the major wheat/fallow-producing region of northeast Oregon where some 2.4 million tons of straw residue are generated. Nearly 600,000 tons of grain straw are generated in the Willamette Valley. The acreage of small grains, from which straw is a by-product, varies substantially from year to year. Most of the straw in northeast Oregon is plowed down as part of a trashy fallow management system. In the Valley, while some grain straw is baled and sold for bedding by livestock and mushroom producers, most grain straw is chopped and plowed down.

Table 11. Potential Grain and Grass Straw Availability in Oregon, 1993.

	Acres	Tons/acre Removable	Total tons Removable
Grain Straw			
Willamette Valley	167,650	3.5	580,000
N.E. Oregon	798,360	3.0	2,400,000
Sub-Total	966,010		3 million tons
Grass Straw			
Willamette Valley	368,630	1.5 - 4.25	665,000 - 911,000
Eastern Oregon	25,045	1.5 - 4.25	25,000 - 55,000
Sub-Total	393,675	1.5 - 4.25	690,000 - 970,000
Total	1,359,685		3.7 - 4.5 million tons

Source: 1993 Oregon County and State Agricultural Estimates. Special Report 190. Revised January 1994. Oregon State University Extension Service. Straw tonnage estimates from Russ Karow, Extension Cereal Crop Specialist, Oregon State University.

One panelboard mill in eastern Oregon is investigating the possibility of using grain straw as a wood fiber extender in its operation.

Potential volume of grass straw available ranges from about 700,000 to 1,000,000 tons annually. Nearly all of this is confined to the Willamette Valley which serves as the international center for cool-season grass seed production, from which grass straw is a by-product. Disposition of grass straw in the Willamette Valley for 1993 is shown in **Appendix M**. Currently some 250,000 tons are marketed, most of it to Japan as livestock feed. Small amounts are shipped to livestock in eastern Oregon. The remainder of the grass straw currently is disposed of by burning (open-field burning, propane flaming, and stack burning), plow down, or is left on the ground after chopping and flailing.

To use grass or grain straw as wood fiber substitutes in the Willamette Valley requires storage after summer harvest to avoid decomposition from high rainfall levels in the winter. Low bulk density of the straw also requires significant densification for field removal and transport to use areas compared to wood fibers. Grain straw in eastern Oregon will require densification for field removal to mill site, but limited storage requirements as rainfall in eastern Oregon is a minimal hazard.

Considerable work has been involved in straw densification, handling, storing, and transporting grass straw and their associated costs. The necessity for straw removal soon after mid-summer grass-seed harvest for cultural practice reasons, and development of a limited domestic and international market for grass straw as a livestock feed, have prompted such developments. **Table 12** provides a summary of current grass-straw utilization costs. An approximation of such costs ranges from $24 to $46/ton. This does not include additional processing (chipping or grinding) necessary for grass straw use as furnish in panelboard or

pulp/paper manufacture. The cost conversion of grass straw at 12 percent moisture to bone dry units (BDU) as a fiber source for panelboard or pulp/paper furnish is $33 to $63/BDU. These costs appears to be competitive with current pulp/paper furnish prices of $60 to $140/BDU, referred to earlier in the study. This allows for $27 to $77/BDU additional costs associated with straw processing (grinding) and pulp/paper mill processing modifications and is competitive with existing wood fiber furnish. In the case of panelboard furnish, currently at $25 to $45/BDU, grass straw appears not yet competitive.

Table 12. Baling, Storage, & Transportation Costs in Utilization of Willamette Valley Grass Straw

Operation	Source	Average $/ton	Cost Range $/ton
Swathing, baling, handling, stacking	Owner	16	
Swathing, baling, handling, stacking	Custom	20	15-30
Swathing & Baling	Custom	12	10-13
Handling & Stacking	Custom	2.50	2-3
Transport field to barn	Custom	3.25	3.25
On-farm Storage	Barn	8.50	7-10
	Tent	3.50	3-4
	Tarp	3.00	2.5-3.5
Trucking (Local) [a]	0-10 mi	3.25	
	11-25 mi	5.00	
	26-40 mi	6.10	
	41-80 mi	7.15	
	81-120 mi	10.72	
Total with Storage		35	24-46

[a] Trucking rates are representative of those typically charged by custom baling/hauling operations. The costs include loading the tractor/trailer at field site and unloading at end user destination with an average haul of 23 tons per load.

Sources: Agricultural Fiber Association, 1993; Mellbye, 1993; Hartung, 1992; Campbell, 1993; Gingrich, 1993; and selected producers, custom balers, and custom haulers.

Use of grass and grain straws as a hog fuel substitute source is unlikely. Low bulk density makes transportation costs expensive and their high potassium content (characteristic of agricultural residues) produces, as yet unresolvable, slag problems in boilers (Conklin).

Orchard and Vineyard Prunings come from 80,000 acres of tree fruits and nuts grown in Oregon. The bulk of such production, 75,000 acres, is concentrated in three areas: (1) the

Willamette Valley, (2) southern Oregon around Medford, Grants Pass, and Ashland, and (3) the Columbia Gorge area around Hood River and The Dalles. The tree fruits and nuts grown include apples, pears, cherries, peaches, apricots, prunes, plums, walnuts, hazelnuts, and grapes.

Estimates of the volume of orchard and vineyard prunings from these regions are presented in **Table 13**. Total tonnage potentially available is estimated to range from some 225,000 to 750,000 tons annually. What is practical to be removed may be significantly less. The majority of the pruning volume is scattered throughout the Willamette Valley.

Table 13. Estimates of Orchard and Vineyard Prunings in Oregon by Region, 1993

Region	Acres of Tree Fruit and Nuts [a]	Estimated Tonnage/acre of Prunings	Tonnage of Prunings Removable
Willamette Valley	45,607	3 - 10	135,000 - 450,000
Southern Oregon	9,707	3 - 10	29,000 - 97,000
Hood River/Wasco Counties	19,405	3 - 10	58,000 - 190,000
Total	**74,710**	--	**225,000 - 750,000**

[a] Included are apples, pears, cherries, peaches, apricots, prunes, plums, walnuts, hazelnuts, and grapes.

Source: 1993 Oregon County and State Agricultural Estimates, Special Report 790, Revised January 1994. Oregon State University Extension Service. Tonnage estimates obtained from Clark Seavert, Area Extension Economist, Oregon State University, personal communications, February 1994.

The most common cultural practice used by growers to dispose of the prunings is to place them between the tree rows and come through with a flail/chopper to grind the prunings and leave the residue for ground cover. This is likely to continue as the best practice for the younger orchards. Small amounts are moved to row ends and burned. Prunings from large and mature trees in the Columbia gorge are sold for firewood in Portland.

The cost to utilize (remove, chip, and transport) orchard and vineyard prunings for panelboard furnish is not known.

Food Processing Wastes result from several agricultural products. These include fruit pits, nut hulls, shells, and cannery wastes. Because they are produced at processing plants, collection costs are nil. These residuals are only available seasonally. An example in use of food processing wastes is the Jefferson Smurfit papermill in Newberg. This mill burns filbert (hazelnut) shells in the fall and winter when they are available to supplement hog fuel supplies. It is estimated that the Newberg mill burns several thousand tons of shells each year (Schmult, 1988).

Very little cannery waste from processing of vegetable, berry, and fruit crops has been utilized to date because of its very high moisture content, usually exceeding 90 percent, which makes transport cost prohibitive.

CHAPTER 7: CONCLUSIONS

The study provides several important conclusions and implications for panelboard plants interested in using some of the wood-waste stream now entering landfills in Oregon as a potential raw-material source.

1. Study results indicate that some 400,000 tons of wood waste from landfills in Oregon already are being utilized annually, largely as a source of hog fuel. An additional estimated 100,000 tons are known to go into landfills. How much more could enter the recycling stream is unknown but suspected of being substantial.

2. The amount of landfill wood waste available, appears to represent perhaps only 4 to 6 percent of the estimated total volume of some 8 to 10 million tons of wood residues currently used in the Pacific Northwest. However, this may be a useful offset for the supply reductions coming from more than 160 mill closures and the overall timber harvest reductions on public lands that are expected to be at about half the volume of harvest levels during the 1980's.

3. Three urban centers in Oregon, covering eight counties and containing two-thirds of Oregon's population, generate much of the wood-waste stream. Each center has a wood-waste recovery program. The total volume currently recycled is nearly 400,000 tons of wood waste annually. A fourth center is being considered for central Oregon.

4. Ten counties are initiating or investigating wood-waste management programs.

5. Wood-waste recovery programs in most instances are conducted by private firms or timber products mills rather than landfill operations. The Metro area of Portland has 27 wood-waste processing firms, most having started recently.

6. Market demand for wood fiber is highest in production of the higher-valued products that also have the most stringent wood furnish requirements. Pulp and paper production ranks highest, followed by pellet/log fuels, panelboard, compost, and finally hog fuel for power plants. Existing supplies of high-quality wood furnish for the pulp/paper industry are adequate under current market conditions. Market improvement could lead to expanded capacity and a search for alternative fiber sources, as Weyerhaeuser is doing.

7. Much wood waste has contaminants that, unless removed or separated from clean wood at wood-waste source site, degrade wood from furnish to low-valued hog fuel.

8. Wood-waste processing for separation into different wood furnish categories is in infancy and, to date, limited principally to the three regional centers. Little is known about alternative process requirements and their costs for separating various wood wastes other than the preferred choice of site separation of wood materials to minimize contamination with non-wood materials.

9. Economic forces influence the extent to which wood wastes end up in landfills:
   - County regulations that permit open burning of wood wastes on site and/or at county landfills serve as disincentives for wood-waste recycling. At least seven counties in Oregon permit such burning.
   - Cost of long transportation hauls of wood waste to end users discourages recycling.
   - The magnitude of landfill tipping (dumping) fees, which range from $35 to $85/ton in Oregon, influence wood-waste recycling. Low fees are a disincentive to recycling of wood waste.

10. Substantial volumes of virgin wood from timber slash and agricultural orchard prunings appear to be available as possible alternative wood fiber sources. If the economics of recovery (currently unknown) are not prohibitive, these sources are likely to be used by pulp/paper and panelboard mills where high-quality virgin wood fiber is a necessary raw material.

11. Grass and grain straw fiber, while available overall in substantial quantities, is likely to continue to be viewed as a second-best choice to wood fibers except under special circumstances. Several reason exist for this:
   - As technical qualities of straw are somewhat different than wood fiber, some wood processing plants may require modification of existing plant and equipment, an additional and unknown cost factor.
   - Low-bulk density of straw makes its transport with existing equipment relatively more costly than wood chips.
   - Straw is subject to degradation from rain making storage an important cost component in the Willamette Valley.

The study, while limited in scope, has in itself had considerable impact. It is the first effort to explore the nature of the industrial and urban wood-waste stream. When the study was initiated early in 1993, only two of 16 panelboard plants in Oregon had tapped into the urban and industrial wood-waste stream. At that time as well, few landfill operations had knowledge of Oregon's timber crisis and potential demand for wood-waste materials. By the end of 1993, all but one panelboard plant was utilizing some wood waste. While 8 counties, largely urban, had wood waste recycling programs, an additional 10 now are considering it. The market for wood waste is new. Clearly, the demand for wood waste is strong in panelboard utilization. This is likely to increase in other uses as well. On the supply side, much has yet to be learned concerning the processing of wood wastes, including sorting of the wood into various use classes, the cost of so doing, and the linking of such operations to the demand side in meeting wood furnish specification requirements.

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APPENDIX B. GLOSSARY

Board foot (BF): Unit of measure for logs and lumber equal to a board 1 inch thick, 12 inches wide, and 12 inches long. The material is commonly measured in thousand board feet (MBF) or million board feet (MMBF). However, BF measurement for standing timber uses a BF log scale and measurement after the log has been processed into lumber is BF lumber scale. The volumetric measure of BF lumber scale is less than BF log scale.

Boiler: Any device used to burn biomass material and wastes to heat water for generating steam.

Bone Dry: Having zero percent moisture content. Wood heated in an oven at a constant temperature of 212 degrees F. or above until its weight stabilizes is considered Bone Dry or Oven Dry.

Bone Dry Unit (BDU): A quantity of wood residue which weighs 2,400 pounds at zero percent moisture content.

Cellulose: The main carbohydrate in living plants, forming the skeletal structure of the plant cell wall. The carbohydrate molecule is composed of long chains of glucose molecules. Cellulose molecules are much larger and structurally more complex than starch molecules, which makes the breakdown of cellulose to glucose more difficult.

Clean Wood: Clean mill residue, such as slabwood from primary forest product mills, untreated pallets, dimensional lumber, construction wood, and demolition wood that contain no non-wood physical or chemical materials. It also can include wood residue harvested during commercial logging, forest management, and site development.

Cogeneration: The technology of simultaneously producing electric energy and other forms of thermal or mechanical energy from a single facility for industrial or commercial heating or cooling purposes.

Combustion: The transformation of biomass into heat, chemicals, and gases through chemical combination of hydrogen and carbon in the wood fuel with oxygen in the air.

Construction Waste: Waste materials resulting from the construction, remodeling, and repair of buildings and other structures.

Contaminated Wood: Foreign material lending impurity to a primary material. Examples include pressure-treated wood surface coated with paints, stains, and/or creosotes or coatings such as painted trim, stained cabinets, plastics, and paper laminates.

Demolition Waste: Solid waste, largely inert, resulting from the demolition or razing of buildings, roads, and other man-made structures. Demolition waste consists of, but is not

limited to, concrete, brick, bituminous concrete, wood, masonry, composition, roofing and roofing paper, steel, and amounts of other metals like copper. Plaster (i.e., sheetrock or plasterboard), any other non-wood material that is likely to produce gases or leachate during the decomposition process, and asbestos wastes are not considered to be demolition wastes.

Densification: A process that compresses biomass into bales, stacks, pellets, briquettes, cubes, or densified logs by subjecting it to high pressure.

Dry Ton: 2,000 pounds of material dried to a constant weight.

Emissions: Substances discharged into the environment as waste material, such as discharge into the air from smokestacks or discharge into the water from waste streams.

Feedstock: Any material which is converted to another form or product.

Fine(s): A very small particle of material such as very fine sander dust or very small pieces of bark.

Forested areas or land: Any land that is capable of producing or has produced forest growth or, if lacking forest growth, has evidence of a former forest and is not now in other use.

Forest Residues: Material not harvested or removed from logging sites on commercial hardwood and softwood stands. This category also includes material resulting from forest management operations such as precommercial thinnings and removal of dead and/or dying trees.

Furnace: An enclosed chamber or container used to burn biomass in a controlled manner where heat is produced for space or process heating.

Furnish: Processed raw material used in the manufacturing of reconstituted panelboards.

Green Ton: 2,000 pounds of undried biomass material. Moisture content must be specified in order to be used as a measure of fuel energy.

Hardwoods: A general term referring to any of a variety of broad-leaved, deciduous trees, and the wood from those trees. The term has nothing to do with the actual hardness of the wood; some hardwoods are softer than certain softwood (evergreen) species.

Hogged (hog) Fuel: Wood residues processed through a chipper or mill to produce coarse chips for fuel. Bark, dirt, and fines may be included.

Incinerator: Any device used to burn solid or liquid residues or wastes as a method of disposal. In some models, provisions are made for recovering the heat produced.

Industrial Wood Waste: Waste wood resulting from manufacturing processes which use virgin or non-virgin wood materials in their operations.

Land-Clearing Debris: Includes grass, leaves, sod, woody debris, limbs, and brush. Does not include concrete, rock, stumps, or treated landscaping timbers.

Mill Residue: Wood and bark waste produced in processing lumber.

Moisture Content: The weight of the water contained in the wood, usually expressed as a percentage of the weight of the wood, either oven-dry or as received.

Municipal solid waste (MSW): garbage.

Organic: Of, relating to, or derived from living organisms and containing carbon compounds.

Organic compounds: Chemical compounds based on carbon chains or rings and also containing hydrogen with or without oxygen, nitrogen, and other elements.

Oven Dry: See Bone Dry.

PVC Laminates: Poly-vinyl coated materials overlayed and laminated to a substrate or panel.

Reconstituted Panelboard: Panel products derived from wood materials which have been processed (ground up) into small particles and then glued back together.

Refuse-derived fuel (RDF): Fuel prepared from municipal solid waste by refining. Minimum refinement is usually removing noncombustible portions, such as rocks, glass, and metals, before chipping pieces into uniform sizes.

Site Sourcing: A waste management term for locating and obtaining materials.

Softwood: A general term referring to any of a variety of trees having narrow, needle-like or scale-like leaves, generally coniferous. The wood from such trees has nothing to do with the actual softness of the wood; some "softwoods" are harder than certain of the "hardwood" species.

Unit: 200 cubic feet, bulk measure, used to measure hog fuel, pulp chips, etc. Contains varying amounts of solid material depending on the amount of compaction. It is now more customary to weigh material, correct for moisture, and calculate the number of bone dry tons.

Urban Wood Waste: Waste wood resulting from construction, demolition, dismantling, land-clearing operations, and yard debris within an urban area.

Virgin Wood Residues: Wood and bark residues produced by primary and forest products mills in processing logs into lumber, plywood, and paper.

Waste Wood: The edgings and scraps left after processing a log or wood.

Woody Materials: Wood residues resulting from commercial logging operations, land clearing, and yard debris. This includes treetops, branches, limbs, whole trees, stumps, and woody shrubs.

Yard Waste: Grass clippings, leaves, branches, weeds, prunings, and other discarded organic material derived from residences or businesses.

Waste streams: A waste management term used to identify the "flow" of waste materials from consumers, manufacturer, processor, etc., to a landfill, or any point of recycling in between.

APPENDIX C. DEQ SOLID WASTE PERMIT LIST

Company	Entire Name	Entire Address	Phone 1
City Of Antelope	Antelope Disposal Site	PO Box 113, Antelope, OR 97001	(503) 489-3388
Ash Grove Cement West, Inc.	Lyod Widener	AGCW Solid Waste Disposal 330 Cement Plant Road,	(503) 877-2411
Ashland Sanitary Service	Gary Rigotti	Ashland Sanitary Landfill 170 Oak St, Ashland, OR	482-1471
Astoria Landfill	Ron Santili	City Of Astoria 1095 Duane St, Astoria, OR	325-4622
Avison Lumber Landfill	Bruce Theil	Avison Lumber Company PO Box 419, Molalla, OR	829-9131
Baker Sanitary Landfill		Baker Sanitary Service, Baker City, OR 97814	523-2626
Bio Waste Management, Inc		Bio-Waste Management Corp PO Box 1559, Palo	
Long Creek Mill Landfill	Roger Kinoble	Blue Mountain Forest Products, Inc. PO Box 1559,	276-4304
Bob's Sanitary Service, Inc.	Attn. John	11919 North Jantzen Dr #143, Portland, OR	286-2930
Dorena Mill Landfill	Tom Arlint	Bohemia Inc., PO Box 1819, Eugene, OR	744-4600
	Glen Patrick	Boise Cascade Corp. PO Box 8326, Boise, ID 83707	(208) 384-6458
Brookings Energy Facility	Spencer Smith	Brookings Energt Facility, Inc. PO Box 1240,	469-2425
Gaffin Road Transfer Station	Bruce Foster	Brown's Island, Inc. PO Box 20, Salem, OR 97308	363-8890
Burns-Hines Disposal Site	Randy Fulton	C & B Sanitary Service 609 N Broadway Ave, Burns,	573-6441
C & D Lumber Co. Disposal Site	Brigid Kennady	C & D Lumber Company PO Box 27, Riddle, OR 97469	874-2281
	Manager	Cannon Beach Sanitary Service PO Box 386, Cannon	436-1460
Cascade Utilities Landfill	Brenda Crosby	Cascade Utilities, Inc. 303 Zobrist, Estacada, OR	630-4202
Rifle Range Disposal Site	Manager	Champion Internation Corp. 1011 E Main Ave #303,	
Milton-Freewater Landfill	Howard Moss	City Of Milton-Freewater PO Box 6, Milton-Freewater,	938-5531
Sawmill Log Pond Site	Dave Howard	Clear Pine Mouldings, Inc. PO Box 309, Prineville, OR	447-4195
Columbia County Transfer Station	Manager	Columbia County Transfer Station, Inc PO BOX 8,	397-1338
Joe Ney Disposal Site	Skip Sumstine	Coos County Solid Waste Dept STA Coos County	396-5444
Gilchrist Timber, Solid Waste Site	John Earnst	Crown Pacific Lumber PO Box 638, Gilchrist, OR	433-2222
	Manager	Curry County Board Of Commissioners 450 N	247-7011
Wridge Creek Ash Disposal Site	Manager	Curry Transfer & Recycling, Inc. PO Box 1240,	469-2425
Tieman Landfill	Aubrey Pendergrass	Davidson Industries PO Box 7, Mapelton, OR 97453	268-4422
Dee Forest Products	Andrea Elingson	Industrial Landfill 4780 Dee Highway, Hood River, OR	354-1711
Southwest Landfill	Doug Hartzell	Deschutes County Public Works 61150 SE 27th	388-6581
D.C. Forest Products Disposal	Jim Roles	Douglas County Forest Products PO Box 848,	672-5711
Department Of Public Works	John Hebard	Douglas County Solid Waste Admin Courthouse Rm	440-4210
Clearwater Landfill	James Sheroan	Dow Corning Corp 1801 Aster St, Springfield, OR	746-7674
Dry Creek Disposal Site	Wendell Smith	Dry Creek Landfill, Inc. 135 West Main St, Medford, OR	779-4161
Dunn LeBlanc, Inc.	Leroy Salzer	Dba/North Lincoln Sanitary Service 1726 SE Hwy 101,	994-5555
Esco Sauvie Island	Carter Webb	Esco Corporation PO Box 10123, Portland, OR 97210	228-2141
Burill Lumber Landfill	Dean Ricks	Eugene F. Burill Lumber Co. PO Box 220, Medford,	826-2221
Finley Buttes Landfill	Roger Paul	Finely Buttes Landfill Co. PO Box 61726, Vancouver,	288-7844
Fort Hill Landfill	Roger Turnbull	Fort Hill Lumber Company PO Box 186, Grande	
Fred V. Smith Landfill	Fred Smith	PO Box 385, Brownsville, OR 97327	466-5850
Fremont Sawmill	Bob Evans	Lakeview Fill Site PO Box 1340, Lakeview, OR 97630	947-2018
Freres Lumber Company	Ted Freres	PO Box 276, Lyons, OR 97358	859-2121
Garden Grow Company	John Graham	PO Box 278, Independence, OR 97351	838-2811
Georgia Pacific Corp	John Steinmitz	PO Box 1618, Eugene, OR 97440	689-1221
Jerry's Flat Landfill	Manager	Gold Beach Plywood, Inc PO Box 579, Centralia, WA	
Fox Hill Landfill	Ron Larvik	Grande Ronde Recovery, Inc. 1202 Willow, LaGrande,	963-5459
Hendrix Landfill	Manager	Grant County Courthouse 200 S Canyon Boulevard,	575-0059
Grants Pass Landfill	Bill Peterson	City Of Grants Pass 101 NW "A" St, Grants Pass, OR	474-6355
Green Veneer Landfill	Scott Munger	Green Veneer, Inc. PO Box 377, Mill City, OR 97360	897-2391
Haines Landfill	Don Berry	City Of Haines PO Box 208, Haines, OR 97833	856-3366
Halfway Disposal Site	Bud LaRue	City Of Halfway PO Box 738, Halfway, OR 97834	742-4741
Hanel Lumber Company, Inc.	Gale McCafferty	4865 Highway 35, Hood River, OR 97031	354-1484
Gunners Mainline Landfill	Manager	Hanson Natural Resources Company 62424 Nehalem	221-7038
L & C Log Yard Landfill		Seaside Office PO Box 998, Seaside, OR 97138	221-7038
Harney County Road Department	Kerry Landers	PO Box 699, Burns, OR 97720-0699	573-6456
Herbert Malarkey Roofing	Joe Dubravac	PO Box 17217, Portland, OR 97217	283-1191
Hillsboro Landfill	Dave Zumwalt	Hillsboro Landfill, Inc. 3205 SE Minter Bridge Road,	640-9427
Hood River Recycling & Transfer Station	Manager	PO Box 757, Hood River, OR 97031	386-4676
City Of Huntington	Ray Trusty	PO Box 369, Huntington, OR 97907	869-2202
International Paper-Wood Products	Max Alston	PO Box 645, Gardiner, OR 97441	271-3688
Jackson County Planning & Dev.	Manager	10 South Oakdale, Medford, OR 97501	
James River Paper Co., Inc.	Mike Woods	RT 2, Box 2185, Clatskanie, OR 97016	455-2221
Molalla Pit	Jeff Tyseling	Jeff Tyseling Enterprises PO Box 748, Estacada, OR	936-8348
Jefferson County Court	Manager	PO Box 709, Madras, OR 97741	
Klamath Falls-Solid Waste Management	Keith Read	Veteran's Memorial Building 334 Main St, Klamath	883-4696
Lake County Road Department	Vern Story	513 Center St, Lakeview, OR 97630	947-6004
Lakeside Reclaimation	Howard Grabhorne	14930 SW Vandermost RD, Beaverton, OR 97005	628-1866
Lakeview Lumber Products	Gordon Wilson	PO Box 229, Lakeview, OR 97630	947-2145
Lane County Public Works Dept.	Ken Sandusky	125 E 8th Ave, Eugene, OR 97401	687-4119
Les' Sanitary Service	Janet Morrow	PO Box 956, Coos Bay, OR 97420	267-2848
City Of Long Creek	Hal Arborgast	PO Box 489, Longcreek, OR 97856	421-3939
Longview Fibre Co; Clatskanie Log	Manager	PO Box 667, Longview, WA 98632	(206) 429-2605
Adrian Sanitary Landfill	Jim Kimberly	Malheur County Public Works 251 "B" St. West, #8,	473-5191
Marion County Solid Waste Mgmt	Jim Sears	388 State St., Suite 735, Salem, OR 97301-3670	588-5036
Medford Corporation	Bruno Meyer	PO Box 550, Medford, OR 97501	773-7491
Mitchell Disposal And Metal Salvage	Annette Wornell	City Of Mitchell PO Box 97, Mitchell, OR 97750	462-3522
City Of Monument	Jackie Oakley	PO Box 426, Monument, OR 97864	934-2629
Goose Lake Lumbr Disposal Site	Manager	North Lake Development Co. PO Box 829, Lake View,	898-2185
Oregon Hydrocarbon, Inc.	Lex Johnson	PO Box 83685, Portland, OR 97283	735-9525
P & M Woodwaste Landfill	John Scott	PO Box 1939, Roseburg, OR 97801	276-1271
Pendleton Landfill	Susan McHenry	Pendleton Sanitary Service, Inc. PO Box 1405,	276-1271
Pilot Rock Landfill	Manager	PO Box 0, Pilot Rock, OR 97868	
Pope & Talbot Landfill	Manager	PO Box 8171, Portland, OR 97207	228-9161
Port Of Tillamook Bay	Bob Schutte	4000 Blimp Boulevard, Tillamook, OR 97141	842-6641
Powers Disposal Site	Manager	City Of Powers PO Box 250, Powers, OR 97466	439-3331

APPENDIX C. DEQ SOLID WASTE PERMIT LIST (cont.)

Company	Entire Name	Entire Address	Phone 1
Prarie City Landfill	Butch Goslin	City Of Prarie PO Box 342, Prarie City, OR 97869	820-3605
Prineville Disposal, Inc.	Gary Goodman	PO Box J, Prineville, OR 97754	447-5208
Rahn's Sanitary Landfill	Manager	Rahn's Refuse Removal Route 1, Box 79, Athena, OR	566-3423
United Disposal Service	Jaon Garren	2215 N Front Street, Woodburn, OR 97071	981-1278
Eagle Cap Sanitation	Manager	PO Box 165, Richland, OR 97870	
Riedel Waste Disposal System	Charles Bird	PO Box 5007, Portland, OR 97208	286-4656
Riverbend Landfill Co., Inc.	Paul Petersen	PO Box 509, McMinnville, OR 97128	472-3176
Rogge Lumber Landfill	Les Bridges	Rogge Lumber Co. PO Box 547, Wallowa, OR 97885	886-2651
Rough & Ready Disposal Site	Link Phillippi	Rough & Ready Limber Co., PO Box 519, Cave	592-3116
Superior Veneer Co.	Ron Branet	PO Box 250, Glendale, OR 97422	832-1130
Salem Airport Disposal Site	Rick Scott	1410 20th St SE, Salem, OR 97302	588-6008
Sanifill Of Oregon, Inc.	Ron Law	300 Drake's Landing Rd Suite 155, Green Breae, CA	865-9800
Umatilla Butte Landfill	Bill Kik	Sanitary Disposal, Inc. PO Box 316, Hermiston, OR	567-8842
Seneca Landfill	John Saunders	City Of Seneca PO Box 208, Seneca, OR 97873	542-2161
Shaniko Disposal Site	Manager	City Of Shaniko PO Box 17, Shaniko, OR 97057	475-3091
Sherman County	Don Sidal	500 Court St., Moro, OR 97039	
Newberg Landfill	Manager	Smurfit Newsprint Corp. 427 Main St, Oregon City, OR	829-2271
South Coast Lumber Co.	Fred Aronald	PO Box 670, Brookings, OR 97415	469-2136
Sun Studs, Inc.	Rick Sown	2635 Old Hwy 99 South, Roseburg, OR 97470	672-5059
Tillamook County Public Works	Linda Shelly	1315 Eckloff, Tillamook, OR 97141	842-3419
Unity Sanitary Landfill	Pat Schiewe	City Of Unity PO Box 98, Unity, OR 97884	446-3421
Valley Landfills, Inc.	Bill Webber	PO Box 807, Corvallis, OR 97339	757-9067
Vernonia Landfill	Manager	City Of Vernonia 919 Bridge St, Vernonia, OR 97064	429-5291
Glide Lumber Products Landfill	Ryle Stemple	WTD Industries PO Box 370, Glide, OR 97443	496-3571
Wallowa County Courthouse	Verne Russell	101 S River St, RM 202, Enterprise, OR 97828	
Warrenton Landfill	Manager	City Of Warrenton 147 South Main St, Warrenton, OR	
Westbrook Wood Products Landfill	Gus Sanford	PO Box 1094, Coos Bay, OR 97420	396-2196
Weyerhaeuser Company	Pam White	PO Box 275, Springfield, OR 97478	
Spray Landfill	Manager	Wheeler County Court PO Box 327, Fossil, OR 97830	
Willamette Industries	Janet Runkle	PO Box 907, Albany, OR 97321	926-7771
Buck Hollow Landfill	Wes Hutchins	Willamina Lumber Co. 9400 SW Barnes Road, Suite	297-7691
Whiteson Landfill	Judy Ashley	Yamhill County Planning And Dev. 535 E 5th,	472-9371
City Of Elgin	Manager	102 North 8th, Elgin, OR 97827	
Excel Disposal & Recycling, Inc.	Manager	PO Box 115, Astoria, OR 97103	
Forest Grove Transfer Station	Manager	PO Box 8, Forest Grove, OR 97116	
Morrow County	Keri Painter	PO Box 61726, Vancouver, WA 98666	
Mt Hood Refuse	Ranelle Lemmon	PO Box 747, Sandy, OR 97055	
City Of North Powder	Manager	PO Box 309, North Powder, OR 97867	898-2185
Roseburg Forest Products	Max Kimmell	PO Box 149, Roseburg, OR 97470	679-3311
Sweet Home Sanitation Service	Manager	PO Box 40, Sweet Home, OR 97386	367-2535
United Disposal Service	Manager	PO Box 189, Sublimity, OR 97385	749-1055
Umpqua National Forest	Manager	Hc 60 Box 101, Idleyld Park, OR 97447	
City Of Union	Manager	PO Box 529, Union, OR 97883	

APPENDIX D. SURVEY LETTER AND QUESTIONNAIRE

Sample Of Cover Letter Which Was Mailed and Telefaxed to Each Identified and Private and Public Land Fill in the State of Oregon

To:

Re: Attached Questionnaire

Dear

Thank you for taking the time to speak with us. The enclosed questionnaire is sponsored by Oregon Department of Agriculture, Oregon Department of Energy, Oregon State University, and the Oregon Wood Products Panelboard Industry. It is designed to establish the availability of certain materials which could be used and/or recycled thus, providing you with an opportunity for additional or increased revenues from new or expanding markets. **Assistance in this analysis could provide you with $40 to $60 per ton recovery on waste wood!**

New technology, research and innovation are expanding the uses, applications and life cycles of low-grade materials. The abundant supply of potential raw materials such as waste wood, mixed paper, straw, plastics, and colored glass continue to be the target for aggressive research towards new technologies and processes.

The panelboard industry perceives that wood fiber in the form of urban wood waste (UWW) and industrial wood waste (IWW) will be selected as the alternatives of choice in extending traditional virgin wood fiber sources. This will most likely be followed by the utilization of straw and other agricultural byproducts in the future.

Market Background

- The western Oregon timber products industry has lost more than 40 mills in the past two years, largely due to reduced timber from locked-up timber lands and increased regulation
- The loss of mills has decreased the supply of wood residuals. Supply is not expected to increase.
- The panel industry throughout the state needs additional good, clean furnish for the manufacturing of panelboard (hardboard, particleboard, MDF, etc.)

Your Role and Opportunity

- By assisting to identify the types, quantities, and conditions of UWW and IWW materials processed by your company, you can provide the much-needed furnish or raw materials to manufacturers.
- Assisting in this analysis can provide value recovery. (Hog fuel prices in Oregon are between $13-30/ton while furnish for panelboard is running $30-50/ton, and pulp chips at $60-120ton.)

All information provided will be compiled into COMPOSITE figures, so as to protect the identity of the respondent. All respondents will be able to obtain a copy of the report upon completion of the study. We thank you for your time and contribution to this analysis.

Sincerely,

APPENDIX D. SURVEY LETTER AND QUESTIONNAIRE (cont.)

Please complete the following questions and return to IRU in the envelope provided. If your responsibility encompasses multiple landfills and transfer stations, please make a photocopy and complete 1 questionnaire for all landfills and 1 questionnaire for all transfer stations. Indicate the number of facilities which are included in your composite figures. We are interested in facilities of Oregon Counties which are on DEQ's Solid Waste Permit List. If you have any questions, please call Troy or Steve at IRU, (503) 344-9454. Thank you for your time and cooperation.

COMPANY NAME: _____

CONTACT NAME: _____ TRANSFERS_____ OR LANDFILLS_____

1. ON A DAILY BASIS, APPROXIMATELY HOW MANY TONS OF ALL MATERIALS DO YOU RECEIVE?

___ 0 - 25 ton	___ 101 - 200 ton	___ 501 - 600 ton	___ 901 - 1000 ton
___ 26 - 50 ton	___ 201 - 300 ton	___ 601 - 700 ton	___ 1001 - 1500 ton
___ 51 - 75 ton	___ 301 - 400 ton	___ 701 - 800 ton	___ 1501 or more
___ 76 - 100 ton	___ 401 - 500 ton	___ 801 - 900 ton	

2. PLEASE CHECK THE MATERIALS WHICH YOU RECEIVE AND THE APPROXIMATE PERCENTAGE THAT EACH IS OF THE TOTAL COLLECTED ENTERED IN QUESTION 1 ABOVE :

WASTE TYPE	PERCENTAGE OF TOTAL
___Construction/demolition	_____%
___Yard debris	_____%
___Woody material	_____%
___Recycling	_____%
___Stumps	_____%
___Other applicable materials,	_____%

please specify_____

3. OF THE YARD DEBRIS, WOODY MATERIAL AND STUMPS, PLEASE ESTIMATE THE VOLUME IN THE FOLLOWING DIAMETERS

0 to 4 inches _____
4 to 8 inches _____
8 inches and above _____

4. LAST YEAR, 1992 WHAT WAS YOUR TOTAL WOOD WASTE COLLECTION ?

___ 0-50/ton	___ 301-350/ton	___656-750/ton
___ 51-100/ton	___ 351-400/ton	___756-850/ton
___ 101-150/ton	___ 401-450/ton	___856-950/ton
___ 151-200/ton	___ 451-500/ton	___956-1050/ton
___ 201- 250/ton	___ 501-550/ton	___1056-1500/ton
___ 251-300/ton	___ 556-650/ton	___1501-2000/ton
		___2001 or more

5. TO DETERMINE MARKETABILITY OF WOOD WASTE, IT IS CRITICAL TO KNOW THE TYPE/FORM OF THE RECLAIMED WOOD. OF THE WOOD WASTE COLLECTED LAST YEAR, WHAT ARE APPROXIMATE PERCENTAGES OF

Pallets _____%
Panels _____%
Construction Debris _____%
Lumber _____%
Doors & Windows _____%
Mill & Moulding _____%
Timbers _____%

6. WHAT PERCENTAGE OF WOOD WASTE COLLECTED IS (PLEASE SEE DEFINITIONS):
Clean ____% Mixed____% Dirty____%

7. DO YOU HAVE SCALES FOR FEE DETERMINATION?
Yes____ No____

8. DO YOU SOURCE SEPARATE THESE MATERIALS?
Yes___ No___
No, we do not accept unsorted materials___

9. IF YES, DO YOU SOURCE SEPARATE
Mechanically___ or Manually____

10. IF MIXED OR DIRTY, DO YOU SEPARATE THE MATERIAL?
yes____ no____

11. IF YES ON 10, DO YOU SEPARATE
Mechanically____ Manually____

12. PLEASE INDICATE THE NUMBER OR AVAILABILITY OF REDUCTION EQUIPMENT WHICH YOU HAVE ON SITE. IF YOU HAVE ADDITIONAL EQUIPMENT, PLEASE LIST BELOW OR ON THE BACK.

Equipment	Permanently on site		Capacity (Tons per hour)
_____Chipper	yes___	no___	_____
_____Drum Debarker	yes___	no___	_____
_____Flayler	yes___	no___	_____
_____Hog	yes___	no___	_____
_____Screens	yes___	no___	_____
_____Separators	yes___	no___	_____
_____Shredder	yes___	no___	_____
_____Trummel	yes___	no___	_____
_____Tub Grinder	yes___	no___	_____

_____Other: please list and indicated availability and capacity.
_____No equipment on site .

13. ARE WOODY MATERIALS RECEIVED BEING RECYCLED AT THIS/THESE FACILITIES?
yes____ no____

IF YES, PLEASE LIST BELOW, THOSE MATERIALS AND ANY RESULTING PRODUCTS WHICH ARE MANUFACTURED AND/OR SOLD.

APPENDIX D. SURVEY LETTER AND QUESTIONNAIRE (cont.)

WOOD MATERIAL DEFINITIONS

FURNISH FEEDSTOCK (CLEAN)
"Clean" or untreated wood which is defined to include wood residue harvested during commercial logging, forest management (i.e. silviculture), and site development. It also includes "clean" mill residue, such as slabwood from primary forest product mills, untreated pallets, dimensional lumber, construction wood, and demolition wood that contain no non-wood physical or chemical materials.

MIXED FUEL AND SOME FURNISH:
- Wood products manufacture with glues and binders, such as plywood, particleboard, and other building products.
- Wood surface-coated with paints, stains, or coatings, such as painted trim, stained cabinets, and plastic laminates.

"DIRTY" LANDFILL:
Both untreated and treated waste wood may be found in municipal, commercial, industrial, and demolition solid waste. Depending on the specific types and amounts of non-wood materials contained in treated wood, its use for fuel may be limited. Overall, there is no single definition of treated wood that is used consistently among waste-wood processors, combustion facilities, and regulators. Treated wood may be referred to as "recycled," "demolition," or "urban" wood.

APPENDIX E. U.S. STRUCTURAL PANEL CAPACITY & PROJECTIONS, 1992-1997.

(Million Square Feet of 3/8" Basis; 1992 = actual)

		WEST	INLAND	SOUTH	NORTH	TOTAL
1992						
Plywood	Capacity	6,620	2,685	13,850	*	23,155
	Production	4,916	2,251	12,165	*	19,332
	Prod./Cap.	74%	84%	88%		83%
OSB	Capacity	0	290	3,555	3,545	7,390
	Production	0	228	2,927	3,498	6,653
	Prod./Cap.		79%	82%	99%	90%
Total	Capacity	6,620	2,975	17,405	3,545	30,545
	Production	4,916	2,479	15,092	3,498	25,985
	Prod./Cap.	74%	83%	87%	99%	85%
1993						
Plywood	Capacity	6,025	2,530	13,950	*	22,505
	Production	3,850	2,230	13,000	*	19,080
	Prod./Cap.	64%	88%	93%		85%
OSB	Capacity	0	290	3,600	3,840	7,730
	Production	0	215	3,320	3,685	7,220
	Prod./Cap.		74%	92%	96%	93%
Total	Capacity	6,025	2,820	17,550	3,840	30,235
	Production	3,850	2,445	16,320	3,685	26,300
	Prod./Cap.	64%	87%	93%	96%	87%
1994						
Plywood	Capacity	4,500	2,450	14,050	*	21,000
	Production	2,900	2,080	13,500	*	18,480
	Prod./Cap.	64%	85%	96%		88%
OSB	Capacity	0	290	4,100	4,050	8,440
	Production	0	220	3,950	3,900	8,070
	Prod./Cap.		76%	96%	96%	96%
Total	Capacity	4,500	2,740	18,150	4,050	29,440
	Production	2,900	2,300	17,450	3,900	26,550
	Prod./Cap.	64%	84%	96%	96%	90%

		WEST	INLAND	SOUTH	NORTH	TOTAL
1995						
Plywood	Capacity	4,200	2,450	14,200	*	20,850
	Production	3,000	2,085	13,150	*	18,235
	Prod./Cap.	71%	85%	93%		87%
OSB	Capacity	0	290	4,550	3,950	8,790
	Production	0	225	4,350	3,840	8,415
	Prod./Cap.		78%	96%	97%	96%
Total	Capacity	4,200	2,740	18,750	3,950	29,640
	Production	3,000	2,310	17,500	3,840	26,650
	Prod./Cap.	71%	84%	93%	97%	90%
1996						
Plywood	Capacity	4,200	2,500	14,300	*	21,000
	Production	3,100	2,100	13,200	*	18,400
	Prod./Cap.	74%	84%	92%		88%
OSB	Capacity	0	290	5,300	4,100	9,690
	Production	0	215	5,185	3,950	9,350
	Prod./Cap.		74%	98%	96%	96%
Total	Capacity	4,200	2,790	19,600	4,100	30,690
	Production	3,100	2,315	18,385	3,950	27,750
	Prod./Cap.	74%	83%	94%	96%	90%
1997						
Plywood	Capacity	4,000	2,500	14,400	*	20,900
	Production	3,200	2,000	13,000	*	18,200
	Prod./Cap.	80%	80%	90%		87%
OSB	Capacity	0	290	6,000	4,100	10,390
	Production	0	215	5,500	3,465	9,180
	Prod./Cap.		74%	92%	85%	88%
Total	Capacity	4,000	2,790	20,400	4,100	31,290
	Production	3,200	2,215	18,500	3,465	27,380
	Prod./Cap.	80%	79%	91%	85%	88%

Source: American Plywood Association (APA), August 1993.

APPENDIX F. WOOD WASTE PROCESSING FACILITIES IN THE METRO REGION.

Company	Salvage & Used Building Materials	Wood	Land Clearing Debris	Corrugated Cardboard
American Compost & Recycling			X	
Architectural Salvage	X	X		
Best Buy in Town Co.			X	
Bredl Saw Service		X		
Durham Wood & Dirt		X	X	
East County Recycling Center		X	X	
EZ Recycling				X
Far West Fibers				X
Grimm's Fuel Co.		X	X	
H & H Wood Recycling Inc.		X	X	
Hillsboro Landfill		X	X	X
Hippo Hardware & Trading	X			
Hyponex			X	
KB Recycling				X
Lakeside Reclamation		X	X	
McFarlane's Bark, Inc.		X	X	
Oregon Paper Fiber				X
Pumilite Building Supply	X			
Reclamation Services, Inc.	X			
Rejuvenation, Inc.	X			
Smurfit Newsprint		X		
Storie Steel & Wood Products	X			
Sunflower Recycling				X
Taylormade Products Inc.		X		
The Wherehouse Project, Inc.	X	X		
Wastech		X	X	
Wood Exchange		X		

APPENDIX G. COUNTY LANDFILL CONTACT SOURCES

County	Contact Person	Telephone
Baker	Loren Henry	523-8207
Benton	Jeff Andrews	757-6800
Clatsop	Mike Caccavano	325-5821
Columbia	Robin Stien	397-1501
Coos	Skip Sumstine	396-3121
Crook	Gary Goodman	447-5208
Curry	Pete Smart	247-7017
Deschutes	Suzanne Johannsen	385-3203
Douglas	Lorna Dobrovolny	440-4320
Gilliam	Althena Bird	384-2311
Grant	Barbara Miller-Sohr	575-0187
	Kevin Campbell	575-0059
Harney	Randy Fulton	573-6641
Hood River	John Rath	386-3970
	Jim Lyon	
Jackson	Brad Prior	776-7248
Jefferson	Don Wood	475-4451
Josephine	Pat Fahey	474-5100
Klamath	Keith Read	883-4696
Lake	Ray Simma	947-6004
Lane		895-3274
Lincoln	Pamela Kambur	265-5747
Linn	Jeff Andrews	967-3831
	Bill Webber-Valley Landfills	
Malheur	Scott Wilson	889-5719
Marion	Jim Sears	588-5169
METRO Region (Clackamas, Multnomah, Washington counties)	Dave Zumwalt - Hillsboro Landfill	797-1700
Morrow	Finley Butte Sanitary	676-9061
Polk	Darrel Brandt	
Sherman	Glen Pierce	296-4636
Tillamook	Jon Oshel	842-3419
Umatilla	Tanya Smith	276-7111
	Sue McHenry	
Union	Ron Larvik	963-1006
Wallowa	Vern Russel	426-4543
Wasco	Art Braun-Dalles Disposal	
Wheeler	Lee Hoover	763-2400
Yamhill	Bruce Macintosh	472-9371

APPENDIX H. COMMON CONTAMINANTS OF WOOD WASTE MATERIALS

WOOD (BIOMASS) PRODUCT and PROCESS LIFE CYCLE ASSESSMENT (Contamination)

WOOD PRODUCT GROUP AND PRODUCT TYPES	PRIMARY NON-WOOD CHEMICAL ADDITIVE CONTENT	AMOUNT OF CHEMICAL(S) IN WOOD PRODUCTS	TYPICAL MOISTURE CONTENT (MC)	PRIMARY USES OF VARIOUS WOOD PRODUCTS	COMMENTS
A. PALLETS & WOOD CONTAINERS					
1.) Pallets (Hardwood/softwood)	Low levels of pesticides and preservatives (penta, lindane dimethyl phthalate, copper-8-quinolinolate, or copper naphthenate	< 10 ppm	4-20%	Shipping & Handling, value added products, furnish for panelboard, biofuels & animal bedding	Testing underway for new pallet products with Eco-Pallet (Recycled Panelboard) & "Enhanced Wood" made of layers of epoxy and/or urethane for wash ability for wash-ability, water & wear resistance
2.) Skids					
3.) Plywood Pallets	Phenolic resins in plywood	2-16%	8-14%		Softwood pallets produced primarily in western and Southern US. (Pine, Spruce, Fir, etc.)
4.) Glued Pallets	Elastomeric adhesives (epoxy)	2-4%	6-12%)		Hardwood pallets produced primarily in Northeast and Mid-western States (Oak(s), Hickory, etc.)
B. PAINTED OR COATED WOOD					
1.) Lead based paint (Construction, Dismantle & Demolition Debris)	Lead level depends highly on the age and volumes of the paint on wood	1400-20,000 ppm (prior to 1950's)	15-20% exterior		Lead levels as much as 50% of paint film prior to mid 1950's. ANSI std. reduced lead to 1.0% by weight in 1955. Federal Legislation in 1971: 1.0% by weight Federal Logislation in 1976: .06% by weight
2.) Acrylic based paint	Acrylic acid, styrene, vinyl toluene, nitrites	< 0.1%	15-20% exterior 6-12% interior		
3.) "Metallic" pigments	Aluminum powder, copper acetate, phenyl mercuric acetate, zinc chromate titanium dioxide, copper ferrocyanide	< 0.1%	15-20% exterior 6-12% interior		
C. STRUCTURAL PANELS (Solid Wood & Reconstituted Wood Fibers)					
1.) PLYWOOD					
1.a.) Interior grade	Urea formaldehyde (UF) resins	2-4% (d.) (dry weight)	6%	walls, floors, cabinets	May be surface coated with fire retardant, preservatives and insecticides; or pressure treated with CCA, etc. (see PALLETS)
1.b.) Exterior grade	Phenol formaldehyde (PF) resins	2-4% (d.)	8-12%	wall & roof sheathing	
2.)* ORIENTED STRANDBOARD (OSB)	Phenol formaldehyde (PF) resins PF/isocyanate resins	2-4% (d.) 3-4% Iso, 1-2% wax (d.)	8-12%	replacement for plywood in roofs, walls, floors, sheathing, siding	OSB making inroads into the furniture, RTA and repair and remodel industries.
3.)* WAFERBOARD ("Aspenite" TM)	Urea formaldehyde (UF) resins	5-15% UF (d.) 2.5% PF, 2% wax (d.)	8-12%	wall & roof sheathing; interior & exterior	May bo sealed w/polyurethane or other sealant to provent "off gassing" of formaldehyde
4.) SPECIALTY GRADES					
4.a.) Medium & High Density Overlay Type Reconstituted Panelboards	Phenol formaldehyde resins PF/isocyanate resins	4-8% (d.) 3-4% Iso, 1-2% wax (d.)		Highway signs, exterior panels	
4.b.) Luan Plywood/ PVC Laminates	Urea formaldehyde, polyvinyl chloride	2.5% UF (d.) 10% PVC		Underlayment for floors	
4.c.) Fire resistant	Salt solutions in core, or borax surface treatment (c)			Where building codes require it	

APPENDIX H. COMMON CONTAMINANTS OF WOOD WASTE MATERIALS (cont.)

WOOD (BIOMASS) PRODUCT and PROCESS LIFE CYCLE

WOOD PRODUCT GROUP AND PRODUCT TYPES	PRIMARY NON-WOOD CHEMICAL ADDITIVE CONTENT	AMOUNT OF CHEMICAL(S) IN WOOD PRODUCTS	TYPICAL MOISTURE CONTENT (MC)	PRIMARY USES OF VARIOUS WOOD PRODUCTS	COMMENTS
D. NON-STRUCTURAL PANELS					
1.) PARTICLEBOARD (PB) (Numerous grades, densities, wood species and blends)	Urea formaldehyde (UF) resins	5-15% (d.)	8-12%	Interior uses	May be sealed w/polyurethane or other sealant to prevent "off gassing" of formaldehyde
1.a) w/PVC laminated surfaces	UF resins w/polyvinyl chloride	4.5% PF, 10% PVC	8-12%	Interior uses	
2.) Medium Density Fiberboard (MDF)	Urea Formaldehyde Resins	3-4% PF	8-12%	Interior uses	Used for smooth finish & painting
	PF/Isocyanate resins	3-4% Iso, 1-2% wax	8-12%	Exterior uses	Siding, highway signs, sheathing
3.) Hardboard (HB)	Phenolic resins	1.5%	8-12%	Interior, Exterior,	Seeing increased use as surface material for composi and plywood substrates
E.) LAMINATED LUMBER (BEAMS) & LAMINATED VENEER LUMBER	Melamine or resorcinol formaldehyde's			Substitute for structural lumber, headers & beams	
F.) POLES, TIES, PILINGS, DOCKING, FENCING, DECKS					
1.) CHROMIUM COPPER ARSENATE (CCA) SOLUTIONS					
1.a.) Pressure treated wood (i.e. Pine, Fir, Cedar)	CCA - three grades	1.0-3.0%	(b)(d)	Exterior uses; decking, posts, fencing, piles, foundations, footings, etc.	Dominant wood preservative; actual levels will be lower due to evaporation or leaching after treatment
1.b.) Surface Treated Wood	CCA - three grades	1.0-3.0%	(b)(d)	Exterior uses; decking, posts, fencing, piles, foundations, footings, etc.	Dominant wood preservative; actual levels will be lower due to evaporation or leaching after treatment
2.) PENTACHLOROPHEOL SOLUTIONS	Chlorinated phenols	1.2-1.5%	(a)(d)	Utility pole, laminated beams, fresh water pilings, bridge timbers	Restricted use due to industry changes and concern over dioxin linkage; not permitted for residential uses
3.) CREOSOTE SOLUTIONS					
3.a.) Creosote - Petroleum	Creosote containing 85% PAH's	14% (by wt.)	(a)(d)	Railroad ties, utility poles, marine pilings, etc.	Losses after treatment estimated to be 20-50% over 10-25 years; not recommended for residential use
3.b.) Creosote - Tar	Creosote containing 85% PAH's	14% (by wt.)	(a)(d)	Railroad ties, utility poles marine pilings, etc.	Losses after treatment estimated to be 20-50% over 10-25 years; not recommended for residential use
3.c.) Creosote - Coal Tar (Marine grade)		15-20%	(a)(d)		
3.d.) Creosote (Marine grade)	Creosote/chlorpyrifos	15-20%	(a)(d)	Saltwater use only	Use Chlorpyrifos where marine borers accelerate wood decay.

FOOTNOTES:

(a.) Moisture content varies depending on species of wood used, exposure, and decay. Dry, treated wood will typically stabilize at 19-25% depending on climate. Kiln dried wood will be initially treated at lower moisture levels (between 10-15%)

(b.) Waterborne preservatives will typically induce swelling of the wood upon application. Following evaporation, wood will stabilize at atmospheric equilibrium.

(c.) There are several fire retardant formulations variously used with wood coating or preservative solutions. Retardants are used on a range of materials including dimensional lumber, solid wood and reconstituted biomass based panelboards, value added overlay products, laminated beams, trusses and joists. Chemicals include monoammonium phosphate, boric acid, ammonium sulfate, and various formulations of nitrogen, boron and phosphorous.

(d.) Caution: Consumer or industry application could constitute illegal action in certain cities, regions, states, counries.

APPENDIX I. PULP AND PAPER MILLS IN THE WESTERN U.S.

STATE	COMPANY NAME	CITY
ARIZONA	Orchids Paper Products Co.	Flagstaff
	Stone Container Corp.	Snowflake
CALIFORNIA	B. J. Fibers	Santa Ana
	California Paperboard Corp	Santa Clara
	Cellulo Co. Inc.	Fresno
	Container Corp. of American	Santa Clara
	Container Corp. of American	Vernon
	Domtar Gypsum	San Leandro
	Domtar Gypsum	Vernon
	Gaylord Container Corp.	Antioch
	Inland Container Corp.	Newark
	Inland Container Corp.	Ontario
	Kimberly-Clark Corp.	Fullerton
	Los Angeles Paper Box & Board Mills	Los Angeles
	Louisiana-Pacific Corp.	Samoa
	Newark Pacific Paperboard Corp.	City of Commerce
	Newark Sierra Paperboard Corp.	Stockton
	PABCO Paper	Vernon
	Packaging Co. of California	Red Bluff
	Paper-Pak Products, Inc.	La Verne
	Reprocell	Sun Valley
	Simpson Paper Co.	Anderson
	Simpson Paper Co.	Eureka
	Simpson Paper Co.	Pomona
	Simpson Paper Co.	Ripon
	Smurfit Newsprint Corp. of CA	Pomana
	Sonoco Products Co.	City of Industry
	Specialty Paper Mills	Sante Fe Springs
	United States Gypsum Co.	South Gate
	Willamette Industries, Inc.	Oxnard
IDAHO	Potlatch Corp., Pulp/Paperboard Group	Lewiston
OREGON	Boise Cascade Corp.	St. Helens
	Concel Inc.	St. Helens
	Evanite Fiber Corp.	Corvallis
	Georgia-Pacific Corp.	Toledo
	International Paper Co.	Gardiner
	James River Corp.	Clatskanie
	James River Corp.	Halsey
	Pope & Talbot Inc.	Halsey
	Simpson Paper Co.	West Linn
	Smurfit Newsprint Corp.	Newberg
	Smurfit Newsprint Corp.	Oregon City
	Weyerhaeuser Paper Co.	North Bend
	Weyerhaeuser Paper Co.	Springfield
	Willamette Industries, Inc.	Albany

STATE	COMPANY NAME	CITY
WASHINGTON	Boise Cascade Corp.	Steilacoom
	Boise Cascade Corp.	Wallula
	Container Corp. of America	Tacoma
	Daishawa America Co. Ltd.	Port Angeles
	Georgia-Pacific Corp.	Bellingham
	Grays Harbor Paper Co.	Hoquiam
	Inland Empire Paper Co.	Spokane
	ITT Rayonier Inc.	Hoquiam
	ITT Rayonier Inc.	Port Angeles
	James River Corp.	Camas
	Longview Fibre Co.	Longview
	North Pacific Paper Corp.	Longview
	Port Townsend Paper Corp.	Port Townsend
	Scott Paper Co.	Everett
	Simpson Tacoma Kraft Co.	Tacoma
	Sonaco Products Co.	Sumner
	Weyerhaeuser Paper Co.	Cosmopolis
	Weyerhaeuser Paper Co.	Longview

APPENDIX J. PANELBOARD MILLS IN OREGON

Company	Address
	Particleboard
Boise Cascade Corp.	P.O. Box 1087 LaGrande, OR 97850-0938 Mr. Rober Carter, Gen. Mgr.
Roseburg Forest Products	P.O. Box 1088 Roseburg, OR 97470 Mr. Robert Crawford, Gen. Mgr.
Timber Products Company	P.O. Box 1669 Medford, OR 97597 Mr. John Wasniewski, Mgr.
Weyerhaeuser Company	Klamath Operations P.O. Box 9 Klamath Falls, OR 97601 Mr. Donn Jensen
Weyerhaeuser Company	P.O. Box 275 Springfield, OR 97477 Mr. Dan Stickler, Gen. Mgr.
Willamette Industries, Inc.	Duraflake Division P.O. Box 428 Albany, OR 97321 Mr. Tom Buglione, Gen. Mgr.
Willamette Industries, Inc.	Korpine Division P.O. Box 1245 Bend, OR 97709 Mr. Phil Wyatt, Mgr.
Willamette Industries, Inc.	P.O. Box 1819 Eugene, OR 97440 Mr. Dennis Adair, Gen. Mgr.
	Hardboard
Dee Forest Products, Inc.	4780 Dee Hwy. Hood River, OR 97031 Mr. Bill Wright, President

Company	Address
Evanite Fiber	Hardboard Div. P.O. Box E Corvallis, OR 97339 Mr. Bill Munk, Mgr.
Georgia-Pacific Corp.	Industrial Wood Products Mfg. Div. 37680 River Road Lebanon, OR 97355 Mr. Tom Alley
Smurfit Newsprint Corp.	Cladwood Division P.O. Box 149 Philomath, OR 97370 Mr. Rick Hostetter, Gen. Mgr.
Weyerhaeuser Company	Klamath Operations P.O. Box 9 Weyerhaeuser Road Klamath Falls, OR 97601 Mr. Chuck Smith, Gen. Mgr.
Wood Fiber Industries	Div. of Masonite Corp. Sub. of International Paper Co. P.O. Box Z Pilot Rock, OR 97868 Mr. C. P. Judy, Gen. Mgr.
Medium Density Fiberboard	
Medite Corp.	Medford Division P.O. Box 4040 Medford, OR 97501 Mr. Ken Hutchison, Gen. Mgr.
Willamette Industries, Inc.	P.O. Box 907 Albany, OR 97321 Mr. John LeFors, Vice President

APPENDIX K. DENSIFIED WOOD FUEL PLANTS IN OREGON

Name	Location	Feedstock	Product
Bear Mtn. Forest Products	Hood River	Cedar/Fir shavings	Pellets
DMH	Forest Grove	Oak shavings/dust	Logs
Evergreen Forest Products	Oakland	Fir	Pellets
Great Western Pellets	Enterprise	Fir	Pellets
Hardwood Industries Inc.	Tualatin	Oak shavings/hog fuel	Logs
Hazelnut Growers of Oregon	Cornelius	Filbert shell/paper	Logs
Kingsford Products Co.	Springfield	Fir hog fuel	Briquets
Modoc Lumber Co.	Klamath Falls	Pine/fir shavings/hog fuel	Pellets
Northwest Pellet Mill	Brownsville	Hog fuel	Pellets
Royal Oak Enterprises	White City	Hog fuel	Briquets
Salem Wood Products	Salem	Shavings, dust, paper	Logs
Straw Products Inc.	Albany	Straw/oak/paper	Logs
Ten Gs	Union	Pine	Pellets
Wood Air	Portland	Oak shavings/hog fuel	Logs

APPENDIX L. WOOD COMBUSTION FACILITIES IN OREGON

Name	Location	Fuel Type [1]	End Use
	Industrial		
American Laminators Inc.	Eugene	Hog Fuel	P
Biomass I Ltd.	White City	Hog Fuel	P,C
Blasen & Blasen Lumber Corp.	Portland	Hog Fuel	P
Boise Cascade Corp.	Elgin	Hog Fuel	P
	Independence	Hog Fuel	P
	Joseph	Hog Fuel	P
	LaGrande	Hog Fuel, Sander dust	P,C
	Medford	Hog Fuel	P,C
	White City	Hog Fuel	P
E. Burrill Lumber Co.	White City	Hog Fuel	P
Cascade Handle Co. Inc.	Eugene	Sawdust, Shavings	P
Cascadian Co. Inc.	Eugene	Hog Fuel	P
Champion Bldg. Products Inc.	Roseburg	Hog Fuel	P
Columbia Plywood Corp.	Klamath Falls	Hog Fuel	P
Cone Lumber Co.	Goshen	Hog Fuel	P
DAW Forest Products Co.	Bend	Hog Fuel	P
	Redmond	Hog Fuel	P
Dee Forest Products Inc.	Hood River	Hog Fuel, Shavings	P
Ellingson Lumber Co.	Baker	Hog Fuel	P,E
Emerald Forest Products Inc.	Eugene	Hog Fuel	P
Fort Hill Lumber Co.	Grande Ronde	Hog Fuel	P
Frank Lumber Co.	Mill City	Hog Fuel	P
Freres Lumber Co.	Lyons	Hog Fuel	P
Gilchrist Timber Co.	Gilchrist	Hog Fuel	P,E
Green Veneer Inc.	Idanha	Hog Fuel	P
Hanel Lumber Co.	Hood River	Hog Fuel	P
Hearin Forest Industries Inc.	Eugene	Hog Fuel	P
Hull-Oakes Lumber Co.	Monroe	Hog Fuel, Shavings	P
International Paper Co.	Gardiner	Hog Fuel	P
	Pilot Rock	Hog Fuel	P
Jeld-Wen Inc.	Klamath Falls	Hog Fuel	P
John Day Lumber Co.	John Day	Hog Fuel	P
D. R. Johnson Lumber Co.	Riddle	Hog Fuel	P,C
Kinzua Corp.	Heppner	Hog Fuel	P,C
Klamath Veneer	Klamath Falls	Hog Fuel	P
Lakeview Lumber Co.	Lakeview	Hog Fuel	P

Name	Location	Fuel Type [1]	End Use
Linnton Plywood Assn.	Portland	Hog Fuel	P
Louisiana-Pacific Corp.	Pilot Rock	Hog Fuel	P
Malheur Lumber Co.	John Day	Hog Fuel	P
Medite Corp.	Medford	Sander dust	P
Miller Redwood Co.	Merlin	Hog Fuel	P
Modoc Lumber Co.	Klamath Falls	Hog Fuel, Shavings	P
Morgan Manufacturing Co.	Springfield	Hog Fuel	P
Multnomah Plywood Co.	St. Helens	Hog Fuel	P
North Santiam Plywood Co.	Lyons	Hog Fuel	P
Ochoco Lumber Co.	Prineville	Hog Fuel	P,E
Oregon Ind. Lumber Prod. Inc.	Springfield	Shavings	P
Oregon Strand Board Co.	Brownsville	Hog Fuel	P
Prairie Wood Products	Prairie City	Hog Fuel	P,C
Rosboro Lumber Co.	Springfield	Hog Fuel	P
Roseburg Forest Products	Coquille	Hog Fuel	P
	Dillard	Hog Fuel	P,E
	Dixonville	Hog Fuel	P
	Green Acres	Hog Fuel	P
	Riddle	Hog Fuel	P
Rough & Ready Lumber Co.	Cave Junction	Hog Fuel	P
Smurfit Newsprint Corp.	Newberg	Hog Fuel	P,E
	Oregon City	Hog Fuel	P,E
Snow Mtn. Pine Co.	Hines	Hog Fuel	P,E
South Coast Lumber Co.	Brookings	Hog Fuel	P
Spaulding & Son Inc.	Grants Pass	Hog Fuel	P
Springfield Forest Products	Springfield	Hog Fuel	P
Stone Forest Industries	Albany	Hog Fuel	P
	Grants Pass	Hog Fuel	P
	Springfield	Hog Fuel	P
	White City	Hog Fuel	P
Stimson Lumber Co.	Forest Grove	Hog Fuel	P
Sun Studs Inc.	Roseburg	Hog Fuel	P
Superior Lumber Co.	Glendale	Hog Fuel	P
Swanson-Superior Forest Prod.	Noti	Hog Fuel	P
Taylor Lumber Co.	Sheridan	Hog Fuel	P
Tim-Ply Co.	Grants Pass	Hog Fuel	P
Timber Products Co.	White City	Hog Fuel	P
Tree Products Mfg. Inc.	Eugene	Hog Fuel	N/A
Warm Springs Forest Products	Warm Springs	Hog Fuel	P,E
Warrenton Wood Products	Warrenton	Hog Fuel	P
Western Craft	Albany	Hog Fuel	P

Name	Location	Fuel Type [1]	End Use
Weyerhaeuser Co.	Cottage Grove	Hog Fuel	P,E
	North Bend	Hog Fuel	P,E
Willamette Industries	Bend	Sander dust	P
	Coburg	Hog Fuel	P
	Dallas	Hog Fuel	P,E
	Drain	Hog Fuel	P
	Eugene	Hog Fuel	P
	Foster	Hog Fuel	P
	Springfield	Hog Fuel	P
	Sweet Home	Hog Fuel	P
	Vaughn	Hog Fuel	P
Willamina Lumber Co.	Willamina	Hog Fuel	P
Young & Morgan Lumber Inc.	Mill City	Hog Fuel	P
	Commercial [2]		
House of Myrtlewood	Coos Bay	Shavings	S
	Institutional [3]		
Bonanza Elementary	Bonanza	Pellets	S,W
Chiloquin Elementary	Chiloquin	Pellets	S,W
Henley High	Klamath Falls	Pellets	S,W
Long Creek	Long Creek	Pellets	S,W
Merrill Upper Elementary	Merrill	Pellets	S,W
	Utility [4]		
Eugene Water & Electric Board	Eugene	Hog Fuel	S,W,E

P = Process Steam
C = Cogeneration
E = Electricity
S = Space Heating
W = Domestic Water Heating
N/A = Not Available
[1] Hog fuel includes wood wastes such as sawdust and bark
[2] Refers to service related industries such as hotels, restaurants, retail trade.
[3] Includes schools, hospitals and public buildings
[4] Includes regulated and unregulated utilities.

APPENDIX M. DISPOSITION OF GRASS STRAW IN THE WILLAMETTE VALLEY, 1993

Species	Acreage	Straw Tonnage Removable				Current Straw Disposal		
		Tons/Acre		Total Tons				
		Low	High	Low	High	Acres Burned [a]	Acres Plowed Down	Straw Tonnage Sold
Annual Ryegrass	119,600	2.1	2.9	250,000	345,000	28,337	119,600	0
Perennial Ryegrass	120,050	1.7	2.1	204,000	250,000	28,336	35,200	125,000
Tall Fescue	70,900	2.4	3.4	170,000	240,000	15,780	17,725	125,000
Fine Fescue	24,350	.1	.2	2,400	5,000	23,626	6,410	
Bentgrass	14,080	.5	1.4	7,000	20,000	3,807	0	all; for hay
Bluegrass	800	.2	1.2	200	1,000	409	100	
Orchardgrass	18,850	1.7	2.6	32,000	50,000	1,768	4,700	
Total	368,630			665,000	911,000	102,063	183,735	

[a] Includes acres open burned, propane burned, and stack burned. There were 73,075 total acres open burned, 15,427 acres propane burned, and 13,561 acres stack burned.

Source: Oregon Department of Agriculture. Data compiled by William Young III, OSU Extension Agronomist.