Evaluating Dead Lodgepole Pine for Products

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Abstract

Dead lodgepole pine is a resource currently abundant in the intermountain West. Possible uses for dead pine range from small power poles to fuel and fiber. Values for products that can be produced from dead trees are evaluated based on ovendry tons of fiber for both logs and products. The technique can be adapted by the reader to make allocation choices among products for any species.

Specific products evaluated as uses for roundwood products are power poles, house logs, and corral poles. These products return high values per unit of log, but have restrictive specifications and limited markets.

Solid wood products include random length dimension, studs, and core veneer. Values are lower than roundwood products but specifications are less restrictive and markets are much larger.

Fiber products generally return low values per unit of volume and values vary from never feasible to feasible under some conditions.

The techniques are applicable by the reader to such diverse questions as, 1) Should Economy lumber be chipped under current market conditions? to 2) What is the best investment possibility for using a timber resource?

THERE IS A HUGE VOLUME of dead lodgepole pine in the intermountain region and the Rocky Mountains. A survey by Forest Insect and Disease Control in Region 1 showed 517 million cubic feet of standing dead lodgepole pine in Montana.[1] In Oregon, trees containing an estimated 280 million cubic feet were killed in the years 1970 to 1979 with most of the mortality occurring after 1974. Virtually all of these trees could be used for fuel or more valuable products if they were accessible and had a ready market. There are, however, several constraints on use. Each class of possible product has specifications that vary from very stringent (power poles) to very lax (fuel). These affect how much of the stand volume can be used for any product. In addition, some of the products have limited markets or cost more to produce than their current value. This paper will examine the relationship between specifications, value, market, and the feasibility of using significant volumes of dead lodgepole pine.

To set the stage for what is to come, I want to start with a 1970 base. At that time, Arabian oil cost $1.80 per barrel and other energy sources were priced competitively. Such cheap fuel caused some strange situations. Sawmills were disposing of woodwaste in wigwam burners while piping in natural gas to supply energy because the natural gas furnaces were simpler and cheaper to operate than wood burners. The October 1979 issue of *Forest Industries* has an article (4) on a mill that converted from oil to wood for energy in 1979 and mentions that the mill had originally switched from wood to oil and gas in 1970.

Federal stumpage was then also relatively cheap. In fact, one of the things that has nearly kept pace with the inflation in energy costs is Federal stumpage rates (1,14) (Fig. 1).

The forest products industry has undergone a quiet revolution the past 10 years. Scarcity of wood, which is really only a shortage of preferred species and sizes, plus increased stumpage and energy costs have changed both the resource base available to mills and to some extent the products produced. Some products such as underlayment particleboard require so much energy (8) that production will be converted to more valuable industrial grades or the price will rise to a point where it is no longer competitive.

Deriving Value of Forest Products

To establish a value for a product, a standard unit of measure is needed. The best unit to use would be cubic volume or ovendry (OD) weight. Because all composition boards and any processed fuel product involves

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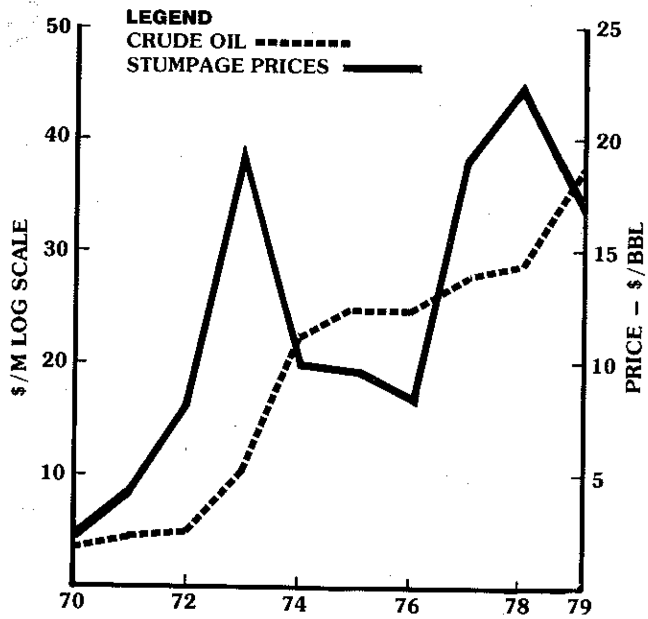

Figure 1. — Stumpage prices, Region 1 lodgepole pine compared to crude oil prices 1970 to 1978.

increased density, I will evaluate everything in dollars per OD ton of logs.

Physical properties of lodgepole pine differ depending on the source of information (4, 10). I am going to use those shown in Table 1.

To determine OD weight of wood plus bark, log cubic volume is determined by Smalian's formula based on log measurement, then divided by 0.95 to allow for inclusion of bark. This volume and OD density are used to calculate OD pounds of wood plus bark. Cubic volume of products is computed using actual sizes of products and densities adjusted for additional shrinkage in further drying the wood, or in making compressed wood products such as pelletized fuel or particleboard. This allows pricing of all products on the same basis.

The main advantage of dead timber over live timber is that the lower moisture content (MC) of the former is superior for fuel. Low MC is advantageous for dry process composition boards and reduces the cost of drying lumber or veneer. There is little or no advantage of low MC in other products, and there are a great number of disadvantages to logging and processing dead timber (9, 16).

Potential Products From Dead Timber

There are several products that can potentially be produced from dead timber (Table 2). Roundwood products require sound straight trees over a limited diameter range. Many trees are not large enough or straight and sound enough for this use.

Solid wood products have less stringent tree size and quality restrictions than roundwood and will, in most stands, be able to utilize considerably more volume per acre.

The fuel and fiber products have almost no specifications that limit use and could constitute virtually 100 percent of the volume on an acre that could be used.

Roundwood Products

Power Poles.—Poles are potentially very high value products that can be produced from dead lodgepole pine. Tegethoff, Hinds, and Eslyn (15) ran a series of plots and destructively sampled to prove that it was possible to produce poles from dead lodgepole pine trees. Their plots averaged 43 trees per acre of power pole size but at least 16 were not suitable because of defect or deformity.

The value of 1 ton of a Class 2 treated power pole is very high (Table 3). I have included an example of the minimum-size pole and a pole of median size for a Class 2, 40-foot power pole, which is near the top end of the size and value for poles. Average-size poles are worth slightly more than $400 per ton. The volume of bark and log end trim that develops is not enough to use for fuel on any commercial scale, so there is little or no anticipated byproduct value.

Corral Poles.—Corral poles are an accepted product from dead lodgepole pine. Value of corral poles including bark are given in Table 4. The value of corral poles is considerably less than the value of power poles and again, there is no expected byproduct value associated with corral poles.

Despite the high values returned, there are several limiting factors to the use of timber for corral or power poles. Currently few places are accepting dead timber for

TABLE 1. — *Physical properties of lodgepole pine (wood and bark combined) to be used as points of reference.*

Property	Value
Heat content (Btu/OD lb.)	9,000
Density (lb./ft.)	24
MC of standing dead trees (%)	20
Amount of bark in stem volume (%)	5

TABLE 2. — *Classes of forest products.*

Roundwood	Solid wood	Fiber
Poles	Lumber	Particleboards
House logs	Veneer	Paper
Corral poles		Fuels

TABLE 3. — *Volume and worth of Class 2, 40-foot, treated power poles.*

	Minimum	Median
Large-end diameter (in.)	13.0	13.5
Small-end diameter (in.)	8.0	8.3
Volume (ft.^{3})	26.8	28.8
Weight (OD lb.)	642	692
Price/pole[a]	$140	$140
Value/OD ton	$436	$405

[a]Price per pole from Cowboy Timber Treating, Inc., November 1979.

TABLE 4. — *Value of 1 ton of corral poles.*

Length (ft.)	16
Diameter-average (in.)	4.0
Weight (OD lb.)	35
Price/pole[a]	$2.50
Value/OD ton	$143

[a]Price per pole supplied by Fenus Lumber Co., November 1979.

TABLE 5. — *Specifications for house logs.*

Minimum diameter	7 in.
Minimum length	16 ft.
Rot allowed	None
Checks 1/4 in. wide	1 full turn spiral
Crook	None
Sweep	Minimal
Taper	1 in. in 10 ft.
Bole deformities (cankers, etc.)	Minimal

TABLE 6. — *Properties and values of house logs (four-sided).*

	Minimum	Average	Maximum
Small-end diameter (in.)	7	8	11
Large-end diameter (in.)	9	10.5	14
Volume (ft.^{3})	11.2	14.9	25.9
Weight (OD lb.)	269	360	655
Value at $1.20/lin.ft.[a]	$36	$36	$36
Value/OD ton	$268	$200	$110

[a]Price supplied by Cody Lumber Inc. for flattened four-sided double tongue and groove log, November 1979.

TABLE 7. — *Value of wood as fuel determined on a cost per million Btu basis.*

Resource	Cost ($)	Cost ($ per million Btu)	Value of wood ($ per OD ton)
Natural gas	0.38/therm	3.80	68.40
Oil No. 6	0.55/gal.	3.67	66.00
9,000 Btu coal	30/ton	1.67	30.00
12,500 Btu coal	40/ton	1.60	28.80

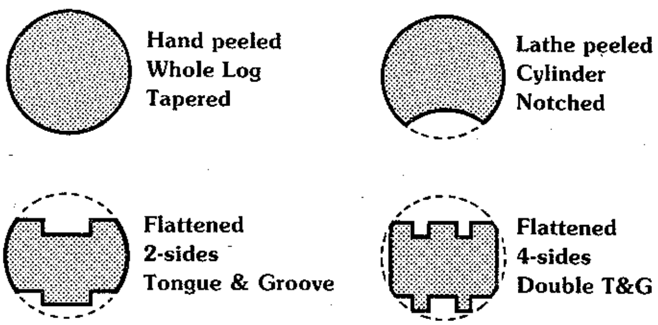

Figure 2. — Some fairly typical profiles of house logs.

use as power poles. They are permitted under pole standards but buyers usually specify poles from live trees. One problem with using dead trees is that blue stain fungus, common in dead but not live trees, increases permeability (9) so treating schedules for live-cut trees would have to be changed for dead timber.

Assuming you could get 30 power poles and 300 corral poles per acre, you would be removing about 15 tons of wood per acre. In stands of dead lodgepole pine, volumes approach 100 tons per acre (1). Finally, you could meet the demand for small power poles and provide every horse in the West with a private corral and still not touch the acreage that is available.

House Logs. — The house log is a relatively popular use for dead timber. The specifications (13) for logs are quite stringent but vary slightly among manufacturers (Table 5). The minimum diameter, length, and rot restrictions are quite rigid. The other specifications on crook, sweep, and deformities vary slightly with the type of house log being produced. The slabbed four-sided log (Fig. 2) can accept a small canker or a degree of sweep that would be totally unacceptable for the hand-peeled whole log.

The house log price (Table 6) used here is for the flattened four-sided double tongue and groove log. Round log value varies with log diameter, but no prices were available. Few companies sell house logs; most of them sell only complete house kits.

For the minimum-size log, the values are quite high — $268 per ton. For the average-size log, the value is approximately $200 per ton. The largest logs accepted by house log makers are worth even less at $110 per ton of OD wood. In a timber stand of low defect, harvesting house logs could remove 40 to 50 tons per acre at best. Potential byproducts from house logs are some chips from squaring log sides and bark and log end trim for fuel. Most log house operators are too small to install chippers, so the predominant byproduct is the log end trim sold locally as fireplace wood.

The number of log houses built in the United States per year is estimated to vary between 20 and 50 thousand. Many of these are smaller second homes in recreation areas. The volume of timber used annually by the house log market is large enough to have a significant impact on the problem but falls short of either full utilization or total stand treatment.

Solid Wood Products

As part of the discussion of solid wood products, it is necessary to establish values of wood as fuel because a real part of the value derived from either peeling or sawing dead timber will be the opportunity to use or to produce fuel as a byproduct.

The value of fuel can be estimated from the value of competing fuels. A problem of conversion is that any new energy source would have to be cheaper to offset the cost of new equipment before it would replace the fuel currently being used. In addition, some fuels are cheaper to use because they are cleaner to burn and require little or no storage space.

Natural gas is a nearly perfect fuel. It comes from a pipe with no storage facilities required and is clean burning in simple standardized furnaces. Oil is only slightly more expensive to use. It varies from slightly dirty to very dirty to burn, and both storage and supply can be problems. Coal and wood burn in similar furnaces, which are more complex and expensive than either gas or oil furnaces.

Coal is dirtier to burn and handle but is more concentrated and easier to store than wood. Table 7 shows the current value of wood as a fuel on a heat content basis, using 18 million Btu per ton of OD wood. This establishes a value of wood as fuel to be $30 per OD ton when compared to coal. It is worth considerably more if substituted for oil or natural gas.

Lumber. — Research by the Timber Quality Project at the Pacific Northwest Forest and Range Experiment Station has resulted in a series of dead timber recovery studies throughout the West. In every study, it was determined that it is possible (17) to make lumber from dead trees. The margin available for stumpage is always less than that for live trees because the volume recovered as lumber is always somewhat lower, and the lumber grade or average lumber value is always lower.

The results of most of these studies are just being prepared for publication. We have learned that dead timber suffers severe losses in value when made into 1-inch boards.[2] This results from lumber grading rules that severely limit the amount of blue stain allowed in grade 2 Common and Better.

The value loss at a random dimension mill is much less than at a board mill because blue stain is not a grading factor for dimension lumber. At a stud mill, the value lost is even less. Because the price of studs is currently lower than the price of dimension lumber, a dimension mill is the optimum place to process dead timber right now. If the stud price recovers relative to dimension prices, there would be little difference but both would have an advantage over a board mill.

What does a sawmill produce from a ton of dead logs? If 30 percent of log volume is recovered as surfaced dry studs and density is adjusted for shrinkage, the approximate weight of various products can be determined (Table 8). Recovering the same weight at a random length dimension mill yields a slightly higher value (Table 9).

It should be stressed that neither of the mills used in this analysis would be considered particularly efficient. The stud mill was an old four-saw scragg and has since been replaced by a modern mill at the same site. The random length dimension mill, a chipping headrig, was one of the first of that type ever built. Most mills currently in operation could recover more lumber from the same log than either of these mills.

Veneer. — Veneer sounds like an implausible use for dead lodgepole pine. The Timber Quality project at the Pacific Northwest Forest and Range Experiment Station recently ran a veneer study using dead lodgepole pine as the resource. The lathe was a small diameter, high-speed, 4-foot lathe. Recovery was much better than anticipated. The veneer did not fall apart at the checks even during layup. It dried on a shorter schedule than the veneer from the live control and laid up into panels so well that the layup crew did not recognize that the veneer came from dead timber.

If 40 percent of log volume was recovered as dry veneer, the value would be slightly more than dimension lumber. Veneer does represent a possible use for logs larger than 7 inches in diameter. Veneer values are shown in Table 10.

The major advantages to peeling dead lodgepole are the high recovery potential from peeling small logs on a core lathe and the volume of fuel recovered. Residues from the relatively dry logs could be worth more as fuel than as chips to a plywood plant using natural gas for driers.

There are several points to keep in mind regarding solid wood products. Log specifications vary by mill type and by product. Veneer plants and board mills tend to require larger diameters than dimension and stud mills.

[2]Unpublished data on file at Pacific Northwest Forest and Range Expt. Sta.

TABLE 8. — *Value*[a] *recovered from a ton of logs at a stud mill.*

Product	Weight (lb.)	Value ($/ton)	Value recovered ($)
Lumber	625	244	76.10
Chips	945	40	18.90
Fuel	430	30	6.50
Value/ton of logs[b]			101.50

[a]Average lumber value $165/fbm or $244/ton.
[b]Lumber continues to shrink while drying so density of surfaced dry lumber is 24.8 lb./ft.[3] There are 18.3 fbm in a cubic foot of surfaced dry stud volume so 1 fbm lumber=1,355 lb. One OD ton of studs=1,476 fbm of lumber tally.

TABLE 9. — *Value*[a] *recovered from a ton of logs at a random length dimension mill.*

Product	Weight (lb.)	Value ($/ton)	Value recovered ($)
Lumber	625	251	78.40
Chips	945	40	18.90
Fuel	430	30	6.50
Value/ton of logs[b]			103.80

[a]Average lumber value $175/Mfbm or $251/ton.
[b]Actual lumber volume at the dimension mill was 17.9 fbm/ft.[3] of surfaced lumber so 1 Mfbm of lumber=1,385 lb. One OD ton dimension lumber=1,444 fbm of lumber tally.

TABLE 10. — *Value*[a] *recovered from a ton of logs in a veneer operation.*

800 lb. veneer at $258/ton	$103.20
800 lb. chips at $40/ton	16.00
400 lb. fuel at $30/ton	6.00
	$125.20

[a]Average veneer value $50/Mft.[2] or $258/ton.
[b]3/16 × Mft.[2]; $50=15.625 ft.[3]×24.8 lb./ft[3]=387.5 lb./Mft.[2].

Lumber or veneer manufacture produces large amounts of fuel and fiber products.

Although up to 70 percent of the wood volume ultimately becomes fiber, more than 70 percent of the value is derived from the lumber or veneer.

Solid wood products could utilize from 70 to 85 percent of the total cubic volume on an acre. Most of the small material left should be susceptible to rapid biological degradation. Also, there are enough potential users to be able to remove a significant volume of dead timber.

Fuel and Fiber Products

Several fiber products can be produced from dead timber. These products come in many grades and values, but the raw materials used are either chips or particleboard furnish. Because values are low, logging costs become critical and must be considered.

Paper. — Paper is a relatively high value, high cost product. Yields range from about 40 to 95 percent of the wood volume brought into the plant. Prices range from about $375 to $1,000 per ton. The raw material for most paper is chips, a commodity that has established markets and prices (Table 11).

A value of $40 per ton for chips leaves very little margin for stumpage, logging, and transportation costs. Logging costs range from approximately $20 to $40 per ton (7) with a fairly realistic estimate for logs to the railhead of approximately $31.40 per ton (6). Truck haul costs are approximately $0.10 per ton mile so a relatively small increase in chip prices can have a large impact on the area that can effectively be logged for chips.

A mill in Montana has a relatively long-standing salvage log chip program (11), which they refer to as the 5-D program. This program operates only when sawmills cannot meet their needs from mill residue chips. Mill residues are a cheaper source of chips when enough are available to meet pulp demand. Large quantities of dead timber could be used by papermills as a fuel to meet energy needs.

Particleboards. — Particleboards offer a relatively limited opportunity for using any significant volume of dead timber. Underlayment grade particleboard is presently worth $115 per ton of wood furnish used. Currently, particleboard plants are paying between $5 and $10 per ton for furnish. With logging costs at present levels, particleboard is not a viable outlet for forest residues (Table 12). Its position in the mill residue market is threatened (3) by the value of wood as a fuel.

The development of a structural particleboard industry would allow the use of large volumes of dead lodgepole. A structural particleboard that was directly competitive with plywood CD Exterior sheathing that used 36 pounds of wood per cubic foot, and could use 90 percent of log volume, would have an upper limit on value of $270 per OD ton. The cost to produce this board would be relatively high. Dead timber would be particularly appropriate because particleboard furnish has to be dried to a very low MC to glue properly.

Fuels. — Using no other consideration than Btu values, the maximum value for wood fuel is about $30 per ton (Table 13). There are other considerations, however. Wood burns cleanly, particularly when compared to some coals and oils, and requires no complex air pollution control mechanisms for sulfur compounds.

TABLE 11. — *Residual value after deducting logging costs for pulp chips.*

	($/ton)
Chip value	40.00
Harvesting	31.40
Margin for chipping, transport, profit	8.60

TABLE 12. — *Residual value after deducting logging costs for particleboard furnish.*

	($/ton)
Particleboard furnish	10.00
Logging costs	31.40
Margin for preparation, transport, profit	-21.40

TABLE 13. — *Economics of three fuel types.*

Type	Hog	Briquetted	Pelletized
	$/OD ton		
Value	30.00	40 to 55	40 to 55
Logging cost	31.40	31.40	31.40
Preparation	4.00	16.00	16.00
Margin	-5.40	-7.40 to 7.60	-7.40 to 7.60

TABLE 14. — *Value, probable demand, and potential of various products to remove significant volumes of dead lodgepole pine.*

Product	Value/ton ($)	Demand	Vol./acre usable (%)	Probable market
Power poles	300 to 400	small	5 to 15	small
House logs	110 to 260	moderate	30 to 60	moderate
Corral poles	120 to 150	small	10 to 20	small
Dimension lumber	90 to 130	large	70 to 85	large
Studs	80 to 120	large	70 to 85	large
Veneer	90 to 130	small	60 to 75	moderate
Paper (chips)	35 to 50	moderate	90	variable
Particleboard (furnish)	5 to 15	none	90	none
Fuel	30 to 55	small	95	possible

At large industrial installations, there is no need to process fuel beyond chipping or hogging the wood to a uniform size. The potential market for processed wood fuels is limited to small industrial users and institutions (schools, hospitals) which require large amounts of energy but are subject to meeting clean air standards. Processing increases the heat content per unit of volume, a definite advantage in shipping and storing fuels.

Summary

The ability to make commercial products from dead lodgepole pine depends on the market for products and the relative cost of alternative products. The potential (Table 14) to use significant volumes depends on how well the resource meets specifications for products and the volume of products that the market will accept.

There are problems with any of the products discussed for using dead lodgepole pine. The highest priced outlets for dead timber have very limited or moderate demand and can use only very select portions of the total volume available. The best solutions in terms of land managment have relatively limited demand and therefore little potential for using volume from very many acres. Lumber and veneer production has some potential for removing relatively large volumes from a lot of acres, but mills are really more profitable operating on green timber sales.

Utilization of this resource will require cooperation and some creative timber appraisal and sales contract approaches. Sorting, log concentration yards, and land management contracts are the most common suggestions and probably the most appropriate.

Complete tree logging, with separation of the more valuable logs for roundwood and solid wood products, would allow an in-the-woods chipper to operate on concentrations of wood that would not otherwise be commercially possible.

Development of a structural particleboard and fuel market shows the greatest potential for increased demand for dead lodgepole pine.

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