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PRODUCTION AND TRANSPORTATION OF FUEL FROM SAWMILL REFUSE

by

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CONTENTS

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SUMMARY

The production and transportation of fuel from sawmill refuse is influenced by considerations of raw material cost, type of equipment, operating supplies, operating labor, and distance from source to market. Fuels from sawmill refuse are transported principally by means of trucks, railroad cars, barges, or combinations of these methods.

Truck Transportation

The larger sized trucks give a lower per unit hauling cost than the small sizes and consequently can go out farther from a given market. All trucks are highly mobile in comparison to other types of transportation. The smaller trucks are more mobile than the large trucks and require less backing and manouvering at loading and unloading points. Cost per mile for truck operation for:

1½	ton truck with	2½	unit body is	10.8¢
1½	" " "	4	" trailer is	14.25¢
3	" " "	9	" " is	18.1¢

Rail Transportation

Rail transportation is more economical than truck on long hauls of more than 40-45 miles. Rail rates are initially high but increase gradually as distance increases. Rail transportation facilities are fixed as to location and are not easily extended.

Barge Transportation

Barge transportation where available is the most economical means of hauling large quantities of wood fuel. Barge routes are decidedly fixed as to position and cannot be extended except as river locations permit.

Combination Hauls

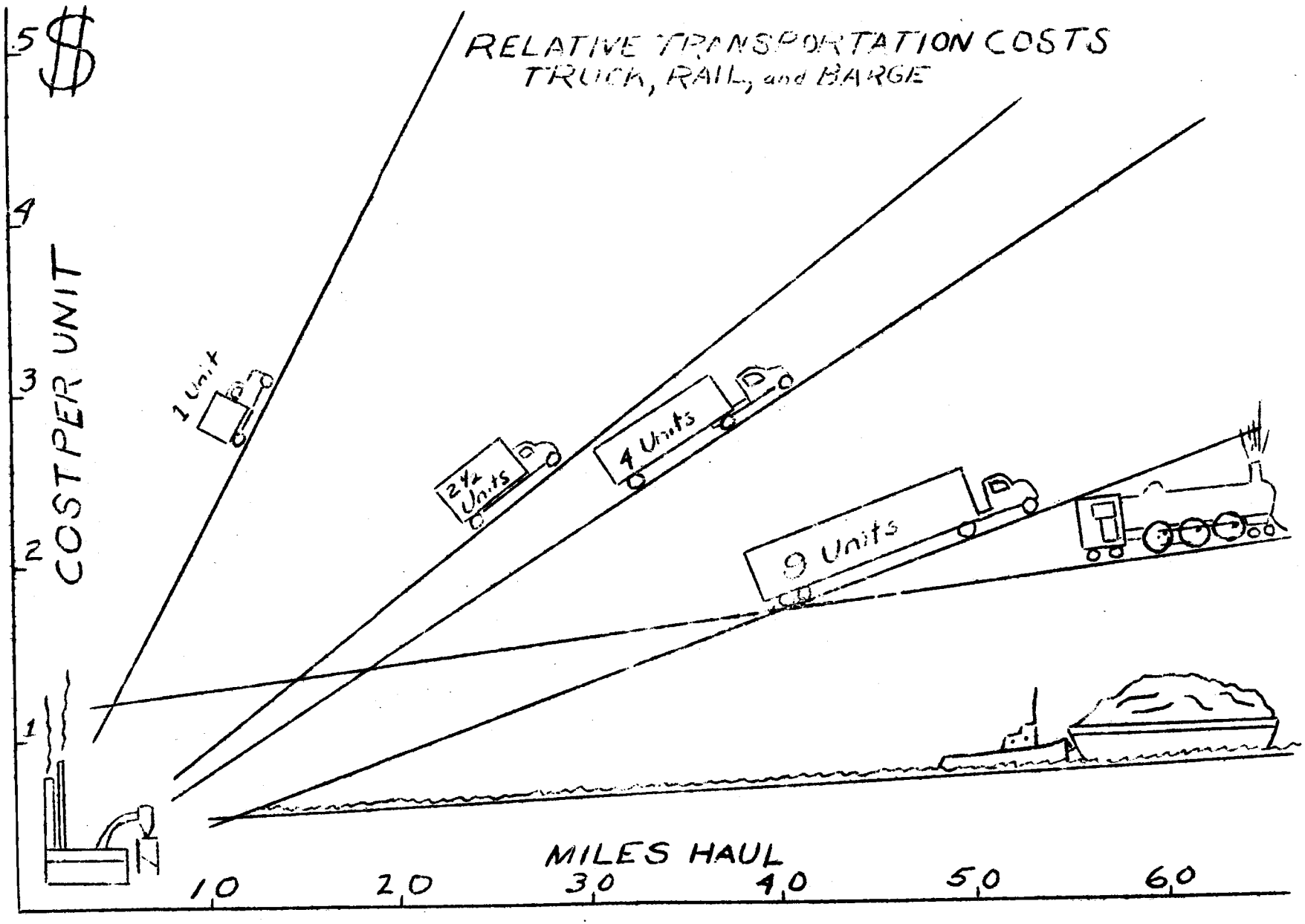
Combination hauls using truck and barge, rail and barge, or truck and rail in special instances to meet special conditions will give lower costs than the use of alternative methods that may be available singly.

Fuel Production Costs

The production of wood fuel from sawmill refuse requires mainly the handling, conveying, cutting up, and storage of material that would otherwise be waste. Where the production operations necessary are accomplished mechanically the resulting cost is low; where a large amount of manual or hand labor is required the costs will be proportionately higher.

Graphic Comparison of Transportation Methods

The graph of the following page indicates the relative costs at various distances for transportation of wood fuels. Four types of trucks, rail freight, and barge hauling, based on hog fuel and sawdust transportation costs, are shown. The same relative costs will apply, however, for other kinds of wood fuel.


RELATIVE TRANSPORTATION COSTS
TRUCK, RAIL, and BARGE
$
5
4
3
2
1
COST PER UNIT
1 Unit
2½ Units
4 Units
9 Units
MILES HAUL
10
20
30
40
50
60

INTRODUCTION

Economic production and transportation will influence considerably the increased utilization of sawmill refuse for fuel or other uses. In general the sawmills and other sources of low value wood are located at a distance from the markets or potential markets for this material. Transportation costs and methods will therefore largely determine mills and sources in the area from which economical deliveries of low value wood can be made to a given market.

In view of the importance of transportation to utilization of sawmill refuse a study of truck, rail, and barging methods and the costs involved was made. The cost of producing fuel from sawmill refuse was ascertained in connection with the transportation phases to complete the picture. The information thus collected is designed to aid in serving present markets and in the development of additional markets for sawmill wood refuse.

Inasmuch as the present market for sawmill wood refuse is largely for domestic and industrial fuel purposes, the majority of the information reported was obtained from sources dealing with these fuels. The problems involved in production and transportation of fuel from sawmill refuse serve to illustrate the problems that must be met in marketing this material for other purposes. Transportation charges in some instances may amount to 75% or more of the total cost of the wood delivered which further emphasizes the importance of transportation in determining markets.

As a fuel, sawmill wood is bulky and heavy per unit of heat output and compared to other fuels has a fairly low value for its bulk. Approximately one-fifth to three-fifths of such material is water which must be transported and for which there is no return in heat value. These characteristics of bulk and low value make handling and transportation costs difficult to meet except on a large scale or with favorable market price conditions. This applies not only to marketing this material for fuel purposes but also to production and transportation of material for uses such as charcoal, fiber board, plastics, and other products.

TRUCK TRANSPORTATION

Of the three types of transportation in use for hauling sawmill refuse--truck, rail and barge--truck transportation is the most widely used. There are several reasons for the predominance of truck hauling over the other two available methods.

Advantages of Truck Transportation

1. Trucks can be used to transport wood refuse from mills and sources that could not be reached by rail or barge transportation except at high cost.

2. Trucks can be used to transport this material to small consumers who could not otherwise be economically served.

3. Truck transportation is advantageous to the small producer and consumer because of the comparatively low initial cost of equipment for loading and unloading.

4. The cost per unit with truck transportation is often lower than with rail. The size of truck influences this considerably. Small 1-2½ unit trucks are more economical only at short distances; large 9 unit trucks show lower costs up to 40-45 miles as compared to rail.

5. Delivery to the consumer is more easily accomplished with trucks than with rail or barge transportation.

6. Unloading costs are less with trucks than with rail hauling. Some industrial users will pay ten to fifteen cents more for hog fuel hauled by truck as compared to rail since they do not have to pay the unloading expense.

Disadvantages of Truck Transportation

1. On hauls longer than 40-45 miles, truck hauling costs more per unit than rail. Conditions of bad roads and adverse grades will modify this further, increasing the cost per unit for a given distance.

2. On all but short hauls truck hauling costs more than barge.

Truck Operating Costs

Truck operating costs include all the items of expenditure that are involved in the use of the truck for hauling purposes. These costs can be segregated into items of fixed expense and items of variable expense. Included in fixed expense are such costs as interest on the investment, state license, Public Utilities Commission license, insurance, and operating overhead and risk. Included in variable expense are items such as tires, gas, oil, maintenance, repairs, lubrication, depreciation and drivers wages, all of which are generally allocated on a per mile basis.

Table 1, "Truck Operating Costs Reported by Fuel Dealers," lists the cost per mile of operation according to the operators records or experience. To the figures given by them has been added the drivers wages at 60¢ per hour or 2.4¢ per mile and

also wages at 75¢ per hour or 3¢ per mile at 25 miles per hour. The figure for wages will of course vary on a per mile basis depending on the average speed and hourly rate. Although wages in certain localities at the present time (1942) are higher than those assumed here, normally the driver's wages for fuel hauling would be close to these figures.

In Table 2 are given costs for 1½-2 ton trucks derived from miscellaneous sources such as lumber truckers, the State Forestry Department and similar haulders. Table 3 lists information obtained from the Public Utilities Commission in Salem on truck operating costs filed by lumber haulers.

Considerable variation was encountered in these per mile costs of operation from the various sources. As indicated in Table 1 the low was 6.7¢ per mile and the high 18.6¢ per mile including the drivers wages at 60¢ per hour. The average for Table 1 when weighted by the corresponding number of trucks was 11.93¢ per mile. Some of the variation can be accounted for on maintenance costs--some operators doing all but major repairs themselves. Additional variation is caused by the fact that some operators included interest on the money tied up in equipment as a cost while others did not. The amount allowed for depreciation is also quite variable. Cost per mile for tires, gas, and oil were quite consistent from one operator to another. Differences in road conditions, type of material hauled, weight of load, type of truck used, and distance of haul are additional factors causing a cost variation.

Using the best information and cost figures available, three operating budgets were compiled for three different sizes of trucks operating on fuel hauls. These operating budgets are given in Table 4. The cost per mile for the 1½ ton truck, not including the drivers wages, is 8.39¢; for the 1½ ton truck and 4 unit semi-trailer, 11.85¢; and for the 3 ton truck and 9 unit semi-trailer, 15.43¢; the corresponding figures including the drivers wages are 10.79¢, 14.25¢, and 18.1¢.

In a number of instances fuel dealers do not own and operate trucks for fuel hauling but pay a truck owner for this hauling on a contract basis.

Table 1. Truck Operating Costs Reported by Fuel Dealers
1½-2 Ton Trucks

Operator	No. of Trucks	Distance of Aver. Haul Miles	Cost per Mile: Per Mile Not Including Drivers Wages	Cost per Mile: Including at 60¢ per hr. Drivers Wages Ave. Speed 25 M P hr .024	Cost per Mile: Including Drivers Wages at 75¢ per hr. Ave. Speed 25 M P hr .030
1	8	53	$ .060	$ .084	$ .090
2	3	10	.100	.124	.130
3	2	10	.043	.067	.073
4	2	7	.150	.174	.180
5	2	7	.100	.124	.130
6	1	10	.100	.124	.130
7	3	10	.070	.094	.100
8	1	12	.080	.104	.110
9	1	40	.100	.124	.130
10	4	5	.101	.125	.131
11	1	24	.086	.110	.116
12	10	5	.126	.150	.156
13	1	4	.076	.100	.106
14	3	3	.135	.160	.166
15	1*	52	.162	.186	.192
16	4	5	.056	.080	.086
	2**	10	.096	.120	.126
Average Weighted according to no. of trucks	49	16.1	$ .0953	$ .1193	$ .1253

*Drawing semi-trailer with 9 unit body
**Drawing semi-trailer with 4 unit body

Table 2. Truck Operating Costs from Miscellaneous Sources
1½-2 Ton Trucks

Operator or Source of Information	Per Mile Not Including Drivers Wages	Per Mile Including Drivers Wages 960¢, 25 MPh .024	Per Miles Including Drivers Wages 975¢, 25 MPh .030
State Forestry Dept.	$ .110	$ .134	$ .140
American Water Works Association*	.075	.099	.105
Lumber hauler A	.060	.084	.090
Lumber hauler B	.100	.124	.130
Truck dealer C	.120	.144	.150
Truck dealer D	.075	.099	.105
Pine Log haul**	.136	.160	.166
Average	.097	.121	.127

*American Water Works Assoc. Journal, V. 33, p. 1362.
Covering approximately 500,000 miles of operation in cities of the United States. Broken down into: gas & oil - $.0232 per mile; Maintenance, repairs, & tires - $.0348 per mile; depreciation & insurance - $.0165 per mile. Total - $.0745 per mile.

**Adjusted to include truck only. Repairs, tires reduced 25%. Break down: Gas and oil - $.034, tires - $.0167, depreciation - $.025, interest - $.004, taxes, insurance, license - $.0225, maintenance - $.0337. Total - $.1359. The Timberman.

Table 3. Truck Operating Costs Filed with Public Utilities Commission by Lumber Haulers 1½-2 Ton Trucks

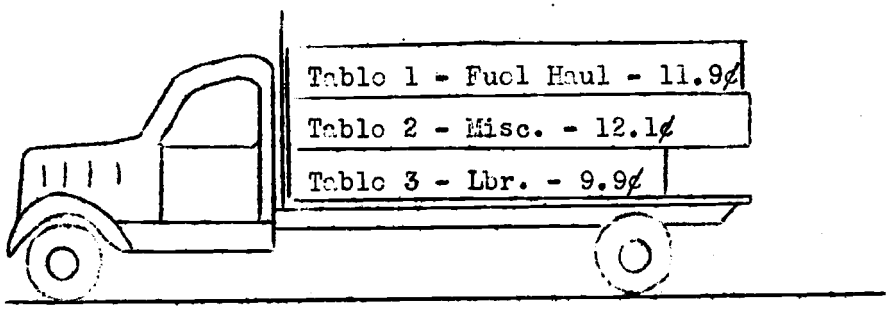
Operator	No. of Trucks	Miles Covered	Gas & Oil	Maintenance, Repairs, tires & Lubrication	Deprec.	Ins., taxes license	Overhead & Office Exp.	Interest	Total	Including Wages @60¢ & Average Speed 25 MPH .024	Including Wages @75¢ & Average Speed 25 MPH .030
1	2	33320	.0496	.0354	.0122	.0088	-	-	.1060	.130	.1360
2	2	57600	.0256	.0302	.0104	.0055	.0013	.0014	.0744	.0984	.1044
3	1	10400	.0133	.0161	.0067	.0049	-	.0012	.0422	.0662	.0722
4	1	7883	.0232	.0346	.0130	.0085	-	-	.0791	.1031	.1091
5	1	90000	.0201	.0168	.0023	.0040	-	.0009	.0441	.0681	.0741
6	1	23572	.0598	.0107	.0255	.0063	-	.0067	.1090	.1330	.1390
Summary	8	222775	.0300	.0226	.0089	.0061	.0003	.0015	.0694	.0934	.0994

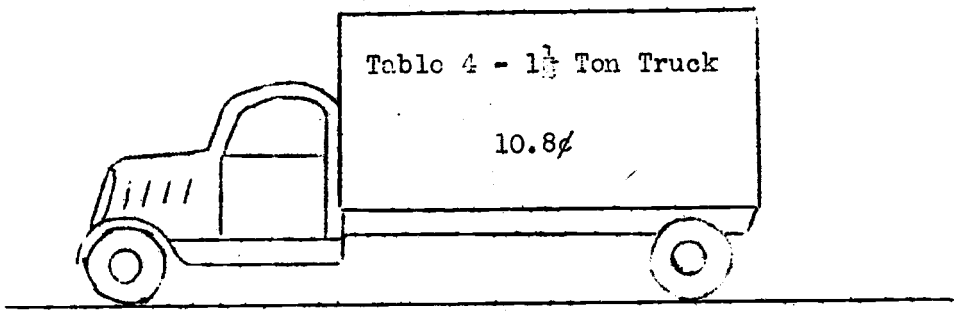
Table 4. Operating Budgets for 2½, 4 & 9 Unit Trucks

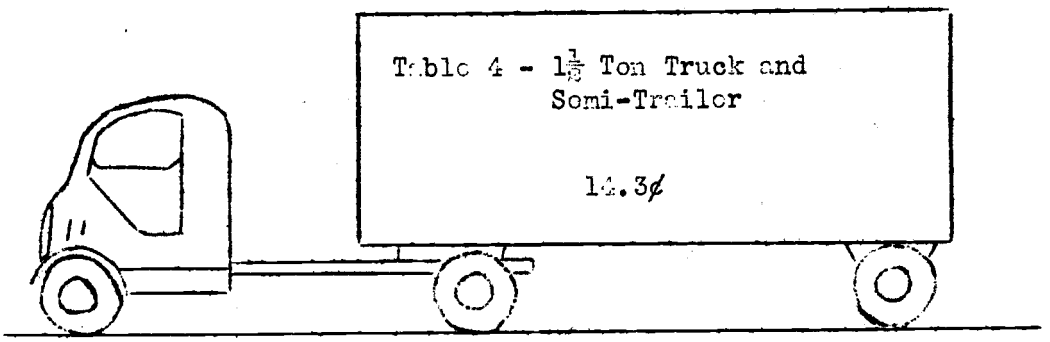
Item	1½ T Truck 2½ Unit Body	1½ T Truck 4 Unit Semi-Trailer	3 T Truck 9 Unit Semi-Trailer
Investment			
Chassis	$1100.00	$1400.00	$2100.00
Body or trailer	250.00	2300.00	2700.00
Gross investment	1350.00	3800.00	4800.00
Tire value--subtract	270.00	450.00	910.00
Net investment	$1080.00	$3350.00	$3890.00
Fixed Expense per Year			
Interest 6% on average net investment	$ 32.40	$ 100.50	$ 116.70
License	65.00	100.00	145.00
PUC	84.00	132.00	228.00
Insurance	28.00	40.80	160.00
Operating overhead & risk, 10% of above	20.94	37.33	64.97
	$ 230.34	$ 410.63	$ 714.67
Operating Expenses on a Per Mile Basis			
Yearly operating mileage	20,000 miles	20,000 miles	25,000 miles
Depreciation	$ .0108	$ .0229**	$ .0246**
*Tires	.0135	.0200	.0404
Maintenance, repairs, lubrication	.0246	.0316	.0340
Gas @18¢ per gal	.0225	.0225	.0257
Oil @50¢ per gal, 500 mi/gal	.0010	.0010	.0010
Fixed expense	.0115	.0205	.0286
Subtotal	$ .0839	$ .1185	$ .1543
Drivers wages	.0240***	.0240***	.0267****
Total	$ .1079	$ .1425	$ .1810

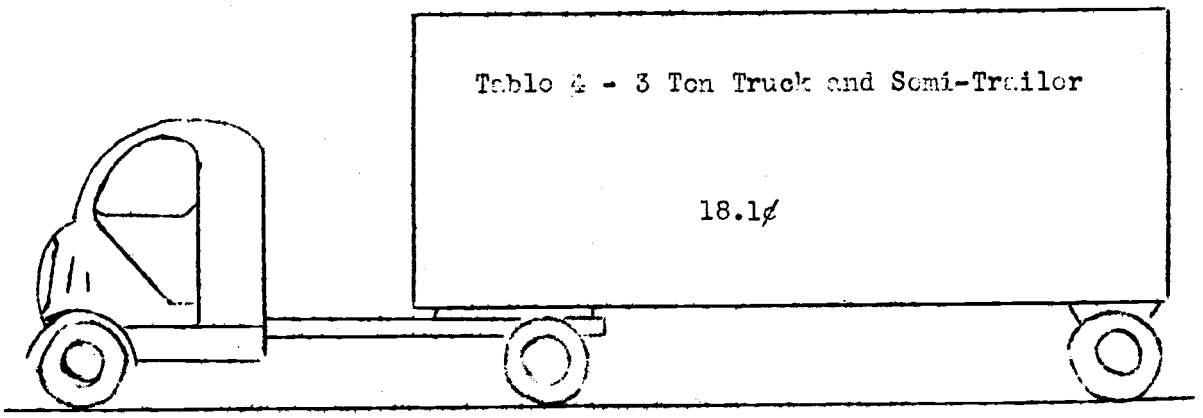
*20,000 mi. for 2½ unit, 22,500 mi. for 4 unit and 9 unit
**4 unit chassis $1230 - 100,000 miles, trailer $2120 - 200,000 miles; 9 unit $1710 - 125,000 miles; $2180 over 200,000 miles.
***60¢ per hr, 25 miles per hr, ave. speed
****80¢ per hr, 30 miles per hr, ave. speed

SUMMARY - AVERAGE PER MILE TRUCK OPERATING COSTS









Contract Hauling Rates

Contract hauling rates are the amounts paid per unit or cord for loading, hauling, and unloading on hauls of different distances and types of fuel.

Table 5, "Truck Hauling Contract Rates", gives the actual rates in effect according to distances and types of fuel hauled for the various contracting firms. These contract rates are influenced up or down by the labor costs and supply, equipment costs and availability, and cost of operating supplies such as gas, tires, etc.

Sizes of trucks used vary from one unit to a 9½ unit body for hog fuel and sawdust and from a one cord to 6-8 cord rack where cordwood is hauled. One and one-half ton trucks with single axle and dual tires are most widely used for fuel hauls. These trucks can safely haul 5 to 6 tons, the approximate weight of 2½ units of sawdust or two cords of wood.

The summarized hauling costs given in the following section illustrate a method that could be used in determining contract rates.

Table 5. Truck Hauling Contract Rates

Operator	Distance Miles	Size of truck	Rate per Unit*
		Hog Fuel & Sawdust	
1	18	4 unit	$1.50
	7	2 -4	1.00
	5	1⅓-2⅓	.80
	Less than 5	1½-2½	.80
2	5	2	.80
	Less than 5	1⅓-2	.65
3	5 or Less	2 -4	.65
4	52	9⅓	1.75
		Cordwood & Slabwood	
1	5	2 cds**	.75
	5	2 cds	1.00
	4	1 -1½	.90
	1	2 cds	1.25
2	24	3 or more	1.75 (1941)
	60	6 or more	3.00 (1942)
3	40	2 -4 cds	3.00 (1942)
			1.75 (1941)
4	40	2½-4 cds	3.00 (1942)

*200 cubic feet when applied to hog fuel and sawdust
192 cubic feet when applied to loose blockwood, planer ends, and 16" wood
**A cord is 128 cubic feet applied to 4' wood or shortwood ricked up in piles.

Summarized Hauling Costs

Using the costs per mile as computed in the operating budgets for 2½, 4, and 9 unit trucks (Table 4) the costs per unit on hauls from 5 to 60 miles were worked out. These costs for truck operation only are given in Table 6. Table 7 includes loading and unloading costs and the price per unit at the mill. These two tables show that the amount for truck operation chargeable to each unit delivered is less than half as much with the 9 unit truck as with the 2½ unit truck. Table 7 indicates the differential per unit in the total delivered cost using the different sized trucks and applies only to sawdust or hog fuel. The same information can be obtained for any one of the other fuel items by adding the proper loading and unloading cost, plus the fuel cost at the mill for that item, to the values given in Table 6.

Table 6. Truck Operating Costs per Unit of Hog Fuel & Sawdust Hauled for Various Distances

Distance of Haul	1 Unit $.1079/Mile	2½ Unit $.1079/Mile	4 Unit $.1425/Mile	9 Unit $.181/Mile
5	$1.08	$ .43	$ .36	$ .20
10	2.16	.86	.71	.40
15	3.24	1.30	1.07	.60
20	4.32	1.73	1.43	.81
25	5.40	2.16	1.78	1.01
30	-	2.59	2.14	1.21
35	-	3.02	2.50	1.41
40	-	3.45	2.85	1.61
45	-	3.88	3.21	1.81
50	-	4.32	3.56	2.01
55	-	4.75	3.92	2.21
60	-	5.18	4.28	2.41

Does not include loading, unloading, or fuel costs at mill.

Table 7. Truck Hauling Costs per Unit of Hog Fuel & Sawdust Hauled

Comparison of Different Size Trucks

Distance	Hauling Cost per Unit Including Loading & Unloading			Total Delivered Cost per Unit Hog Fuel Cost at Mill @ $.75/Unit***		
	2½ Unit*	4 Unit**	9 Unit**	2½ Unit	4 Unit	9 Unit
5	$ .53	$ .45	$ .29	$1.28	$1.20	$1.04
10	.96	.80	.49	1.71	1.55	1.24
15	1.40	1.16	.69	2.15	1.91	1.44
20	1.83	1.52	.90	2.58	2.27	1.65
25	2.26	1.87	1.10	3.01	2.62	1.85
30	2.69	2.23	1.30	3.44	2.98	2.05
35	3.12	2.59	1.50	3.87	3.34	2.25
40	3.55	2.94	1.60	4.30	3.69	2.35
45	3.98	3.30	1.90	4.73	4.05	2.65
50	4.42	3.65	2.10	5.17	4.40	2.85
55	4.85	4.01	2.30	5.60	4.76	3.05
60	5.28	4.37	2.50	6.03	5.12	3.25

*Loading cost 5¢ per Unit, Unloading 5¢ por Unit.
**Loading cost 5¢ per Unit, Unloading 4¢ per Unit.
***This cost is bare cost only and does not include any margin for profit or risk and does not consider the influences of market supply and demand on delivered price.

Loading and Unloading

Hog fuel and sawdust with few exceptions are loaded from a bin or hopper located at the mill. A small number of fuel haulers load sawdust by hand from the open pile but this is considered an expensive practice. Unloading is accomplished by dumping the load with a hoist, shoveling it out of the side door, or by use of a power conveyor running lengthwise in the bed of the truck and powered by a gas or electric motor.

Blockwood, plane-ends, and 16" slabwood are generally loaded from a bin at the mill and unloaded by dumping. Some operators throw this kind of wood on the truck by hand.

Four foot green slab may be loaded by hand from a pile accumulated by the slab conveyor, loaded directly on to the truck from the conveyor, or piled on racks and the racks slid or rolled onto the truck bed. This last method, although not widely used, is more economical than hand loading as it saves one handling that would otherwise be necessary. Four foot slab is unloaded by hand and piled as it is unloaded.

Table 8 is a summary of the loading and unloading times reported by fuel dealers. A cost based on a wage rate of 60¢ per hour has been assigned to give the average cost per unit or cord for the different operations and fuels. The results of actual timing of loading and unloading sawdust gave an average of 5.05 minutes for loading and 17.5 minutes for unloading.

A comparison of loading time per cord where racks are used for 4' slab as against hand loading is also given in Table 8. Hand loading takes approximately 30 minutes per cord while loading with racks required but 5 minutes per cord.

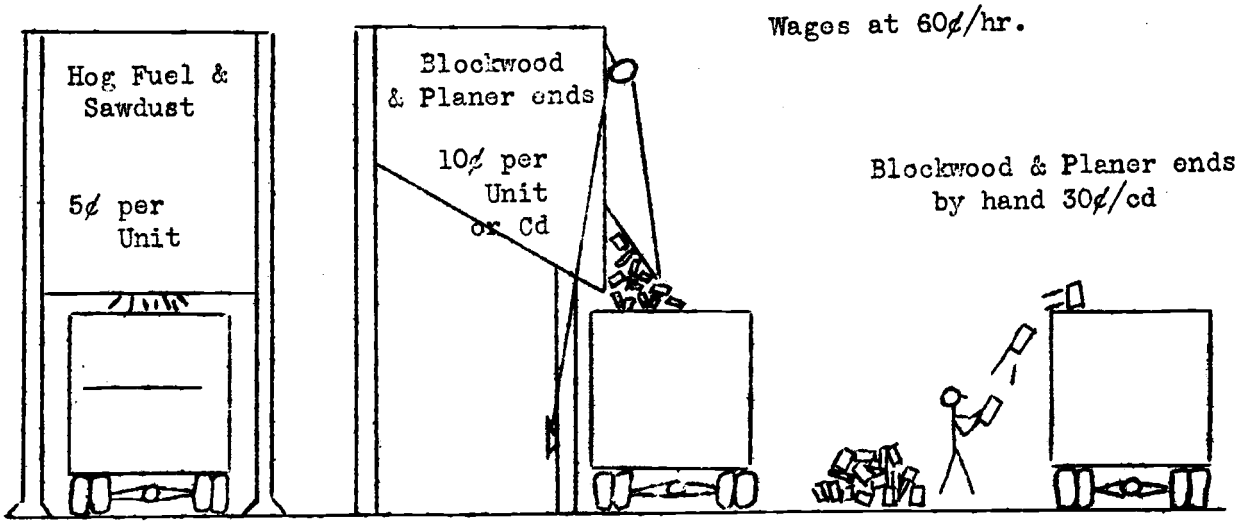
In the summary of loading and unloading costs approximate average or standard times based on the reports of fuel dealers, observation, and timing of loading and unloading were given a cost value based on a wage rate of 60¢ per hour. This gives the standard costs for loading and unloading on truck hauls.

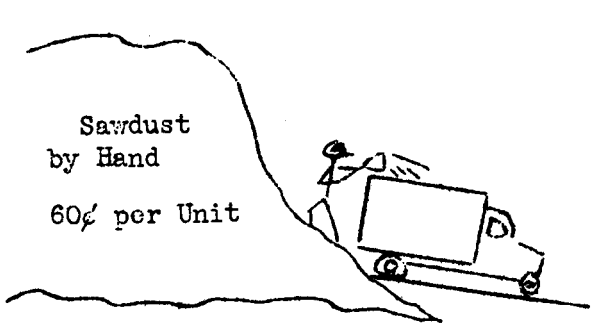
Table 8. Loading and Unloading Time and Cost Reported by Fuel Dealers

Type of Fuel and Method of Handling	Number Reporting	Time in Minutes per Unit or Cord			Average Cost @60¢/Hour
		Low	High	Average	
Loading					
Hog fuel & sawdust from:					
Bin	14	2.5	20.0	5.6	$.056
Blockwood & planer-ends:					
Bin	3	10.0	10.0	10.0	.10
Hand	5	30.0	40.0	34.5	.345
4' Slab:					
Racks	2	5.0	5.0	5.0	.050
Hand	5	22.7	40.0	29.8	.298
Unloading					
Hog fuel & sawdust by:					
Side door	6	6.0	22.5	14.8	.148
Dump	7	3.3	6.7	4.8	.048
Conveyor	4	3.2	4.2	3.6	.036
Blockwood & planer-ends					
Dump	6	5.0	15.0	7.7	.077
4' Slab					
Hand	5	30.0	33.0	31.3	.313

SUMMARY - LOADING AND UNLOADING COSTS

Wages at 60¢/hr.

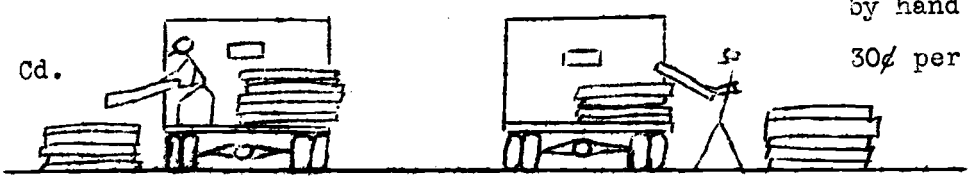


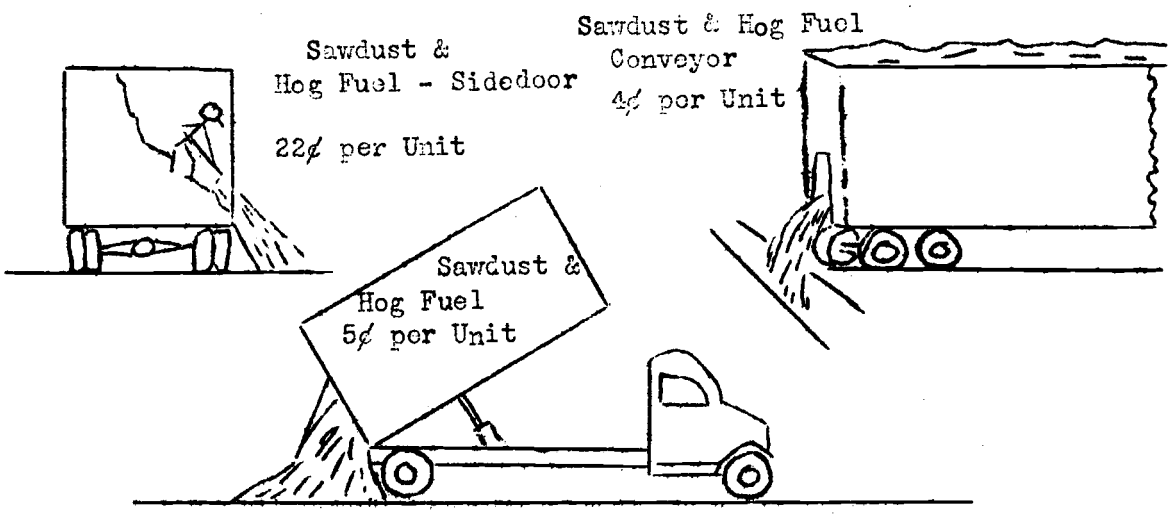


4' Slab - Racks - 5¢ per Cd.

4' Slab - Unload by hand
30¢ per Cd.

4' Slab - Load by hand
30¢ per Cd.





RAIL TRANSPORTATION

Sawmill refuse and fuel wood transported by rail is loaded on racked cars at the mill and a per unit, cord, or car rate paid to the railroad for hauling to the destination.

There are several advantages and disadvantages to rail transportation of sawmill refuse and fuel wood.

Advantages

1. Rail transportation costs less than truck at distances above 40-45 mis.
2. Where cars can be loaded directly by conveyor less equipment such as bins and hoppers is needed than with trucks.
3. Rail transportation is not influenced adversely by considerations of tire rationing. Under present conditions this may become a deciding factor in choosing between rail and truck transportation.
4. Most of the medium-sized and large sawmills as well as many of the smaller ones are situated so as to make use of rail shipments on refuse material. In many instances sidings are already available.

Disadvantages

1. Rail transportation costs more than truck on short hauls and more than barge on both short and long hauls.
2. Unloading costs more than with truck.
3. Use of rail transportation in supplying a consumer who does not have adjacent rail facilities necessitates additional expenditure for unloading, reloading on trucks for final delivery.

Rail Freight Rates

The rail rates for fuel wood or mill wood are published in the form of commodity (point to point) rates or as distance rates. The distance rates are to be applied where commodity rates are not available for a particular originating point and destination. Rates on rail shipments are set by the Interstate Commerce Commission on interstate hauls and by the Public Utilities Commission on intrastate haul

Cars used for fuel wood shipments of hog fuel, sawdust, or shortwood must be racked and the racks maintained by the shipper; if the railroad furnishes and maintains the racks a flat charge of $1.10 per car per trip is made. The cost of racking a car for hog fuel or short wood shipments is about $225 per car.*

Using the distance rates in Local Freight Tariff 237-O the total delivered costs were computed for various distances. These costs are in Table 9, "Rail Transportation Costs," and include rail rate, unloading, and fuel cost at the mill on hog fuel, sawdust, shortwood and 4' slab.

*Complete details on rates and shipping regulations on fuel wood shipments can be obtained by consulting Local Freight Tariff No. 237-O, Southern Pacific RR, containing specific commodity rates and distance rates on fuel wood, pulpwood, and wood bolts or by contacting the Railroad Company, the Interstate Commerce Commission or the Public Utilities Commission.

Table 9. Rail Hauling Costs--Freight Rates taken from SP Tariff 237-O, Schodule No. 1

Distance --Miles	Freight Rate per unit*	Hog Fuel & Sawdust: Plus Unloading Cost of 20¢	Hog Fuel & Sawdust: Plus Fuel Cost at Mill of 75¢	Blockwood, Planer Ends, 16" Slab: Plus Unloading Cost of 25¢**	Blockwood, Planer Ends, 16" Slab: Plus Fuel Cost of Mill of $1.50	4' Slab: Plus Unloading Cost of 30¢**	4' Slab: Plus Cost at Mill of $2.00
5 or less	$1.01	$1.21	$1.96	$1.26	$2.76	$1.31	$3.31
5.1 to 10.0	1.06	1.26	2.01	1.31	2.81	1.36	3.36
10.1 to 15.0	1.11	1.31	2.06	1.36	2.86	1.41	3.41
15.1 to 20.0	1.16	1.36	2.11	1.41	2.91	1.46	3.46
20.1 to 25.0	1.23	1.43	2.18	1.48	2.98	1.53	3.53
25.1 to 30.0	1.28	1.48	2.23	1.53	3.03	1.58	3.58
30.1 to 35.0	1.34	1.54	2.29	1.59	3.09	1.64	3.64
35.1 to 40.0	1.45	1.65	2.40	1.70	3.20	1.75	3.75
40.1 to 45.0	1.56	1.76	2.51	1.81	3.31	1.86	3.86
45.1 to 50.0	1.67	1.87	2.62	1.92	3.42	1.97	3.97
50.1 to 60.0	1.78	1.98	2.73	2.03	3.53	2.08	4.08
60.1 to 70.0	1.90	2.10	2.85	2.15	3.65	2.20	4.20
70.1 to 80.0	2.00	2.20	2.95	2.25	3.75	2.30	4.30
80.1 to 90.0	2.12	2.32	3.07	2.37	3.98	2.42	4.42
90.1 to 100.0	2.23	2.43	3.18	2.48	3.98	2.53	4.53

*Rate applies to 200 cu. ft. unit of hog fuel or sawdust or a 192 cu. ft. unit of blockwood, planer ends, or 16" slab, or a 128 cu. ft. cord of 4' wood.

**Loading cost not included here since mill pays for the loading. For loading costs see Table 15.

Loading and Unloading Costs

Loading cars with hog fuel and sawdust is commonly done by running the conveyor directly to the car; short wood is also loaded in this manner. Bins are less widely used for loading cars than the direct conveyor method while hand loading of short wood is expensive and is seldom used. Four foot slab is loaded by hand at the mill; this type of wood does not lend itself well to mechanical handling. The cost of loading fuel wood on freight cars, as reported by operators using rail hauls, is given in Table 10.

Where a conveyor is located so that the car can be unloaded from both sides, unloading costs approximately 20¢ per unit on hog fuel and sawdust. Shortwood can be unloaded by the same method or thrown by hand from the freight car to a truck for delivery. No dealers were contacted who were getting this type of material by rail. Four foot slab must be unloaded by hand which increases considerably the total cost of handling. Table 10 also lists the unloading costs reported on the different kinds of wood.

Table 11 is based on reports from operators and observation of both rail and truck loading and unloading operations. The result is a list of expected average costs for loading and unloading freight cars.

Table 10. Loading & Unloading Costs Reported by Operator on Rail Hauling

Type of Material	No. of Operations Reported	Cost per Unit for Loading			No. Operators Reported	Cost per Unit for Unloading		
		Low	Average	High		Low	Avo.	High
Hog fuel and sawdust	4	$.05	$.08	$.12	8	$.19	$.26	$.39
Planer onds, blockwood 16" slab	3	.30	.62	.80	-	-	-	-
4' Slab	2	.60	.68	.75	3	.50	.67	.90

Table 11. Rail Hauling
Expected Average Costs for Loading and Unloading

These figures are based on reports from operators and observation of both rail and truck loading and unloading operations. Wages figured at 60¢ per hour.

Type of Material	Method	Cost per Unit
	Loading	
Hog Fuel & Sawdust	Conveyor runs directly to car	$ .06
Blockwood, Planer ends,	Conveyor runs directly to car	.06
16" Slabwood	From bin or bunker	.20
	By hand	.75
4' Slab	By hand	.40
	Unloading	
Hog Fuel & Sawdust	Shovel from both sides of car into conveyor	$ .20
	Shovel from one side of car	.25
Blockwood, Planer ends, 16" Slab	Unloaded from both sides of car down into conveyor	.25
	By hand into truck or bin	.60
4' Slab	By hand into truck or pile	.30

BARGE TRANSPORTATION

Fuel wood or sawmill refuse transported by barge is loaded on the barge at the mill and then towed to the destination. The fuel transported by barge usually goes to a large scale industrial user whose plant is also on the river or water route.

This water transportation is advantageous because of the low cost in comparison to other types of transportation. It is limited in availability and the quantities necessary to make it economical restrict its use to transportation from large sources and to large scale users.

Barge Rates

Barging rates are set according to the distance of tow, the number of barges in a tow, and whether the towing company furnished the barges or not. The minimum sized barge used is one with a capacity of 200 units and larger barges of 300-350 units are commonly used.

Table 15 gives barging rates charged by one towing company in Portland and are for barging where they furnish the barges. Rates where either the seller or shipper furnishes the barges would be somewhat less although the total cost would be comparable to these rates. Rail rates and distances are also listed to furnish a comparison.

No information was obtained on barging of other wood fuel items such as blockwood and slabwood as none of these are being barged at this time. These types of fuels would be more difficult to handle by mechanical means; however, correspondingly low transportation costs compared to rail hauling could be expected.

Loading and Unloading

The barges are loaded either by a conveyor running directly to the barge or the hog fuel is dumped onto the barges from storage bins. The estimated loading cost where a large amount of hog fuel is loaded amounts to 5¢ per unit. The barges are unloaded using a crane and clamshell bucket. A few barges in the Puget Sound area are equipped with conveyors running the length of the barge and are unloaded into the conveyor hopper on shore. The unloading costs on this fuel using a clamshell bucket varies from 3¢ to 10¢ per unit depending mainly on the amount moved per day with a given crew and equipment setup.

Table 15. Barge Hauling Rates
Portland Harbor and Columbia River Areas
Hog Fuel & Sawdust

From	To	Barge Rate	Rail Distance	Rail Rate
Wauna & Westport	Camas	$ .97	92	$2.23
"	Oregon City	.90	86	2.12
Lower Portland Habor	Camas	.58	18	1.11
"	Oregon City	.58	18	1.11
Vancouver	Camas	.56	14	1.06
"	Oregon City	.59	26	1.23

Rates given above are for barging when towing company furnishes barges.

Loading & Unloading--Barge Hauling

Estimated loading cost where a large amount of material is handled as in this type of hauling amounts to 5¢ per unit.

Unloading costs using a crane, clam shell bucket, and conveyors are as follows

User #1 - $.03-$.07 per unit depending on amount moved per day.
User #2 - $.06 per unit
User #3 - $.10 per unit

COMPARISON OF RAIL AND TRUCK TRANSPORTATION

The application and use of the material in this report can be illustrated by applying the results to an actual transportation situation. Three mills in the area southeast of Eugene were selected and a comparison made of rail and truck transportation on the different length hauls from these mills. The mills used in this comparison are numbered 1 to 3 on the map in Figure 1. As indicated on the map, these mills have both rail and truck transportation available. It is assumed that each of the three mills has the same facilities for loading and can load either trucks or freight cars; further, that the user is equipped to adequately handle either truck or rail unloading.

The rail rates used are distance rates from S.P. RR Tariff 237-O. The truck operating costs, fuel costs at the mill, loading and unloading costs are taken from corresponding sections of this report.

Table 12 contains the costs of transporting by rail from each of the three mills. Table 13 gives the costs for truck transportation with two sizes of trucks from the same mills. The comparison of the rail and truck transportation costs is given in Table 14.

Table 12. Rail Haul on Hog Fuel or Sawdust

Item	Cost per Unit Mill #1	Mill #2	Mill #3
Rail distance to Eugene	6 miles	21 miles	33 miles
Freight rate per unit	$1.06	$1.23	$1.34
Unloading cost	.20	.20	.20
Fuel price at the mill	.75	.75	.75
Total cost delivered and unloaded	$2.01	$2.18	$2.29

Assuming a delivered and unloaded price of $2.25 per unit, Mill #3 would be outside the marginal hauling limit and would probably reduce the fuel price at the mill.

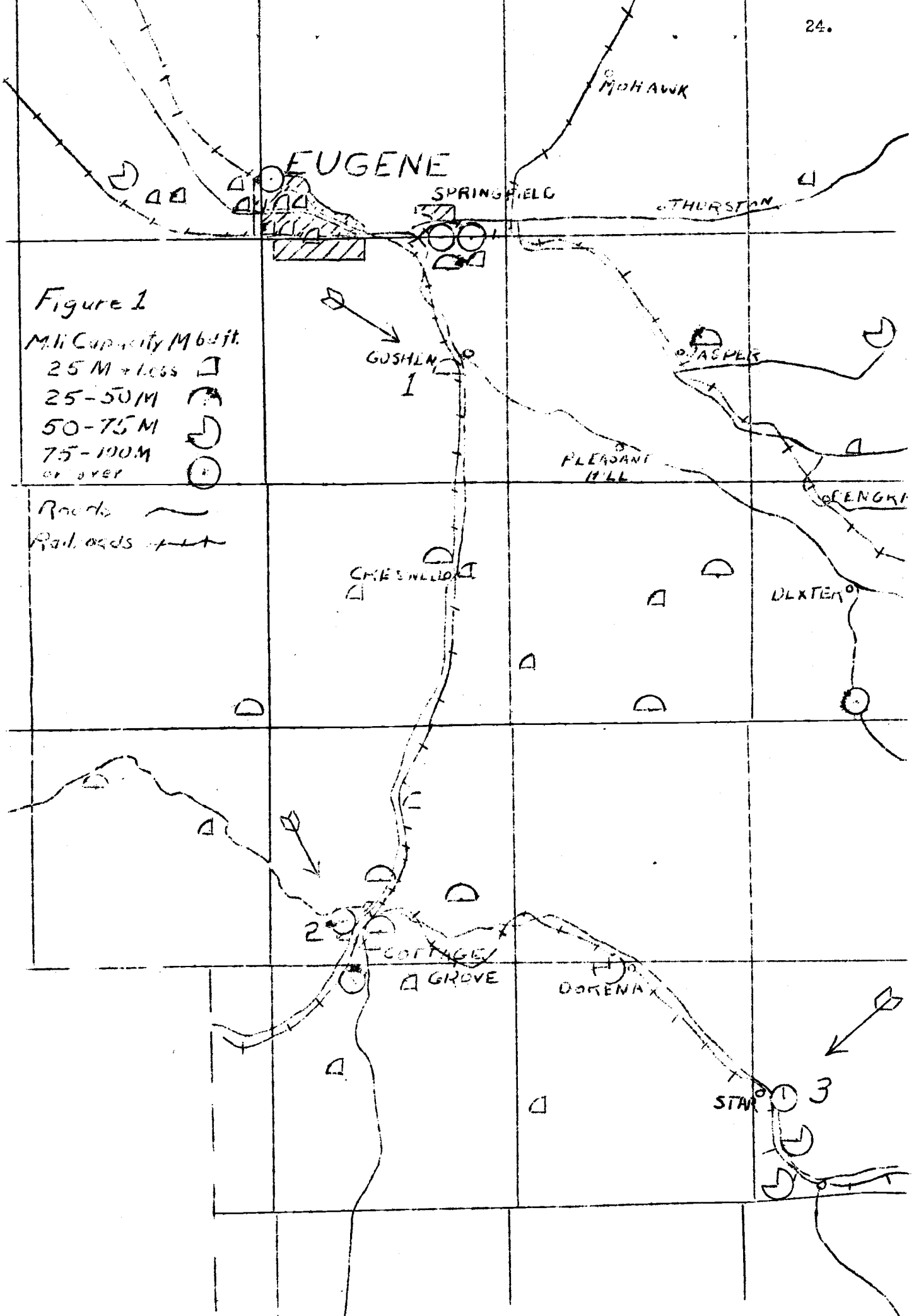
Table 13. Truck Haul - Hog Fuel or Sawdust

Item	Cost per Unit Mill #1		Mill #2		Mill #3	
Road distance to Eugene	7 miles		22 miles		33 miles	
	4-Unit	9-Unit	4-unit	9-unit	4-unit	9-unit
Truck operation	$ .50	$ .28	$1.57	$ .88	$2.35	$1.33
Loading cost	.05	.05	.05	.05	.05	.05
Unloading cost	.04	.04	.04	.04	.04	.04
Fuel price at the mill	.75	.75	.75	.75	.75	.75
Total Cost delivered & unloaded	$1.34	$1.12	$2.41	$1.72	$3.19	$2.17

Assuming again a delivered price of $2.25 per unit, Mills #2 and #3 would be beyond the marginal limit with a 4-unit truck.

Table 14. Comparison of Rail Haul and Two Methods of Truck Transportation from Mills 1-3 to Eugene

Mill No.	Rail Distance	Road Distance	Total Cost per Unit Delivered & Unloaded Rail	4-Unit	9-Unit
1	6	7	$2.01	$1.34	$1.12
2	21	22	2.18	2.41	1.72
3	33	23	2.29	3.19	2.17


EUGENE
SPRINGFIELD
MOHAWK
THURSTON
GOSHEN
1
JASPER
PLEASANT HILL
CRESWELL
DEXTER
2
COTTAGE GROVE
DORENA
STAR
3
Figure 1
Mill Capacity M bd ft.
25 M + less
25-50 M
50-75 M
75-100 M
or over
Roads
Railroads

COMBINATION HAULS

Conditions of market price, demand, or available transportation facilities in a given locality might make it economically desirable to transport wood fuel items using a combination of two different methods. For example, a truck-rail haul or a truck-barge haul might be worked out. The principal problem to be met would be in reducing the additional handling cost involved in transfer from truck to barge or truck to car on these combinations to a reasonable figure. Such combination hauls could make use of the advantages of each type of transportation and at the same time minimize the disadvantages.

The following hypothetical case will serve to illustrate how this could be worked out. A mill located 90 miles from a potential market has a quantity of hog fuel to dispose of to a large steam power plant. A road-river junction is located 20 miles from the mill; the power plant is also on the river and is equipped to unload from barges, trucks or freight cars. Using the rates and costs given in other parts of the report, the following comparison is obtained.

Table 16. Comparison of Truck-Barge Haul with Rail or Truck Haul

Item	Cost per Unit		
	Truck-Barge 9-Unit	Rail Only	Truck Only
Loading cost at the mill	$ .05	$ .05	$ .05
Truck operation, 20 mile haul	.81	-	3.62 (90 miles)*
Unloading truck and loading barge at river	.09	-	-
Barge rate, 70 miles	.90	2.12*	-
Unloading at destination	.10	.20	.04
Total Cost, 90 mile haul	$1.95	$2.37	$3.71

*Rail rate

Assuming a price of $2.50 per unit delivered and unloaded at the power plant the margin on the truck-barge haul would be $.55, on the rail haul $.13, and on the truck haul -$.21.

FUEL PRODUCTION COSTS

In the preceding sections the costs incurred and the methods used for transporting fuel wood have been discussed. The utilization of sawmill refuse for fuel purposes is influenced not only by transportation but also by methods of production and the costs of these methods.

The cost of producing fuel from sawmill refuse is made up of the costs resulting from handling, cutting up, conveying, and storage of the refuse material. The costs given below do not include any proportionate amount that could be allocated to pay for the wood material itself. Fuel production costs vary with different types of fuel and methods of production.

Hog Fuel

The cost of producing hog fuel as reported by the mills ranged from 25¢ to 75¢ per unit, the average being 44¢ for the thirteen mills reporting. One mill which kept cost records on their hog fuel production gave a cost of 29¢ per unit for the five months ending June 1, 1942. The cost per unit will vary considerably depending on the output with given equipment and crew. Where the hog is operating at somewhere near capacity a cost in the neighborhood of 30¢ per unit can be expected.

Sawdust

No operators were contacted who figured any cost on the handling at the mill of sawdust for fuel purposes. It is a product that has to be disposed of in some manner, consequently the cost of conveyors and chutes to remove it from the point of origin are not charged against the sawdust fuel. About the only costs involved are for additional conveyors, bin construction, and a small amount for power; the total of these, in most instances, will not exceed 10 cents per unit.

Blockwood and Planer-ends

The cost of handling this material where a separate conveyor is used would be comparable to the cost on sawdust and would be in the neighborhood of 10-15¢ per unit.

The cost per cord for picking blockwood from the conveyor varies with the amount thrown out per day. With wages at 75¢ per hour and picking 8 cord per day this would amount to 75¢ per cord. At the smaller mills handling blockwood by throwing it to one side at the trim saw, the cost would be negligible.

4' Slab

The cost of picking 4' slab from the conveyor and piling for loading as reported by 8 operators ranged from 30¢ to 90¢ per cord with an average cost of 46¢ per cord.

16" Dry Slab

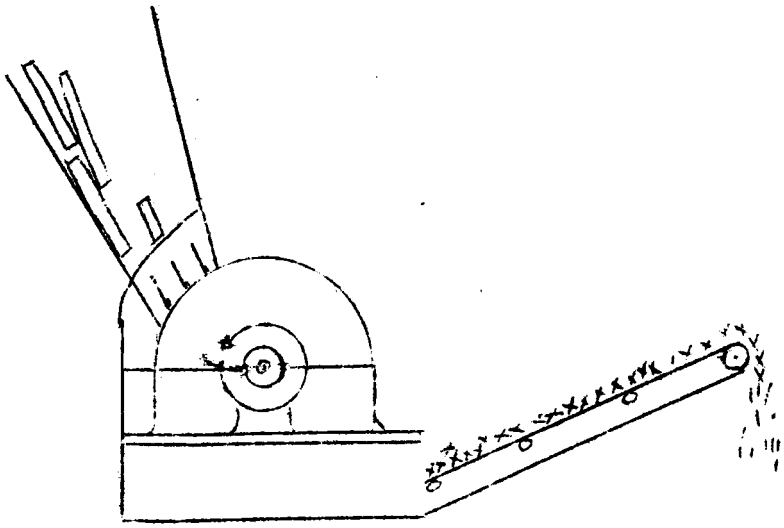
16" dry slab is produced by cutting up 4' green slab that has been piled in storage long enough to season. The 4' wood is cut on a buzz saw and thrown on the truck for delivery or is conveyed to a hopper for later loading. The following two examples serve to illustrate the cost of producing 16" dry slab.

	Example 1		Example 2	
Wood--2 cds	$4.00		$2.00	
Loading the racks on truck	.10		.10	
Unloading and piling	.60		.60	
Truck operation--10 miles/10.8¢/mi.	2.16		2.16	
Subtotal	$6.86		$4.86	
Cost per cord piled in yard	3.43	per cord	2.43	
Interest 36¢ for 8 months	.14	" "	.10	
Fire insurance	.04	" "	.04	
Other items--overhead, etc.	.05	" "	.05	
Saw to 16" length	.75	" "	.75	
	$4.41		$3.37	
Delivery 2 miles & unload	.48		.48	
Total cost delivered to customer	$4.89	" "	$3.85	per cd.

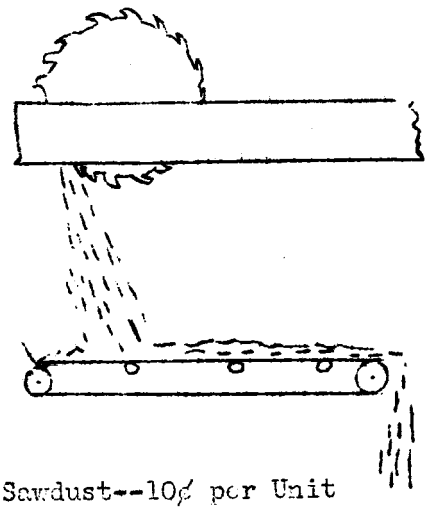
Table 17. Reported Fuel Prices at the Mill

Type of Fuel	No. Reporting	Cost per Unit or Cord		
		Low	Average	High
Hog fuel	13	$ .50	$ .753	$1.29
Sawdust	14	.25	.467	1.00
Blockwood	9	.75	1.787	3.00
Planer-ends	3	1.50	2.00	2.50
4' green slab	10	.25	1.325	2.50

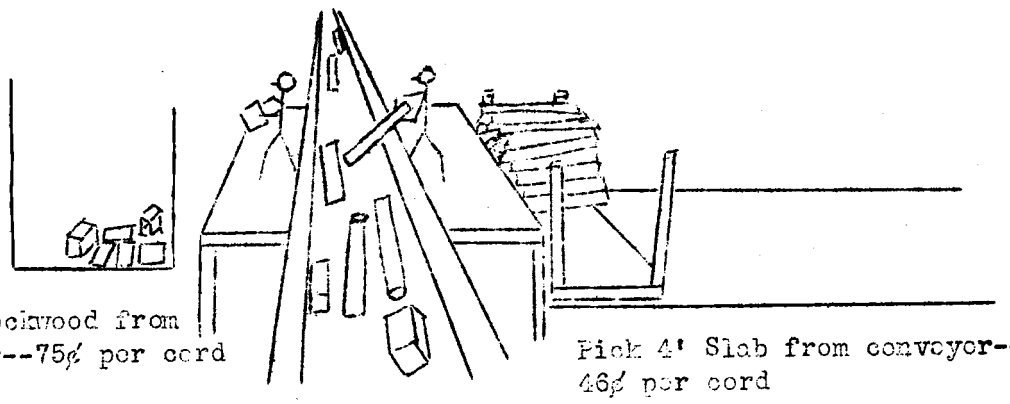
COST OF FUEL PRODUCTION
FROM SAWMILL WASTE



Hog Fuel--Average 44¢ per Unit



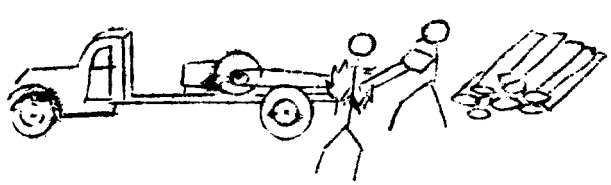
Sawdust--10¢ per Unit



Pick blockwood from Conveyor--75¢ per cord

Pick 4' Slab from conveyor--46¢ per cord

Buzz-saw 4' wood to 16"
75¢ to $1.00 per cord



Blockwood and Planer ends direct to bin--15¢ per cord