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SURVEY COMPLETION REPORT

RESIDENTIAL FUELWOOD USE IN THE UNITED STATES: 1980-81

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July 1983

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ABSTRACT

This report presents results of a survey of U.S. households which determined fuelwood consumption and acquisition during 1980-81. Data on fuelwood consumption are given by regions, household characteristics, and selected economic factors. Data on household acquisition include amounts purchased and harvested and are given by region, species type, and source of fuelwood.

Key Words: residential, survey, household, wood burning, harvesting, consumption, fuelwood, prices, sources, equipment

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RESIDENTIAL FUELWOOD USE IN THE UNITED STATES: 1980-81

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HIGHLIGHTS

During 1980-81, 28 percent of U.S. households, or about 22.2 million, reported burning 40.5 million cords^{2/} in their primary homes and an additional 1.5 million cords in second homes.

Fifty percent of wood-burning households burned 1.25 cords or less, but 7 percent of households burned 4.5 cords or more and account for 10.1 million cords burned. Households burning large amounts account for a high average, 1.8 cords burned per wood-burning household.

Six and one-half million households reported using wood as their primary heating fuel and burned 21.7 million cords.

Homeowners burned four-fifths of all fuelwood, 34.7 million cords. Renters burned the remaining one-fifth.

^{1/} Post Office Box 5130, Madison, Wis. 53705. The laboratory is maintained in cooperation with the University of Wisconsin.

^{2/} "Cords" refer to standard cords--128 cubic feet of stacked bark, wood, and air--unless otherwise noted.

Households living in rural areas were 2-1/2 times more likely to burn one-third cord or more than households in urban areas. A rural wood-burning household burned twice as much, on average, as an urban wood-burning household. Forty-three percent of rural households burned one-third cord or more and burned an average 2.9 cords. Rural households burned 53 percent of all fuelwood but accounted for only 21 percent of all households.

Most fuelwood, 21.1 million cords, was burned in stoves or furnaces. An additional 19.3 million cords were burned in ordinary fireplaces or fireplaces with air-circulating devices or energy efficient inserts. On average, furnace users burned 3.7 cords, stove users burned 2.7 cords, and fireplace users burned 1.2 cords.

Fuelwood displaced more fuel oil than any other fuel, but a greater percentage of electrical heating was displaced than fuel oil.

Households acquired 44.8 million cords of mill waste and roundwood for fuelwood in 1980-81. This is slightly more than the 42 million cords consumed in primary and secondary homes.

Twenty-eight percent of all fuelwood acquired in 1980-81 (mill waste and roundwood) was purchased; 12.4 million cords.

Some 11.1 million cords of roundwood were purchased at an estimated average price of \$56 per cord. Purchases of 1 cord averaged \$70. Purchases of less than 1 cord averaged more than \$100 per cord.

Seventy-nine percent of fuelwood acquired (mill waste and roundwood) was hardwood, 35.3 million cords.

Of all roundwood acquired, 80 percent was hardwood and 20 percent was softwood. In the East, 95 percent was hardwood. In the West, 68 percent was hardwood.

Households cut and gathered 30.2 million cords of fuelwood. Almost three-fourths was from woodland areas outside city or village limits. Only 28 percent of self-cut fuelwood comes from

standing live trees from woodland. These live trees potentially could have contained saw logs or pulpwood usable for other wood products.

Household members traveled an average 28 miles (oneway) to cut firewood from woodland, but 50 percent traveled 5.5 miles or less.

In the Eastern United States, most self-cut fuelwood from woodlands comes from private land, 90 to 96 percent. But in the West, only 43 percent comes from private land.

Of the estimated 7.8 million forest landowners in the United States, 3.9 million owners cut fuelwood from their own land during 1980-81. Additional land areas were cut by households that did not own the land.

Of the 3.9 million landowners who cut fuelwood from their own land, 12 percent or 460,000 cut wood based on advice from a professional forester.

INTRODUCTION

In 1981 the Forest Products Laboratory, in cooperation with the University of Wisconsin Survey Research Laboratory, conducted a nationwide telephone survey to answer questions about the size and importance of residential wood burning. This report presents the basic results of the survey. The objectives of the study were to, first, determine consumption characteristics: (1) the amounts of fuelwood consumed, (2) the geographic and demographic characteristics associated with wood burning, (3) the displacement of traditional fuels, and, second, determine acquisition characteristics: (1) the species and potential merchantability of acquired wood, (2) the land ownerships harvested, (3) the relative size of self-cutting and purchasing, and (4) the prices paid for purchased fuelwood.

Until the mid-1800's, American households and industry used wood more than any other energy source (Graves 1919). For early settlers there was never a fuel wood shortage except near iron smelters or charcoal operations. In fact, the abundance of timber was a burden when clearing land for farming. Despite its abundance, families considered fuelwood to be as important as food, clothing, and a roof over their heads; and providing a cord of wood for one's family could take a skilled axman a day of hard work. A farm family living in a poorly insulated house commonly burned 6 to 12 cords^{1/} per year for heating and cooking, and sometimes as many as 20 cords (Reynolds 1942).

During the late 1800's, fuelwood lost its dominant position. A booming industrial economy and a growing urban population required greater quantities of energy and sought cheaper fuels. Coal rapidly replaced wood, and cheap and convenient oil and natural gas subsequently replaced coal.

^{1/} "Cords" as used here are standard cords, 128 cubic feet of stacked bark, wood, and air, unless otherwise noted.

By 1960, wood was no longer a significant fuel for households or nonforest products industries. Consumption of roundwood for fuel had declined from a high of 2.9 quads^{2/} per year (140 million cords) in 1870 to about 0.3 quad (16 million cords) in 1960 (Reynolds 1942; USFS 1981). But this long downward trend reversed for both industrial and household use as the cost of fuel oil, increased. Households faced rising fossil fuel prices after the 1973-74 OPEC oil embargo and rapidly increased their purchase of wood stoves. This suggested that households had increased their fuelwood consumption substantially.

But what was the new magnitude of wood burning and how could it be measured? A number of state-level surveys conducted by various public agencies and private companies suggested high levels of burning in many states. But these surveys cover only a fraction of all states. Traditional Forest Service timber product surveys, conducted routinely for individual states, would take many years to estimate fuelwood use for all states. A nationwide survey was needed to learn about the impact of fuelwood consumption nationwide.

A nationwide survey was needed because of responsibilities assigned to the Forest Service by the Forest Rangeland Renewable Resources Research Act of 1978 and subsequent amendments. The Act directs the Secretary of Agriculture to:

"...make and keep current a comprehensive survey and analysis of the present and prospective conditions of and requirements for the renewable resources of the forest and rangelands of the United States and of the supplies of such renewable resources, including a determination of the present and potential productivity of the land, and of such other facts as may be necessary and useful in the determination of ways and means needed to balance the demand for and supply of these renewable resources, benefits, and uses in meeting the needs of the people of the United States...."

^{2/} A quad is 10^{15} British thermal units of energy.

This report provides survey results and analysis of the demand for and nature of supplies used for fuelwood by households. Our report first gives a brief discussion of study methods and their limitations, followed by sections that describe fuelwood consumption and acquisition characteristics. Description of results is followed by several appendixes which contain detailed data tables, copies of the questionnaires used, and discussion of survey design and adjustment of data for nonresponse bias and respondent error in estimating amounts burned.

STUDY METHODS

Our study used three nationwide telephone surveys of households to determine fuelwood use, each was conducted by the Wisconsin Survey Research Laboratory. The first survey, a pilot survey of approximately 500 respondents, tested question formats and determined variation in amounts burned by households to aid in sample design. The main survey of 5,569 households was conducted during summer and early fall 1981. Our survey data cover the period September 1980 to September 1981. Sample sizes were chosen to achieve a relative standard error of ± 10 percent for amounts burned in each of nine regions in the continental United States.^{3/}

Interviews were concentrated in "rural" areas of each region. Sample telephone numbers for the pilot survey and main survey were randomly generated for working telephone exchanges. The response rate in most sample strata was 75 to 80 percent.

Following the main survey, we conducted a resurvey of approximately 600 of the 1,918 wood-burning households interviewed during the main survey. This survey asked more detailed questions about amounts burned, acquired, and self-cut. These questions determined

^{3/} ± 10 percent standard error in amounts burned means that if our survey were repeated identically over and over, 67 percent of the repeated estimates would be within ± 10 percent of the true amount burned.

the likely degree of error made by respondents in reporting amounts during the main survey. Results of the resurvey and main survey were compared. Where significant differences were found, amount estimates from the main survey were adjusted to match resurvey results.

Adjustments for nonresponse bias were formed after an analysis of "easy to reach" and "hard to reach" respondents. We assumed the 20 to 25 percent of households we did not reach were more like "hard to reach" respondents (four or more calls to reach) than "easy to reach" respondents. We evaluated two methods to correct for nonresponse bias and concluded one method provided sufficient adjustment. That is, we found households we did not contact were more likely to be renters than owners. To adjust for the resulting overrepresentation of owners in our sample, we decreased the weight placed on owners and increased the weight on renters.

Estimates of relative standard errors shown in data tables were computed using bootstrap and jackknife procedures (Efron, 1982).

FUELWOOD CONSUMPTION

During the 1980-81 heating season, 28 percent of U.S. households, about 22.2 million, burned a total of 40.5 million cords of wood in their primary residences. In addition, 1.5 million cords were burned in second homes. These estimates show burning in 1980-81 was several times larger than estimates for the early 1970's (U.S. Dep. Agric., Forest Serv., 1981). The large amounts being burned can be explained to some degree by looking at the concentration of wood burning. Our discussion will focus on wood burning in primary homes. Second-home wood burning is not included in consumption estimates unless specifically mentioned.

Concentration of Wood Burning

Consumption of large amounts of wood was concentrated in relatively few households burning large amounts of wood. Of 22.2 million households burning wood in their primary homes, 4.4 million or 20 percent accounted for 50 percent of all wood burned. Each of these households burned 3 cords or more (table 1). Even more striking is the fact that 7 percent of wood burners each used 4.5 cords or more and accounted for 25 percent of all wood burned. These 1.6 million households burned 10.1 million cords.

Because of large amounts burned by relatively few households, wood-burning households burned an average 1.8 cords during the 1980-81 heating season. The average rises to 2.2 cords if we exclude 4.4 million households burning less than one-third cord (table A-1).

Table 1.--Concentration of wood burning, 1980-81

Amount burned was greater than or equal to	Cumulative percentage of households	Cumulative percentage of cords burned
<u>Cords</u>		
4.50	7	25
4.00	10	32
3.00	20	50
2.00	35	70
1.25	50	85
.33	80	>98

Note: 22.2 million households burned a total of 40.5 million cords.

Fuelwood Consumption by Timber Region and State^{4/},^{5/}

The Northwest and Northern Rocky Mountain regions stand out as having the most ardent wood-burning populations; 47 and 34 percent of the households burned one-third cord or more, respectively (table A-1). New England households are next in wood-burning activity; 28 percent burned one-third cord or more. Although these regions are in cold climates, warmer regions also have many wood burners. Participation in the Southeast, 27 percent, was almost as high as in New England. The lowest participation, 16 to 17 percent, occurs in the heavily urbanized mid-Atlantic region and the Southern Rocky Mountain region which includes urbanized Southern California.

Households in the Northwest, Northern Rocky Mountains, Lake States, and New England which burned one-third cord or more burned an average 2.7 cords or more. This was well above the national average, 2.2 cords.

Even though individual households in cold regions burned more than households in warm regions, on the whole households in the cold North Central States do not burn more than those in the warm South Central States. Each region had about 22 million households, and each region burned about 12 million cords during 1980-81. Higher average amounts burned in the North were offset by higher participation in the South (table A-1).

Our survey made very rough estimates of fuelwood consumption by state. The relative standard error of the estimates is quite large, and our estimates should only be taken as rough indicators

^{4/} This section discusses only wood-burning households that burn one-third cord or more.

^{5/} A map of the nine timber regions used to subdivide our data is shown in figure B-1. The nine timber regions are sometimes grouped into four major timber regions; the West, North Central, Northeast, and South.

of state-level consumption. Our state estimate shows that the seven states with the highest per household burning rates are:^{6/}

Arkansas	Oregon
Idaho	Vermont
Maine	Washington
New Hampshire	

Our state level estimates may be compared with other state-level estimates shown by Norwood and Warnick (1982). There are large differences between some estimates which serve to emphasize that our estimates have large relative standard errors (table A-3).

Who is Burning Fuelwood?^{7/}

The urban or rural location of households is a primary demographic factor in determining intensity of wood burning. The price of the fuel they used besides wood (if any) is also associated with variations in wood burning. Additional important factors include the income of the household, and ownership or rental of a home and climate.

Consumption by urban and rural location.--Households in rural locations were 2-1/2 times more likely to burn one-third cord or more than urban households; 43 percent of rural households versus 17 percent of urban households. In addition, wood burning rural households burned two times as much wood per household on average; 2.9 cords versus 1.8 cords respectively. These substantial differences exist in each major timber region (table 2). Wood burning is particularly strong in the rural west and south where 57 percent and 47 percent of households, respectively, burn one-third cord or more. Nationwide, the 17 million rural households burned more wood as a group than the 63 million urban households (table 2).

^{6/} Total consumption divided by the total number of households in the state.

^{7/} Wood burning households discussed in this section refer only to those burning one-third cord or more.

Table 2.--Fuelwood consumption in primary homes by urban or rural location, 1980-81

Timber region	Percent of households burning 1/3 cord or more		Average burned by households burning 1/3 cord or more		Total amount burned by all households ^{1/}		
	Urban	Rural	Urban	Rural	Urban	Rural	Unknown
			- - - <u>Cords</u> - - -		- - <u>Million cords</u> - -		
West	17 *	57 *	1.7 *	2.8 *	4.1 *	3.0 **	(1/) --
North Central	17 *	35 *	1.8 *	3.3 *	5.1 **	6.7 **	0.1 —
Northeast	15 *	44 **	2.0 *	3.0 *	5.0 *	4.3 **	.1 \$\$
South	<u>18</u> *	<u>47</u> *	<u>1.6</u> *	<u>2.6</u> *	<u>4.5</u> *	<u>6.9</u> *	<u>.6</u> \$\$
U.S. Total	17 *	43 *	1.8 *	2.9 *	18.7 *	20.9 *	.9 \$

^{1/} Includes households burning less than 1/3 cord.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

— Relative standard error is greater than 50 pct.

Consumption by cost of the alternate home-heating fuel.--The intensity of wood burning in rural areas varies notably with variations in the cost of the household's nonwood fuel. The cost of nonwood fuels appears to have less influence in urban areas.

Almost all households have some nonwood fuel to help heat their home regardless of whether or not they burn wood. We would expect that higher costs for these nonwood fuels--fuel oil, natural gas, electricity (or other fuel)--would induce more households to burn wood and to burn in larger average amounts.

This association is strong in rural areas, but less so in urban areas. In rural areas, we found that households with

nonwood fuel costs^{8/} of \$11 per MM Btu or more were 3 times more likely to burn one-third cord or more than rural households paying \$5.60 per MM Btu or less; 57 percent versus 19 percent (table A-34). But in urban areas, wood burning only increased from 16 percent to 18 percent between the low and high cost categories. The average amount burned per household in rural areas was 1.8 cords in the low cost category and 2.8 cords in the high cost category. Average amounts burned in urban areas varied less between these cost categories; from 1.5 cords per household to 2.0 cords per house (table A-35).

By averaging fuelwood consumption over all households in each of four nonwood fuel cost categories, we can see that rural wood burning is strongly associated with differences in fuel costs whereas the association is much weaker in urban areas (table A-37).

The strong association in rural areas is due in part to the fact that high costs for nonwood fuels in rural areas are more likely to be found in colder climates where more wood is burned. In addition, higher fuel costs in rural areas are more often incurred by higher income households and a higher income population tends to burn more wood on average. In urban areas the high and low costs of nonwood fuels is more evenly distributed among high and low income households and among warm and cold climates.

^{8/} We computed the cost of the nonwood heating fuel used by a household in our survey by using 1980 prices obtained from the Los Alamos National Laboratory (LANL 1982). The price of a household's nonwood fuel, say natural gas, was taken from 1 of 220 regional natural gas prices prepared by LANL. Natural gas, fuel oil, or electricity prices were converted to the cost to produce 1 million Btu's of heat. In making this conversion we assumed a natural gas furnace efficiency of 61 percent, fuel oil furnace efficiency of 66 percent, and electric heater efficiency of 100 percent (ORNL 1978). Nonwood fuel cost was only computed for households using natural gas, fuel oil or electricity. Average costs of nonwood fuels are shown in table A-36.

These facts should make it clear that the variation in amounts burned in rural areas are not entirely due to variation in non-wood fuel costs.

Consumption by income group.--Households with higher incomes were more likely to burn wood than lower income households. But higher income households were more likely to burn smaller quantities and use fireplaces rather than stoves or furnaces. The likelihood of wood burning in ordinary fireplaces increases sharply with income.

Only 2 percent of households with \$10,000 or less income burned one-third cord or more in an ordinary fireplace as opposed to 19 percent for households with \$40,000 or more income (fig. 1). The increase in use of stoves or furnaces between these low- and high-income groups was smaller; from 6 percent to 10 percent (fig. 1). The likelihood of burning one-third cord or more in any type of equipment increased substantially, from 10 percent for households with income \$10,000 or less to 40 percent for households with income \$40,000 or more (table A-5).

Because higher income households burned small amounts of wood in fireplaces, average amounts burned, including all equipment, decreases with income. Average amounts burned in ordinary fireplaces and stoves or furnaces do not change very much with income. But, there is a notable decline in average use in fireplace inserts with greater income (fig. 2, table A-6).

Consumption by owners and renters.--Households which own their home burned 87 percent of all fuelwood burned in primary homes. Thirty-one percent of homeowners burned one-third cord or more while only 7 percent of renters burned this much (fig. 3, table A-7).

FIGURE 1.--PERCENT OF HOUSEHOLDS BURNING ONE-THIRD CORD OR MORE BY INCOME GROUP AND EQUIPMENT USED MOST.

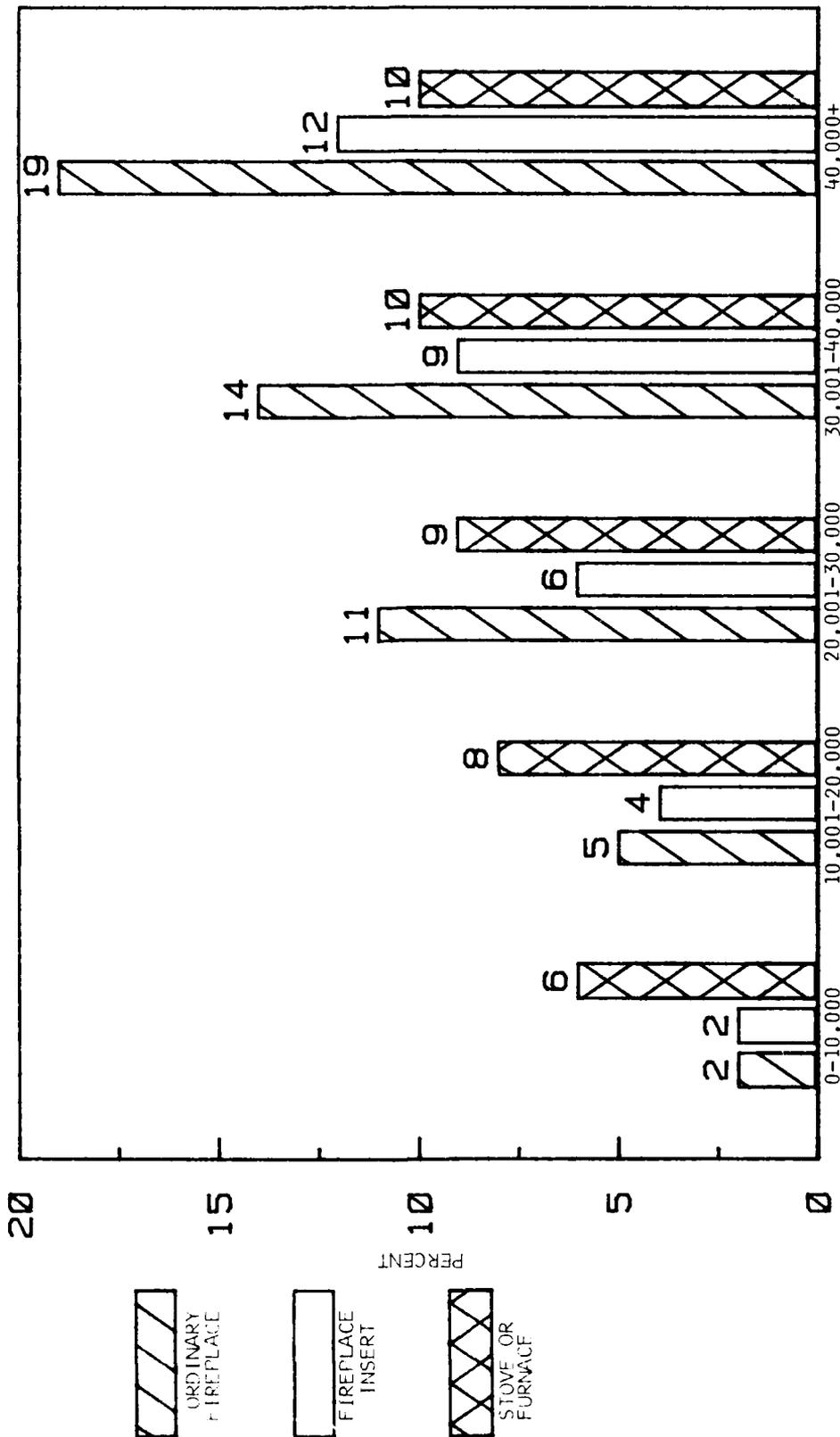
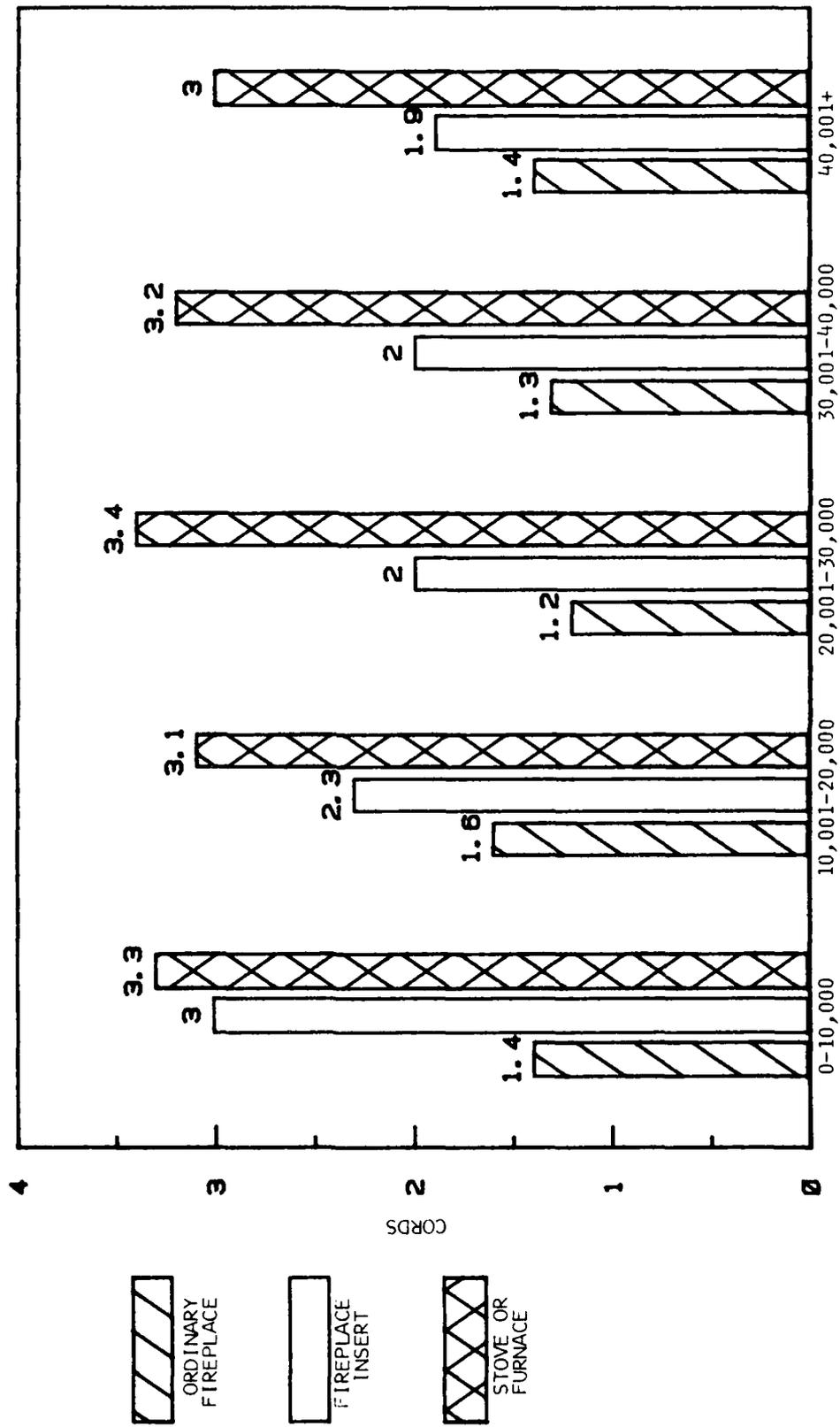


FIGURE 2.--AVERAGE AMOUNT BURNED BY HOUSEHOLDS BURNING ONE-THIRD CORD OR MORE BY INCOME GROUP AND EQUIPMENT USED MOST.



Consumption by climatic zone.--Wood burning is considerably more intense in the coldest climate than average. In the northern United States, which experiences 7,000 heating degree days or more each year, 33 percent of households burned one-third cord or more for an average 3.2 cords each (fig. B-2, table A-7). This northern region burned at twice the intensity of other climatic zones, 1.1 cords per household.

Climate Zone	Total consumption ^{1/} divided by total number of households
<u>Heating degree days</u>	<u>Cords</u>
7,000+	1.1
5,500-7,000	.5
4,000-5,499	.6
Less than 4,000	.4
Less than 4,000 and high cooling degree days	.3

^{1/} Total consumption excludes amounts from households burning less than 1/3 cord.

The warmest region only consumed an average 0.3 cord per household.

Urbanization within climate zones has considerable influence on wood burning. The 5,500-7,000 HDD zone burned less intensely than the 4,000-5,499 HDD zone because it is more urbanized. Urbanization in the North Central States and the large rural population in the South lead to almost equal wood burning in the two regions. Each region had about 22 million households, and each region burned about 12 million cords. The colder climate of the North did not induce greater wood burning because of differences in urbanization (table A-1).

Consumption by other demographic groups.--Wood burning was most popular among households with these additional characteristics (figs. 3,4, table A-7):

Households in single-family dwellings,
Households with four family members,
Households with head of household aged 30 to 44,
Households with head of household having a college degree.

What Wood-Burning Equipment Is Used?

Ordinary fireplaces are by far the most common wood-burning equipment. But the average amount burned in them is 0.9 cord, versus 2.8 cords for airtight stoves and 3.7 cords for furnaces.

To assess equipment available for wood burning, households were asked for the number of fireplaces, stoves, or furnaces they had and how much wood, if any, was used in each type of equipment. If they used a fireplace, we asked if any had "an air-circulatory device or special energy-efficient insert." If they used any stoves, we asked if any were airtight. Because we did not define "fireplace insert" precisely, the category may contain some ordinary fireplaces or some stoves sitting in old fireplaces using the fireplace flue. As a result, the number of stoves and ordinary fireplaces may be too small and the number of fireplace inserts may be too large.

While ordinary fireplaces were the most widely used equipment (used by 11.1 million households), airtight stoves were used to burn the most wood, 15.5 million cords versus 9.8 million cords for ordinary fireplaces (figs. 5A,5C, tables A-8,A-9). The high total amount of wood burned in airtight stoves is due to the high average 2.8 cords burned per stove (fig. 5B).

While 22.2 million households actually burned wood, 28.7 million had some type of usable equipment for a utilization rate of 78 percent. Utilization of stoves and furnaces, 86 percent, was notably higher than utilization of ordinary fireplaces and fireplace inserts, 71 percent (table A-10).

FIGURE 3.--PERCENT OF HOUSEHOLDS BURNING AND AVERAGE AMOUNTS BURNED FOR HOUSEHOLDS BURNING 1/3 CORD OR MORE, BY DEMOGRAPHIC GROUP, 1980-81.

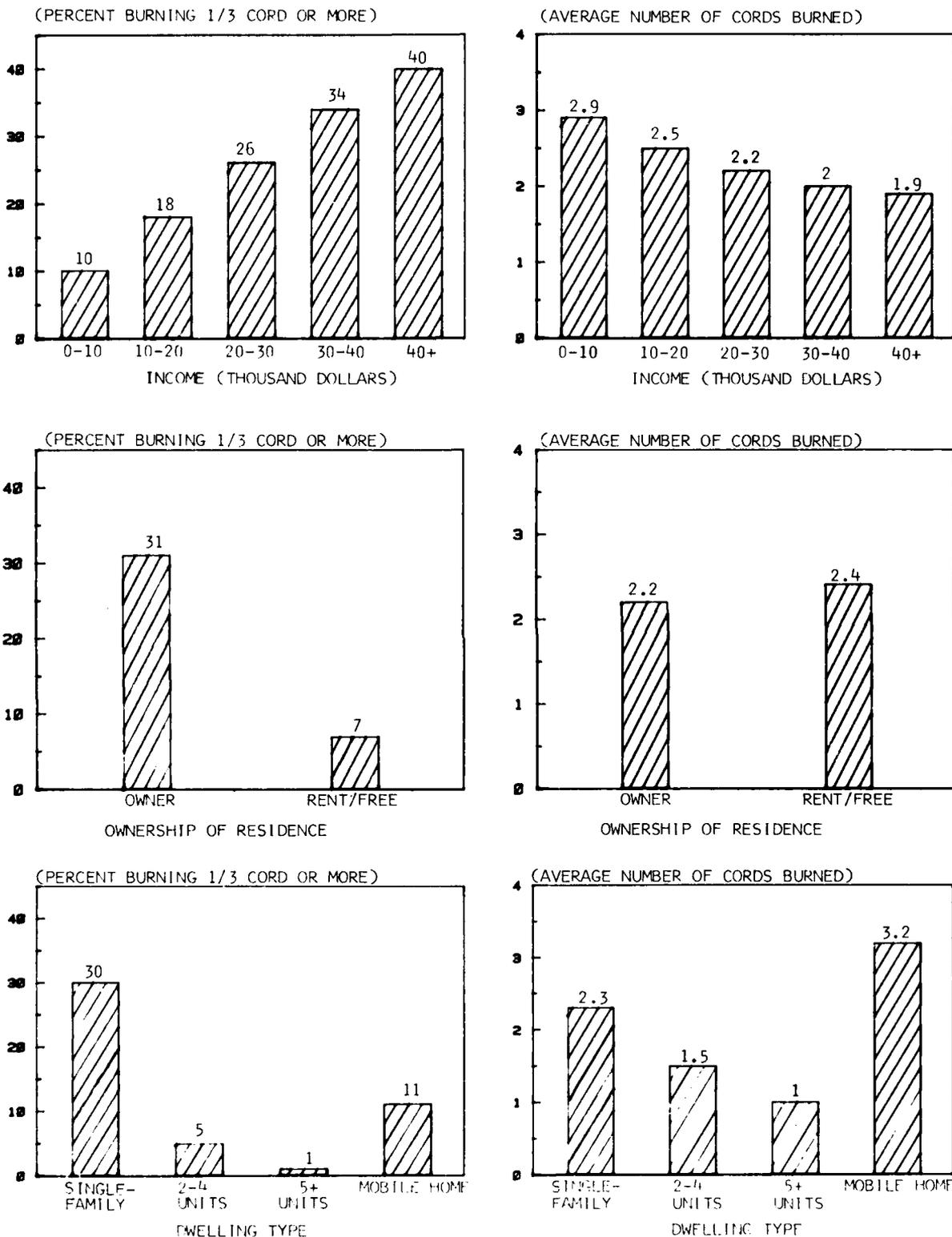


FIGURE 4.--PERCENT OF HOUSEHOLDS BURNING AND AVERAGE AMOUNTS BURNED FOR HOUSEHOLDS BURNING 1/3 CORD OR MORE, BY DEMOGRAPHIC GROUP, 1980-81 (CONT.)

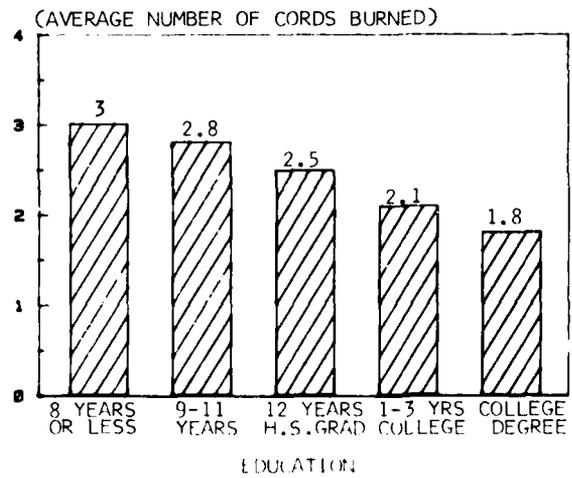
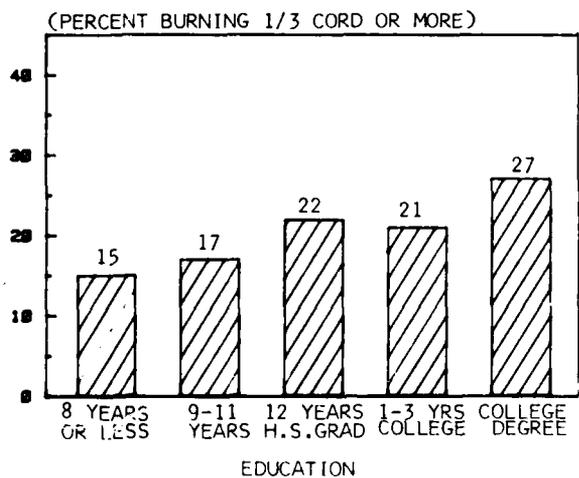
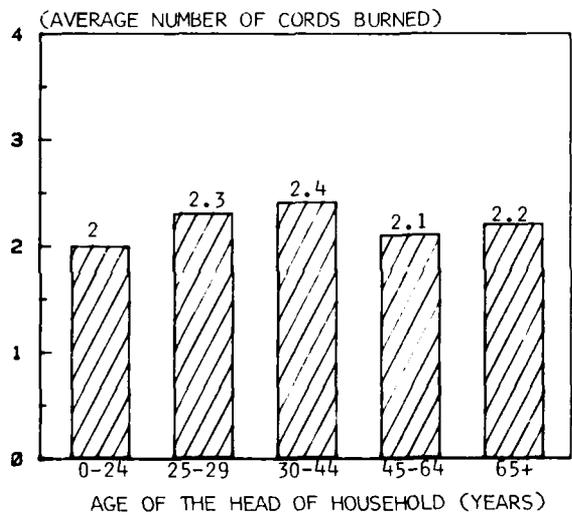
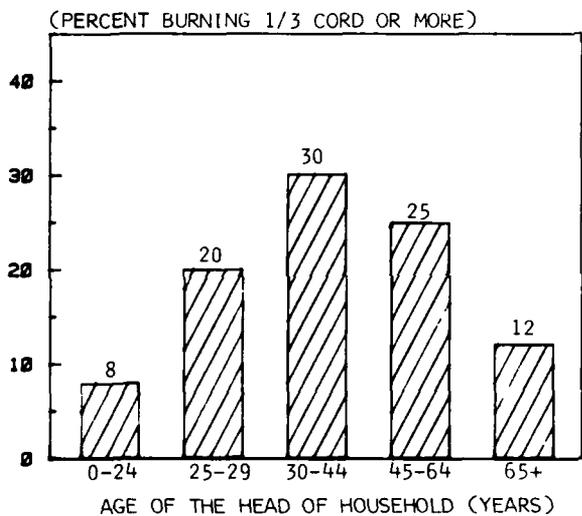
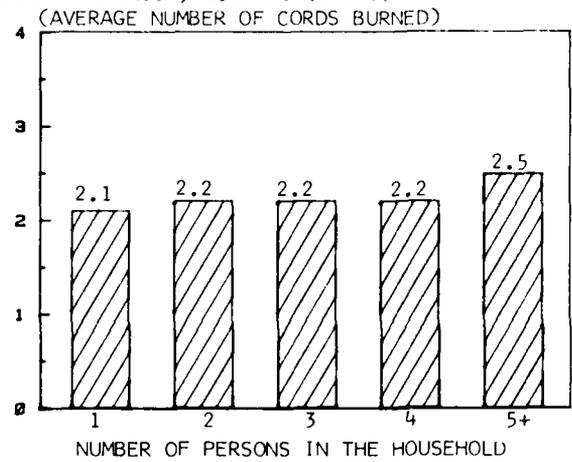
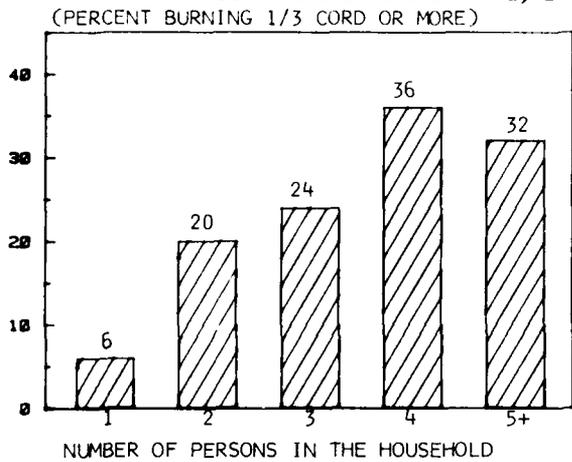


FIGURE 5A.--CONSUMPTION OF WOOD BY TYPE OF EQUIPMENT, 1980-81.

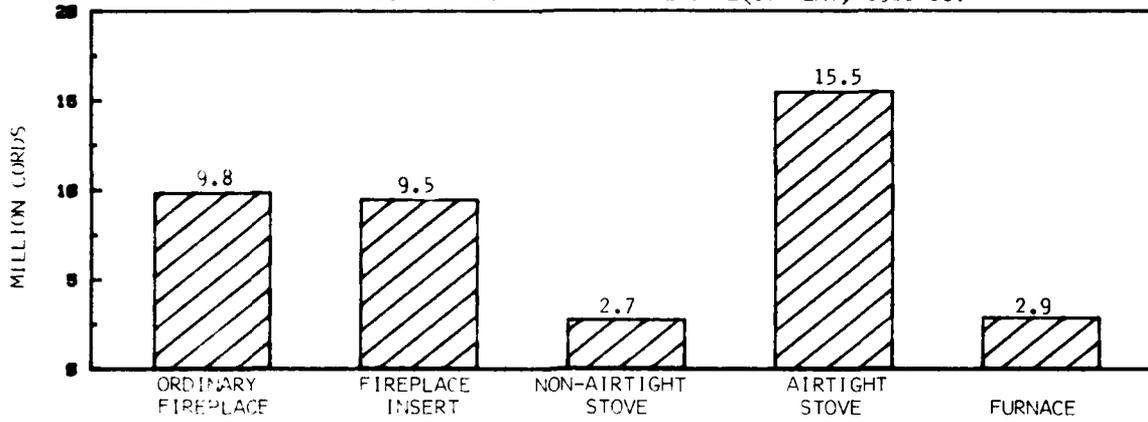


FIGURE 5B.--AVERAGE AMOUNT BURNED BY TYPE OF EQUIPMENT, 1980-81.

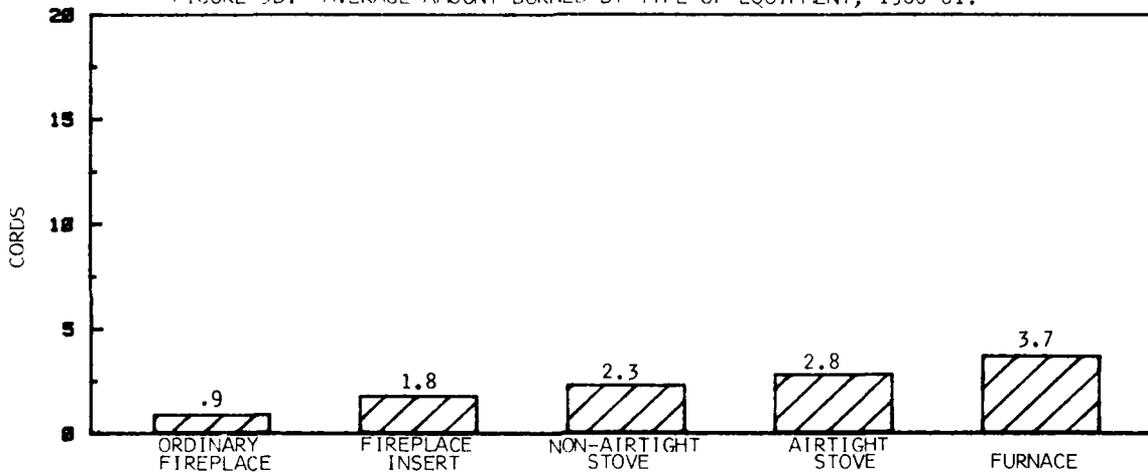
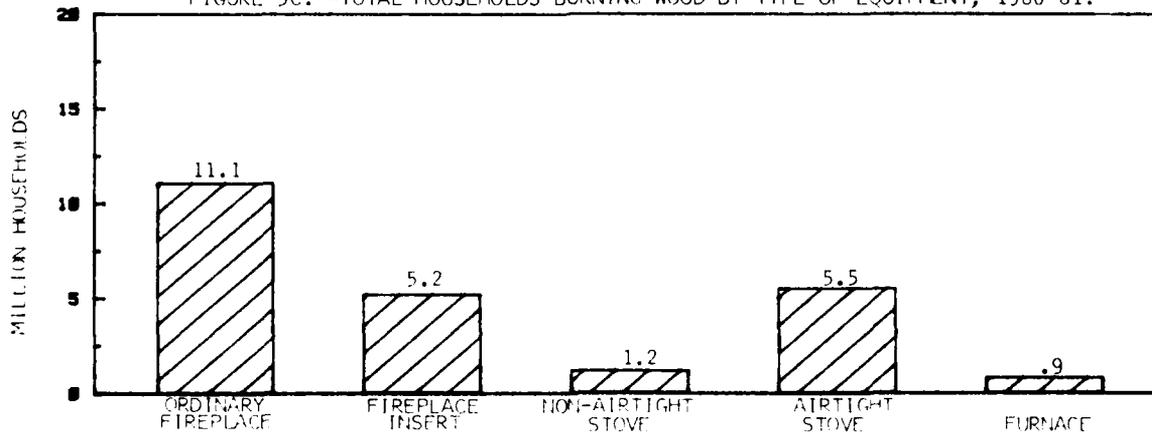


FIGURE 5C.--TOTAL HOUSEHOLDS BURNING WOOD BY TYPE OF EQUIPMENT, 1980-81.



The 28.7 million households with equipment had more than one piece of equipment in some cases. In total, these households held 27.6 million fireplaces, 8.9 million stoves, and 1 million furnaces for a total of 37.5 million pieces of equipment (table A-11).

The preceding comments do not include equipment in second homes. Almost half of second-home owners, 1.7 million, had wood-burning equipment in their second home, but only 63 percent used this equipment during 1980-81 (table A-12).

What Fuels Are Displaced By Wood Burning?

More gross energy in the form of fuel oil was displaced than any other home-heating energy source, roughly 650 million gallons. Despite the displacement of this notable amount, a greater fraction of electric heating was displaced; 4.3 percent versus 3.6 percent for fuel oil. Overall, the fraction of home heating displaced by fuelwood in 1980-81 was small, 2 to 3 percent.^{9/}

The fact that more fuel oil was displaced than natural gas or electricity is notable because households with fuel oil as an alternative fuel actually burned less wood than households with natural gas or electricity as an alternative (fig. 10. By burning more wood in efficient stoves and furnaces, fuel oil users burned less wood in total while displacing more energy than did natural gas users (fig. 6, table 3).

^{9/} The amount of energy displaced by fuelwood was computed using the following assumptions:

A cord of wood contains 20 million Btu's of energy.

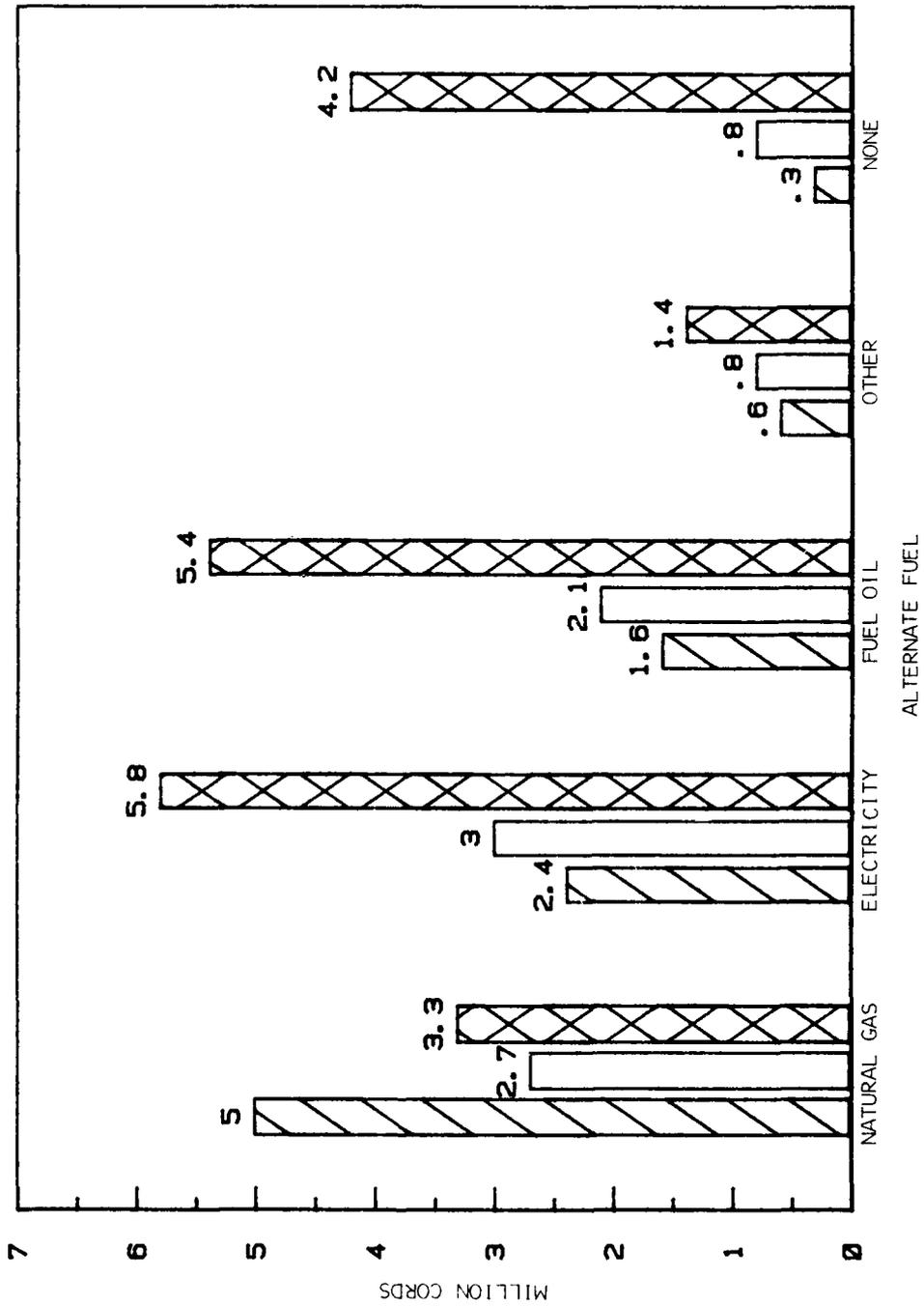
The efficiency of ordinary fireplaces is 5 percent and is 15 percent for fireplace inserts, 30 percent for nonairtight stoves, 50 percent for airtight stoves, and 55 percent for wood furnaces.

The efficiency of natural gas furnaces is 61 percent, fuel oil furnaces 66 percent, and electric heaters 100 percent (Oak Ridge National Laboratory 1978).

Wood burning does not influence households to turn off heat in unused rooms and heat only a few rooms with wood.

Results are shown in tables A-16, A-17, and A-18.

FIGURE 6.--TOTAL AMOUNTS BURNED BY HOUSEHOLDS USING DIFFERENT WOODBURNING EQUIPMENT AND DIFFERENT ALTERNATE FUELS, 1980-81.



 ORDINARY FIREPLACE
 FIREPLACE INSERT
 STOVE OR FURNACE

Table 3.--Estimated gross energy of alternate fuels displaced by wood burning, 1980-81

Item	Fuel displaced			
	Natural gas	Fuel oil	Electricity	Other, none, or unknown ^{1/}
	<u>10¹² Btu</u>			
<u>Equipment used</u>				
Fireplaces	21.7	11.9	11.5	5.6
Stoves	41.8	64.9	54.0	49.2
Furnaces	<u>7.5</u>	<u>15.1</u>	<u>4.0</u>	<u>13.2</u>
Total	71.0	91.9	69.5	68.2
<u>Total U.S.</u>				
Residential energy consumption, 1980 excluding wood ^{2/}	4,950	2,460	1,550	370
Ratio of displaced fuel to total fuel used	.014	.036	.043	--

^{1/} Where the alternate fuel was not known, energy displaced is the heat output of the wood-burning equipment.

^{2/} Source: (Energy Inf. Adm. 1982c).

The complete story of the high energy displacement by fuel oil users begins by noting the relatively small number of fuel oil users. Only 13.5 million households had fuel oil available as a fuel, whereas 42 million households had natural gas available. Seventeen million households had electricity available (fig. 7). Households with natural gas--generally located in more urban areas and having lower fuel costs--burned less frequently and with much less wood on average than did households with fuel oil available. Almost one-third of fuel oil households (and households with electricity) burned some wood, whereas less than one

fourth of natural gas households burned wood. Furthermore, natural gas households burned a low 1.2 cords on average, relative to 2.2 cords for fuel oil households (figs. 8,9). Households with electricity burned wood just as often and in the same average quantities as fuel oil households.

Households with electricity and fuel oil displaced the most energy by burning most wood in stoves and furnaces rather than fireplaces (fig. 6, table 3). A comparison of wood use between electricity and fuel oil users shows electricity users actually burned more wood in each type of equipment than fuel oil users (fig. 6). The reason more gross fuel oil energy was displaced than gross electric energy is the fact that fuel oil furnaces need 1.51 Btu's of fuel oil on average to produce 1 Btu of heated air, where electric heating needs 1 Btu of electric energy to produce almost 1 Btu of heated air. The net result is that 1 cord of wood displaces much more gross fuel oil energy than electric energy.

The overall amount of energy replaced by wood, 2 to 3 percent, is relatively small. It could have been higher if the average efficiency of wood-burning equipment was higher than an estimated 30 percent. This low efficiency was due to large amounts of wood being burned in inefficient fireplaces. This wood-burning efficiency is far short of the estimated average national efficiencies for natural gas and fuel oil furnaces, 61 and 66 percent respectively.

In more conventional units, wood-burning displaced:

65 billion ft³ of natural gas

653 million gallons of fuel oil, and

20 billion kWh of electricity.^{10/}

In addition, wood produced 68×10^{12} Btu of energy where there was no alternate fuel or the alternate was not determined.

^{10/} Conversion factors: natural gas, 1,092 Btu/ft³; electricity, 3,412 Btu/kWh; fuel oil, 140,825 Btu/gal. Source: (Energy Inf. Adm. 1982a) (table A-18).

FIGURE 7.--TOTAL HOUSEHOLDS BY TYPE OF ALTERNATE FUEL AVAILABLE, 1980-81.

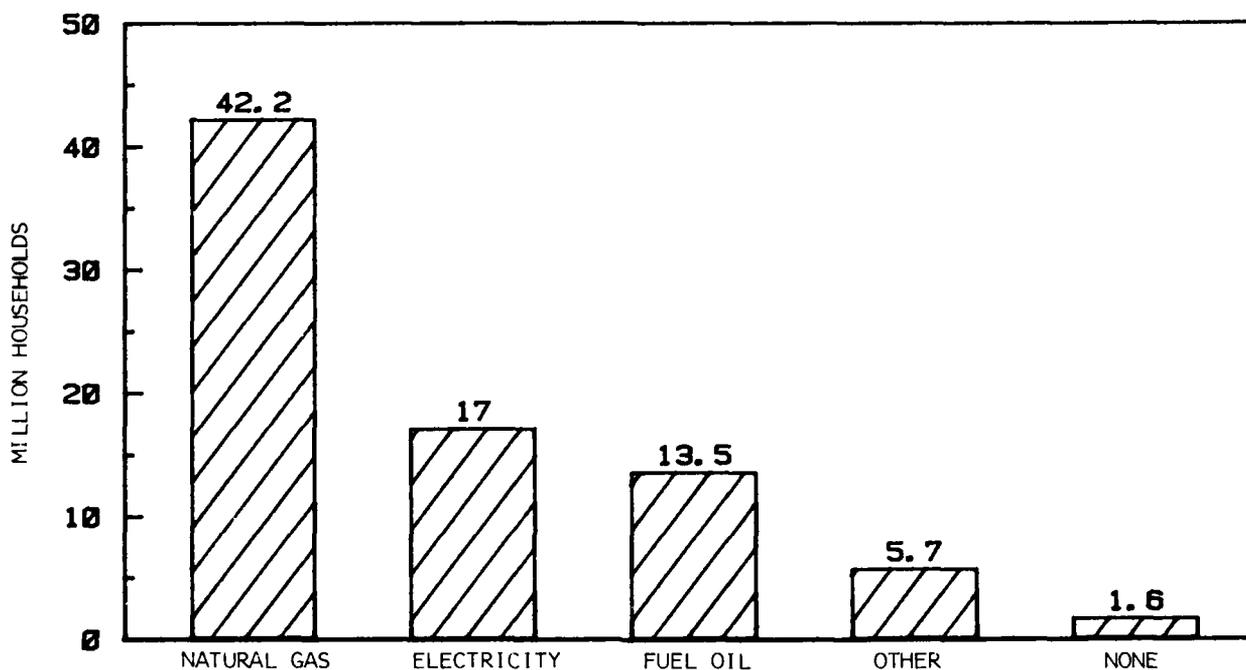


FIGURE 8.--PERCENT OF HOUSEHOLDS BURNING WOOD BY TYPE OF ALTERNATE FUEL AVAILABLE, 1980-81.

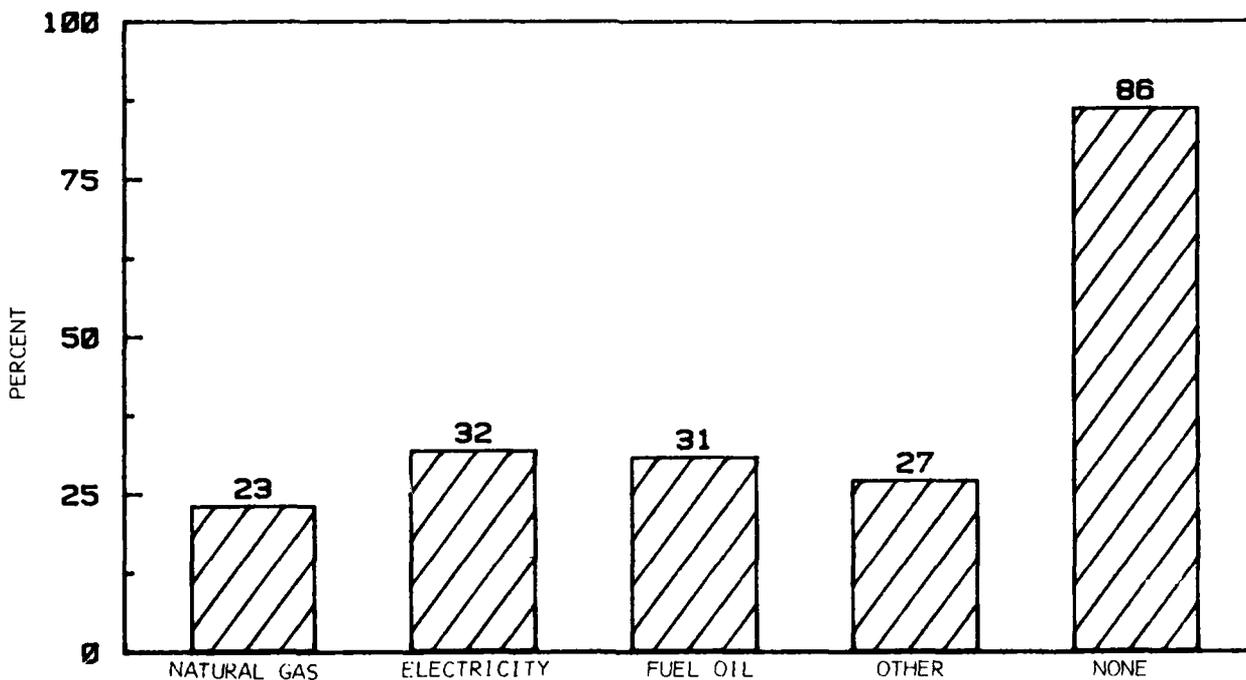


FIGURE 9.--AVERAGE AMOUNT BURNED BY TYPE OF ALTERNATE FUEL AVAILABLE, 1980-81.

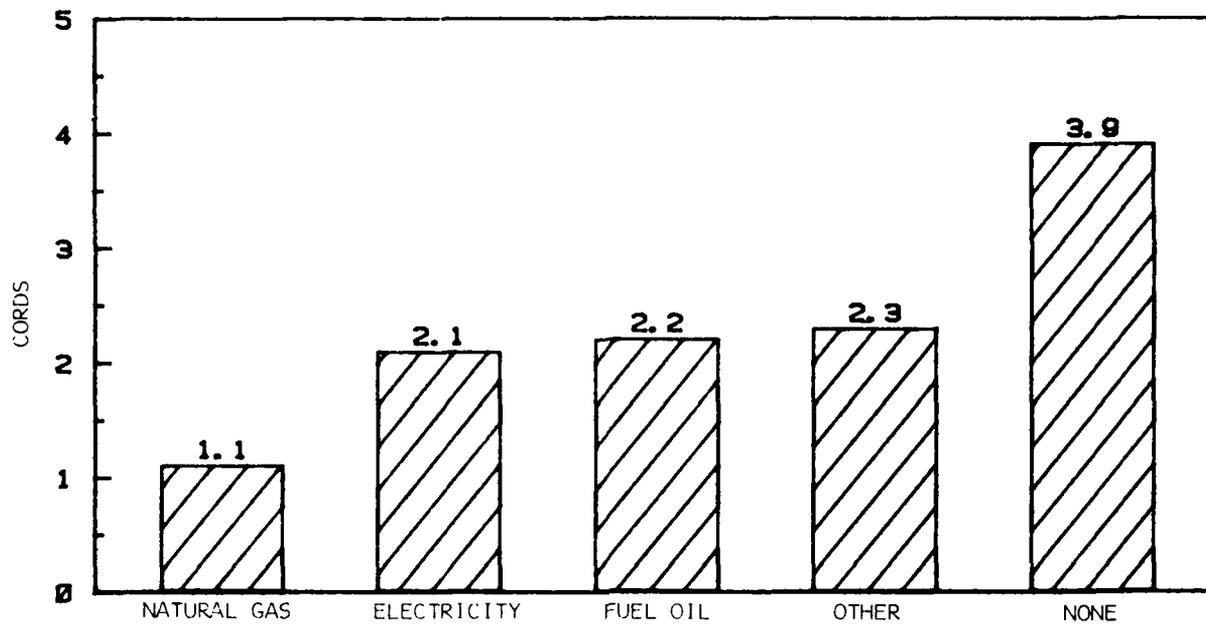
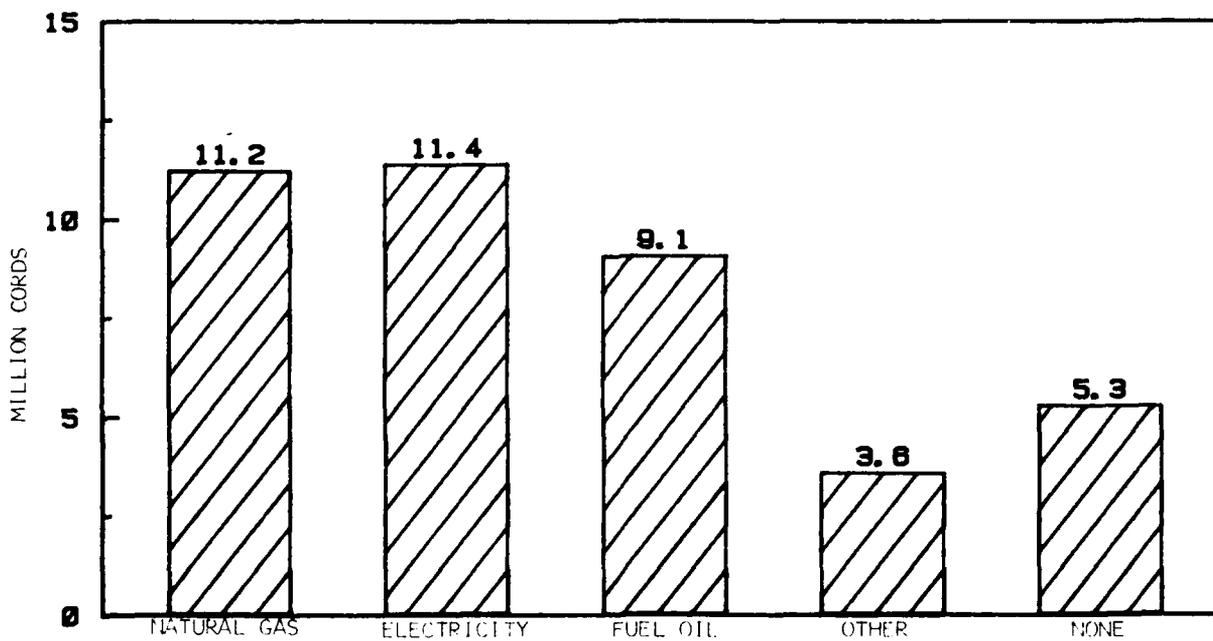


FIGURE 10.--TOTAL AMOUNT BURNED BY TYPE OF ALTERNATE FUEL AVAILABLE, 1980-81.



FUELWOOD ACQUISITION

In addition to estimating the characteristics of fuelwood consumption and fuelwood consumers, our survey sought information about total fuelwood acquired and sources of fuelwood. We sought to learn about amounts, prices, and kinds of purchased fuelwood and about the impact of fuelwood removals on forest resources. We asked questions during our survey to learn:

How much and what types of fuelwood were acquired by households?

How much fuelwood was purchased and what were fuelwood prices?

Which biomass types and land ownerships were used by households when they cut and collected fuelwood?

To answer these questions we asked woodburning households to estimate amounts for two different categories of fuelwood acquired. First, we asked about all fuelwood they had acquired for their own family's use during 1980-81. Second, we asked for the amount of roundwood they cut and collected themselves from the land where it was grown. This self-cut amount could include amounts they intended to sell or give away.

All fuelwood acquired includes wood purchased, self-cut, or received as a gift which was intended for burning by the household in their primary or second home. Information was obtained about three types of fuelwood acquired by households:

- Discarded wood products such as scrap lumber, wood parts of buildings, crates, pallets, or other wood products.
- Mill waste from a wood products mill in the form of slabs and edgings, chips, logs or other wood waste.
- Roundwood; which is logs, branches, stumps, and tops of trees cut and/or split for burning.

Households estimated total amounts of mill waste and roundwood acquired and the portions of these which were purchased. We did not ask about amount of discarded wood acquired. We only

obtained a count of households that acquired discarded wood. We also asked for price and amount purchased for the most recent purchase of mill waste or roundwood (fig. 11).

Households made a separate estimate of self-cut roundwood. We defined this as fuelwood cut or collected by households from land where it was grown. It includes fuelwood to be burned by their household as well as amounts to be sold or given away. This included quantities to be sold or given away so as to learn the source of as much self-cut wood as possible. We excluded self-cut amounts from households cutting more than 30 cords to exclude commercial cutters and avoid the possibility that these were errors in estimates.

We asked survey respondents to subdivide self-cut roundwood into several categories. First, we asked how much came from woodland areas as opposed to nonwoodland areas. Woodland areas were defined to the respondent as any land covered--even lightly--with trees, outside cities or villages and outside the yards of homes. Woodlands also excluded trees on pasture or crop land and trees in wind breaks or fence rows. This definition was an attempt to loosely define "forest land" as the term is used by the U.S. Forest Service. After identifying amounts cut from woodland, a respondent was asked how much of the woodland fuelwood came from:

- Hardwoods or softwoods;
- standing live trees, logging residue, or dead and fallen trees; and
- their own land, other private land, national forest, or other public land.

They were also asked how far they traveled one way to the woodland area where they cut most of their wood (fig. 12).

FIGURE 11.--BREAKDOWN OF SURVEY INFORMATION ABOUT FUELWOOD ACQUIRED FOR BURNING BY HOUSEHOLDS.

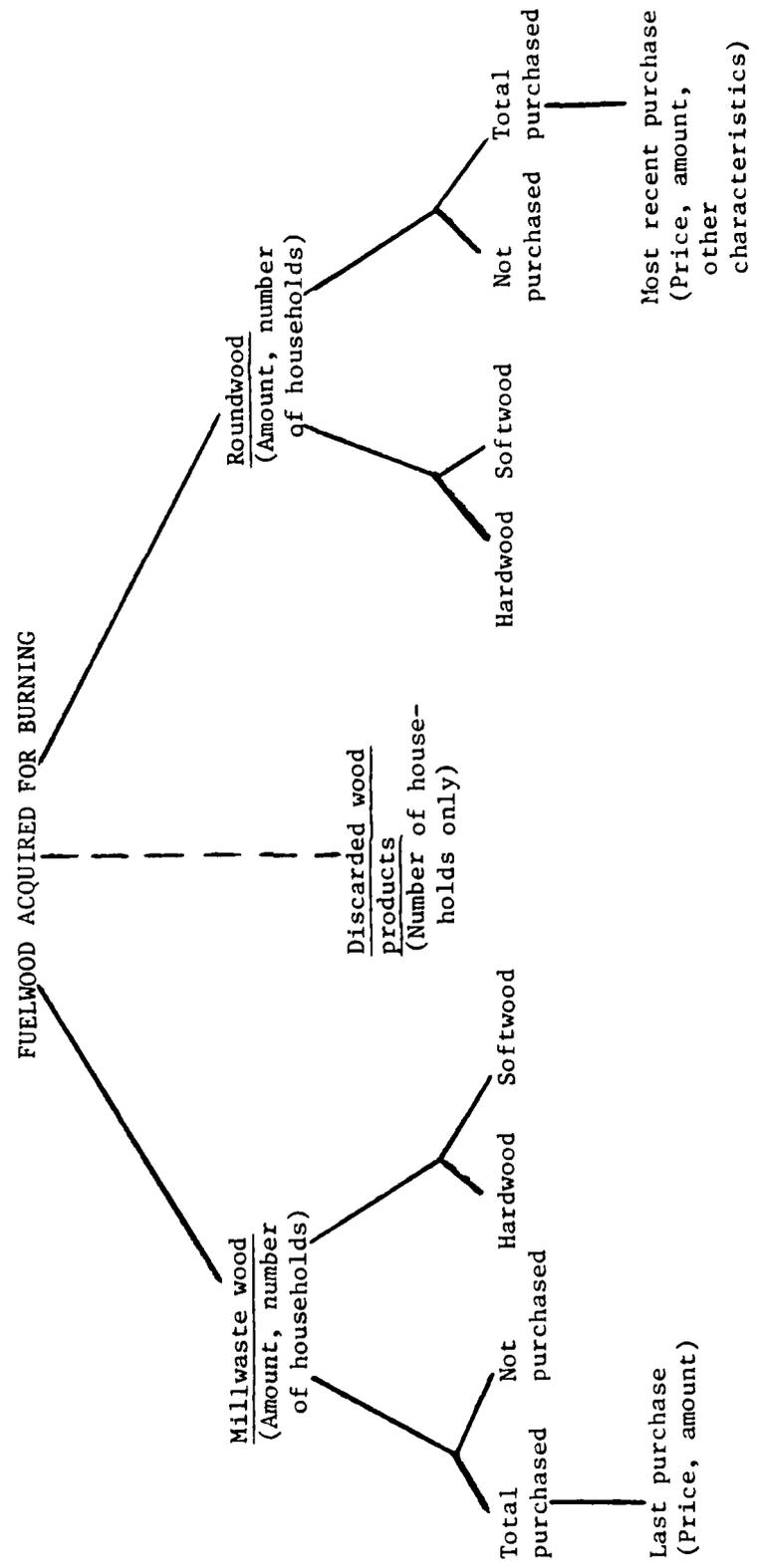
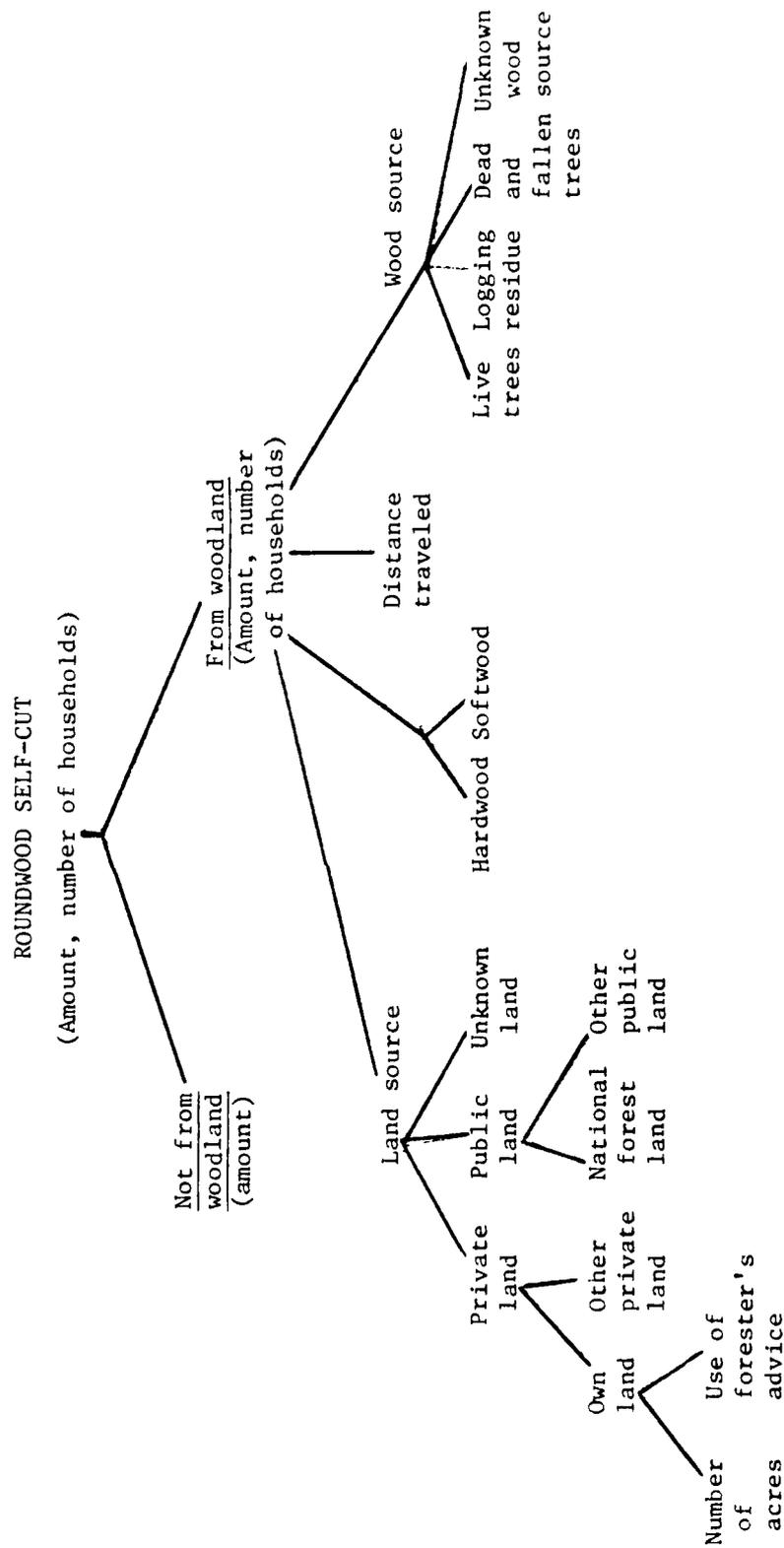


FIGURE 12.--BREAKDOWN OF SURVEY INFORMATION ABOUT ROUNDWOOD SELF-CUT.



The Number of Households Acquiring Wood from Different Wood Sources

Many more households acquired roundwood for fuel than acquired mill waste or discarded wood products. Approximately 22.2 million households burned wood in 1980-81. Of these, 19.7 million acquired some roundwood, 7.3 million acquired some discarded wood products, and 2.3 million acquired some mill waste wood.

Households in the West were more active in acquiring wood than in any other region (fig. 13).

Characteristics of Mill Waste and Roundwood Acquisition

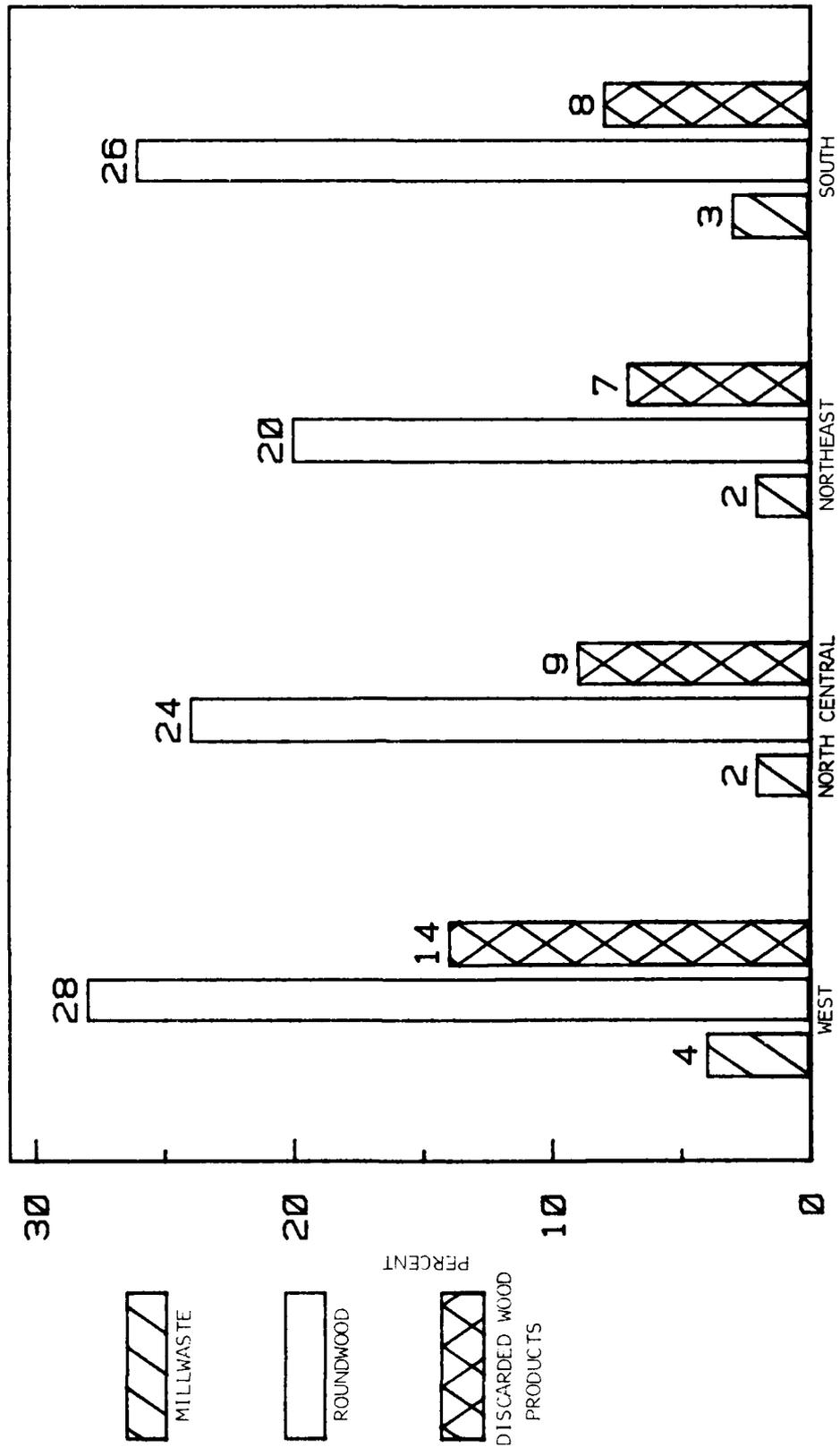
Roundwood accounts for 93 percent of the 44.8 million cords of mill waste and roundwood acquired. Three million cords of mill waste were acquired. Roundwood and mill waste acquisition includes amounts to be used in primary and secondary homes. The acquisition of 44.8 million cords in 1980-81 was slightly greater than the 42 million cords consumed. Mill waste was acquired most in the West where 900,000 cords were acquired, 9 percent of the total acquired (table A-22).

About 80 percent of fuelwood acquired was hardwood, 35.3 million cords. In the East 87 to 93 percent was hardwood. In the West only 40 percent was hardwood. In the West mill waste is largely softwood, 75 percent. In the East mill waste is predominantly hardwood, 78 to 85 percent (table A-23).

Purchases account for 28 percent of fuelwood acquired or 12.4 million cords. About 42 percent of mill waste was purchased, but only 27 percent of roundwood was paid for. Purchasing is heaviest in the Northeast where one-third of all wood is purchased (table A-25).

The average price paid for the most recent purchase of roundwood is almost three times the price paid for mill waste, \$74 versus \$26 per cord. These prices include many small purchases with high

FIGURE 13.--PERCENT OF HOUSEHOLDS OBTAINING MILLWASTE, ROUNDWOOD OR DISCARDED WOOD PRODUCTS BY REGION, 1980-81.



prices per cord and are higher than the average price per cord (see the following section on roundwood prices).

Additional Characteristics of Roundwood Acquisition

Amounts of roundwood acquired by region.--Roundwood acquisition characteristics are quite close to fuelwood consumption characteristics in most regions. Participation in acquisition of roundwood is 2 to 3 percent less than participation in consumption in most regions. Overall, 25 percent of all households acquired an average 2.2 cords each. Twenty-eight percent of all households consumed an average 1.8 cords each (tables A-1, A-22).

The acquisition of hardwood roundwood varies widely between Eastern and Western regions, from 97 percent hardwood in New England to 17 percent hardwood in the Northern Rocky Mountains. Nationwide, 79 percent of roundwood was hardwood or 33.2 of 41.8 million cords (table A-27).

Amounts of roundwood purchased.--Nationwide, 11.1 million cords of roundwood were purchased, 27 percent of all roundwood. These purchases included some cases where buyers cut the wood themselves (5 pct of the most recent purchases were cut by the buyer). The fraction of roundwood purchased is greatest in the Northeast, 34 percent, and lowest in the South, 23 percent (fig. 14, table A-25). Nationwide, 19.7 million households acquired roundwood, 36 percent or 7.0 million purchased some roundwood.

Prices paid for roundwood.--Prices for the most recent purchase of roundwood averaged \$74 per cord for purchase amounts of one-third cord or more. But when most recent purchase prices are weighted by total amounts purchased for the year, the average price is \$56 per cord. Survey respondents who purchased roundwood gave the price and amount of their most recent purchase of roundwood. Their purchase may have been hardwood or softwood, dried or green, 8-foot logs or split 16-inch sticks. A few households purchased wood in a wooded area and cut or gathered it

FIGURE 14.--AMOUNT OF ROUNDWOOD PURCHASED AND NOT PURCHASED, BY MAJOR TIMBER REGION.

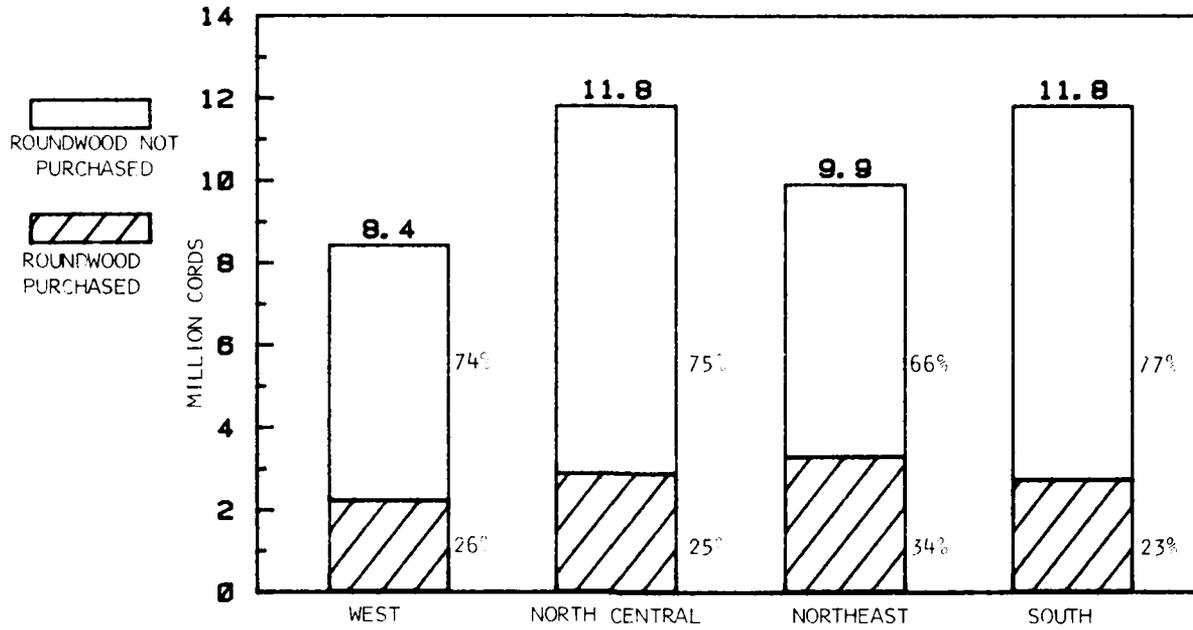
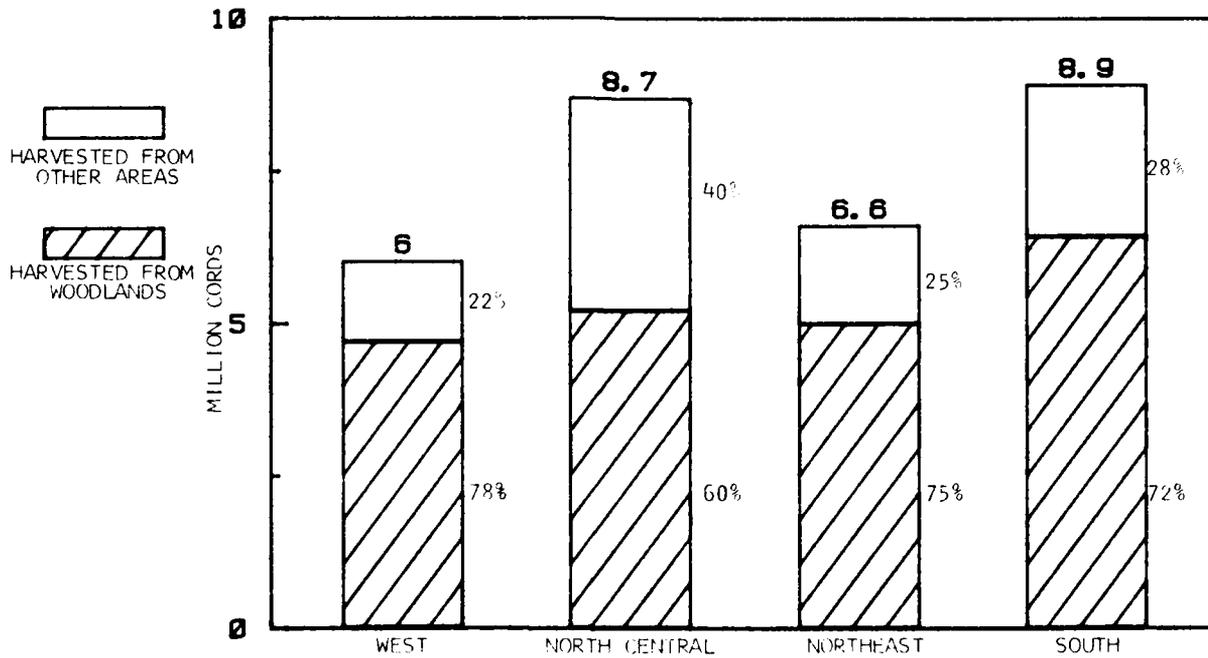


FIGURE 15.--AMOUNT AND PERCENT OF SELF-CUT ROUNDWOOD WHICH IS CUT FROM WOODLAND AND NON-WOODLAND, BY MAJOR TIMBER REGION.



themselves. Purchased amounts ranged from an armload-size bundle to more than 10 cords. The average of all the most recent purchase prices per cord (representing 6.8 million purchases) was \$85 per cord. The average size of the most recent purchase was 1.5 cords. Large purchase amounts cost much less per cord than small purchase amounts.

<u>Amount of most recent purchase</u>	<u>Average price \$/Cord</u>	<u>Percent of most recent purchases</u>
Less than 1/3 cord	193 *	13
0.33 to 0.98 cord	97 *	27
0.99 to 1.12 cords	71 *	32
1.13 cords or more	<u>55</u> *	<u>28</u>
Average/total	85 *	100

* Relative standard error is 10 pct or less.

The very high price for amounts less than one-third cord, \$193 per cord, is likely to have a large error because respondents were not able to give accurate estimates of small amounts they purchased. The average price for all purchases of one-third cord or more (87 pct of all most recent purchases) was \$74 per cord.

When computing the average of \$74 per cord, we placed the same weight on the price per cord for a purchase of 5 cords as for a purchase of 1 cord. To obtain an estimate of the average price paid for a cord of wood rather than the average price for the most recent purchase, we weighted the per cord price of the most recent purchase by the total roundwood purchased by the household during 1980-81. We assume the price of the most recent purchase was representative of all purchases made by the household. Computations were made using prices for purchases of one-third cord or more only. Weighted prices were much lower than unweighted prices:

<u>Timber region</u>	<u>Average weighted price per cord^{1/} \$/Cord</u>	<u>Average price of most recent purchases^{1/} \$/Cord</u>
West	56	94 *
North Central	50	70 *
North East	62	76 *
South	54	65 *
U.S. average	56	74 *

^{1/} Prices for purchases of 1/3 cord or more.

* Relative standard error is 10 pct or less.

The lower weighted average prices indicate many households bought relatively large quantities of wood at low prices per cord. In fact, 24 percent of the most recent purchases were less than \$50 per cord. These purchases averaged 2.5 cords each at \$29 per cord. Also, households paying high prices purchased small quantities. Households paying over \$100 per cord purchased an average 0.7 cord for their most recent purchase. At \$56 per cord the 11.1 million cords of purchased roundwood had a sale value of \$620 million.

Prices vary not only with the amount purchased but also by other characteristics of the purchase and the location of purchase. To discuss these variations we use unweighted prices for the most recent purchases of one-third cord or more. The most notable differences in prices occur between (1) urban and rural areas, (2) dried and green wood, and (3) delivered and nondelivered wood. Our survey results represent 6.0 million "most recent" sales of one-third cord or more.

<u>Characteristic</u>	<u>Percent of most recent purchases^{1/}</u>	<u>Average price for 1/3 cord or more \$/cord</u>	<u>Average amount Cords</u>
Urban households	71	80 *	1.6 *
Rural households	27	57 *	1.9 **
Dried fuelwood	60	82 *	1.5 *
Green fuelwood	28	58 *	2.0 *
Delivered	78	79 *	1.8 *
Not delivered	16	66 **	1.2 **

^{1/} Percent amounts may not total 100 percent because characteristics of some purchases were not determined.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

Most purchases, 71 percent, were by urban households. The low prices for rural households and green fuelwood can be explained in part by their larger average purchase amounts.

Prices also vary depending on whether the fuelwood was obtained from a retail store, independent fuelwood sellers, or from a landowner allowing cutting by a household. Most of the most recent purchases were from independent fuelwood vendors (85 pct). For one-third cord or more, fuelwood vendor prices were the same as in retail stores--\$77 per cord. But retail stores had an additional 300,000 purchases of amounts less than one-third cord with much higher prices. Prices for stumpage were much lower. The average price for purchased self-cut wood was \$23 per cord (table A-29).

Climate is also associated with prices in that colder climates had larger average purchase amounts and lower average prices. In the coldest climate zone, 7,000 heating degree days or more, the average most recent purchase of one-third cord or more is 3.6 cords. The average price was \$57 per cord versus \$74 on average.

Roundwood Self-Cut by Households

How self-cut roundwood differs from roundwood acquired without purchase.--To determine the source characteristics of as much self-cut fuelwood as possible, we asked households a separate question about how much fuelwood they cut themselves, including amounts they intended to sell or give away. Self-cut roundwood also included purchases of wood which were cut or gathered by the household. Some households told us they cut very large amounts. Since we could not determine if they made errors or were households which operated a fuelwood business, we chose to avoid some errors by excluding amounts self-cut over 30 cords. Separate survey questions determined roundwood acquired without purchase which includes only wood intended for a family's own use. The amount of roundwood self-cut turns out to be less than roundwood acquired without purchase. This is probably because of differences in our adjustment for respondent error and exclusion of self-cut amounts over 30 cords.

<u>Timber region</u>	<u>Roundwood not purchased</u>	<u>Roundwood self-cut</u>
	- - - Million cords - - -	
West	6.3 *	6.0 *
North Central	8.9 *	8.7 *
Northeast	6.6 *	6.6 **
South	9.1 *	8.9 **
Total	30.9 *	30.2 *

* Relative standard error is
10 pct or less.

** Relative standard error is
10.1-15 pct.

Self-cut wood from woodland versus nonwoodland areas.--
Nationwide, 30.2 million cords were cut by households during
1980-81. Seventy-one percent of the wood came from woodland areas.
To determine woodland/nonwoodland sources we asked households who

cut fuelwood to identify how much wood came from woodland areas^{11/} as opposed to nonwoodland areas. Nonwoodland trees include any trees inside city or village limits, any trees in the yards of homes, and any trees on pasture land, in fence rows, or windbreaks. Table A-30 shows 71 percent of the 30.2 million self-cut cords came from woodland areas. The percentage from woodland is highest in the West, 78 percent, and lowest in the South, 60 percent. The forest products industry uses very little of the timber from nonwoodland areas in the United States. The 29 percent of self-cut fuelwood removals from nonwoodland does not compete with demand for sawlogs or pulpwood from commercial forest land (fig. 15, table A-30).

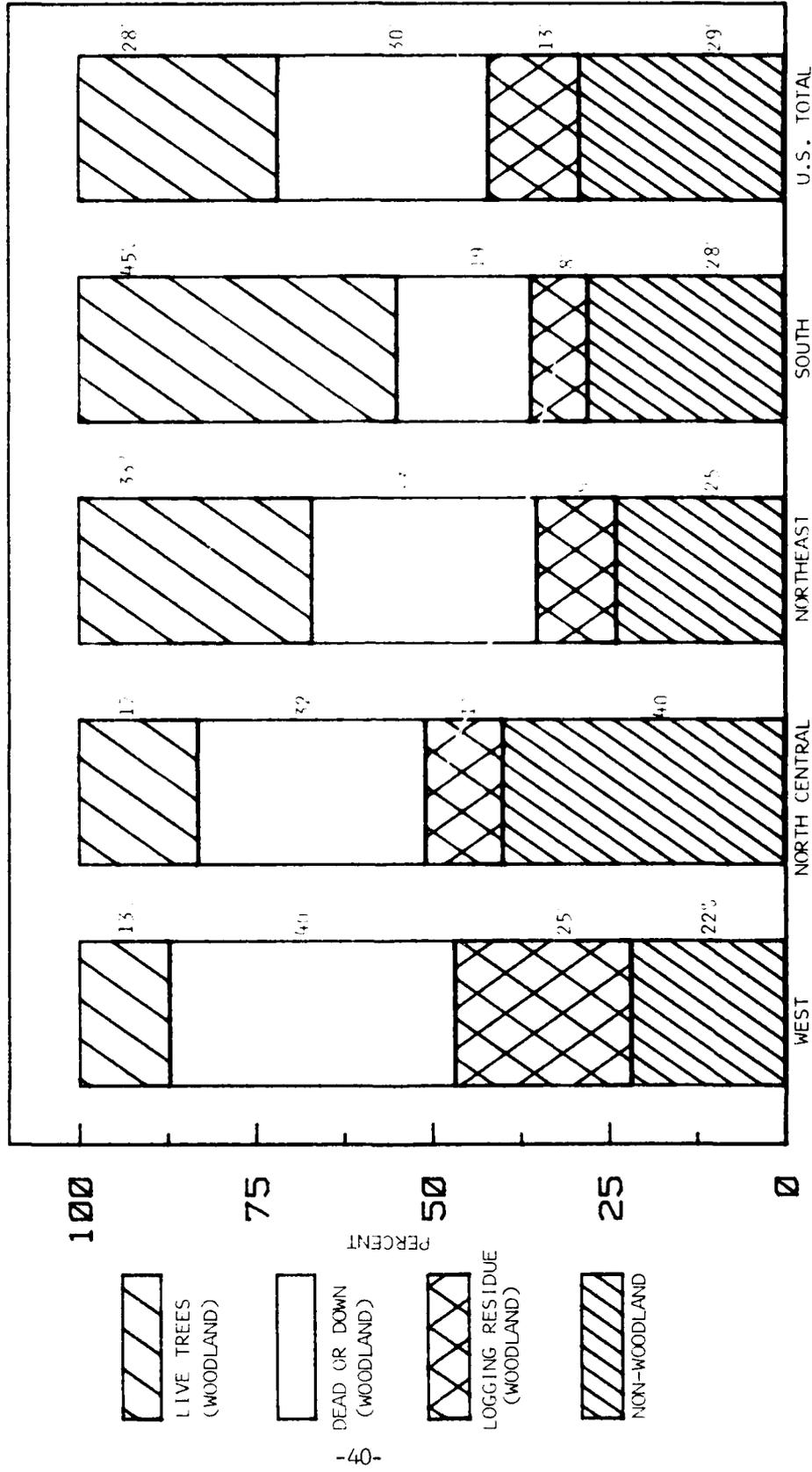
Sources of self-cut wood from woodland: Standing live trees, logging residue, and dead or down trees.--Harvest of fuelwood from woodland could potentially compete with demand for sawlogs and pulpwood if woodland fuelwood is taken from merchantable portions of trees. But only a portion of all self-cut wood comes from standing live trees on woodland. Most firewood was from logging residue, dead or down trees on woodland, or from nonwoodland areas.

Nationwide only 28 percent of all self-cut wood was cut from standing live trees on woodland areas. Amounts from live trees were highest in the Northeast and South, 33 percent and 45 percent respectively. Use of logging residue was 13 percent overall and highest in the West, 25 percent. Use of dead or down trees was 30 percent overall and lowest in the South, 19 percent (fig. 16, table A-30).

Sources of self-cut wood from woodland: Private land versus public land.--Nationwide, 81 percent of woodland fuelwood came from private land. In the South, Northeast, and North Central states, 90 to 96 percent came from private land. In the West only 43 percent came from private ownerships (tables 4, A-32).

^{11/} The definition of woodland given to respondents was intended to be an approximation of the Forest Service definition of forest land.

FIGURE 16. ---PERCENT OF SELF-CUT ROUNDWOOD FROM NON-WOODLAND; AND FROM WOODLAND LIVE TREES, LOGGING RESIDUE, AND DEAD OR DOWN TREES, BY REGION, 1980-81.



Fuelwood is being cut from a substantial number of the private woodland ownerships in the United States. It has been estimated that there were 7.8 million private forest landowners in the United States in 1978 (Birch et al. 1982). Our survey estimates that 3.9 million households cut fuelwood from their own woodland area. This is roughly 50 percent of all private forest

Table 4.--Total amounts of self-cut roundwood from woodland, private land, and public land by major timber region, 1980-81

Major timber region	Total woodland self-cut	Private land		Public land	
		Total	Percent of woodland self-cut	Total	Percent of woodland self-cut
	<u>Million cords</u>	<u>Million cords</u>		<u>Million cords</u>	
West	4.7 **	2.0 **	43	2.7 \$	57
North Central	5.2 **	4.7 **	90	.5 \$\$	10
Northeast	5.0 **	4.8 **	96	.2 \$\$	4
South	6.4 \$	5.8 \$	91	.6 \$\$	9
Total	21.3 *	17.3 *	81	4.0 **	19

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

landowners. In addition, 3.4 million households cut fuelwood exclusively from private land they did not own. Undoubtedly a substantial portion of the 3.4 million households cutting from land they did not own were cutting from land where the owner cut also. So, less than 3.4 million additional ownerships are cut. Combining cutting by owners and nonowners, it is likely that more

than 50 percent of the private woodland ownerships had some fuelwood removed in 1980-81. Total harvest from private woodland by households is 17.3 million cords. This total excludes harvesting by many commercial fuelwood vendors. We asked households who cut fuelwood from their own land if they cut their wood based on advice from a professional forester. Of 3.9 million woodland owners cutting fuelwood, 12 percent or 460,000 used such advice.

Distances traveled to obtain self-cut wood from woodland.-- Distances traveled by households to cut wood indicate the degree to which cutting will be widely disbursed or concentrated around populated areas.

We determined distances traveled only for households who cut from woodland areas. We asked for the one-way distance traveled from their primary home. In many cases households cut from woodlots next to their home and the distance was very short. In some cases they traveled more than 100 miles. Most households traveled a very short distance. The few households traveling long distances made the average distance traveled much higher than the median distance. We computed the average and median distances traveled by households and by cords of wood.

One-way distances traveled to obtain self-cut fuelwood from woodland, 1980-81

Distance up to miles	Accumulated percentage of households	Accumulated percentage of cords
0.5	30	30
6.5	53	50
20.0	79	80
50.0	89	90
100.0	94	95

There is little difference between distances traveled by households and cords. We only discuss distances traveled by households. Median and average distances traveled per cord cut are shown in table A-33.

The vast majority of households, 80 percent, traveled 20 miles or less to woodland areas. Fifty percent traveled 5.5 miles or less. The high average distance traveled, 28 miles, is due to a relatively few households traveling long distances. Six percent of households traveled 100 miles or more.

Households traveled a greater distance to woodland if they lived in densely populated areas. To a small degree, this reduces overcutting near populated areas. Urban households traveled twice as far as rural households on average, 39 miles versus 19 miles. But much cutting is very close to populated areas. One-half of urban households traveled 9 miles or less. In comparison, rural households cut much closer to home. Many have woodlots nearby and one-half traveled 2.5 miles or less. Because of the wide dispersion of rural households, the cords they cut are likely to be widely dispersed over a large land area. But cords cut by urban households mean some heavier cutting near populated areas.

Nationwide, the median distance traveled by all households was small, 5.5 miles. But it is quite large in the West, 19 miles, and very small in other regions, 2.5 to 4.5 miles. Long travel distances in the West are associated with travel to public land which is more abundant in the West than other regions. As a result, distance traveled to public lands nationwide, largely in the West, was a median 19 miles versus 4.5 miles to private land.

COMPARISON OF SURVEY RESULTS TO THE 1980 RESIDENTIAL ENERGY CONSUMPTION SURVEY AND THE 1980 CENSUS OF POPULATION AND HOUSING

Comparison of our results to results of two major studies serves to highlight the differences and similarities in methods used, definitions of quantities estimated, and actual amounts estimated. The 1980 Residential Energy Consumption Survey (RECS) (Energy Inf. Adm. 1982d) conducted by the Energy Information Administration obtained information about households burning wood and amounts burned for calendar year 1980. They used personal

interviews and followup mail questionnaires to survey 6,051 households. The 1980 Census of Population and Housing determined demographic characteristics of households and primary heating fuel used "most" by households by sampling approximately 19 percent of the nation's housing units (Bureau of Census 1982). The time of data collection was different for each survey. The midpoint of our data collection was early September 1981. Income data were requested for calendar 1980. The RECS midpoint of data collection was November 1980. It collected income data for calendar 1979. The 1980 Census survey was conducted on April 1, 1980. They also asked for household income for calendar 1979.

Household Income

Because the Residential Fuelwood Survey was a telephone survey, households without telephones (7 pct of all households) were not represented directly in the survey. There is a possibility that after our adjustment for owner/renter balance the demographic characteristics of households, as determined by our survey, may be somewhat different than those found by the 1980 Census or RECS. Because wood burning is influenced by income, we chose first to compare our estimate of 1980 income distribution to Census and RECS estimates of 1979 income distribution. Because of passage of 1 year and possible slight overrepresentation of higher income household by surveying households with telephones only, we might expect our survey to show a greater proportion of higher income households. Table 5 shows our survey estimated 8 percent more households with income of \$20,000+ than the 1980 Census. Although we cannot be certain, it is possible we have slightly overrepresented higher income households in our sample. Because higher income households burn more wood on average, we may have overestimated wood consumption by a small amount. If we use the 1980 Census distribution of income rather than our distribution, we compute nationwide fuelwood consumption

in primary homes about 3 percent less than our estimate of 40.5 million cords.

Urban or Rural Location

Urban/rural location is another demographic characteristic which is closely associated with wood burning in our survey and the 1980 REC survey. Rural households burn much more on average than urban households. Urban/rural estimates of wood burning from our survey are not comparable to estimates from RECS. RECS used 1970 Census identification of urban and rural places when contacting households in occupied housing units. We asked households if they lived in a place of 2,500 population or more. Our count of urban and rural households is close to 1980 Census counts (table 5). By using 1970 Census identification of rural places, RECS counted many more rural households. As a result, the RECS shows much more rural wood burning than our survey.

Wood as the Main Heating Fuel

A key characteristic of wood burning in the United States, estimated by each of the three surveys, is the number of households using wood as the "main heating fuel"^{12/} or "the fuel used most for house heating."^{13/} The terms used in survey questions are somewhat different among the surveys and may elicit different responses from the same household.

^{12/} Terms used in REC survey and Forest Service Survey.

^{13/} Terms used in 1980 Census Survey.

Table 5.--Comparison of survey estimates of number of U.S. households by income, urban/rural location, and main heating fuel

Item	1980 Census	Nationwide Residential	DOE Residential
	of Population and Housing	Fuelwood Use Survey 1980-1981	Energy Consumption Survey, 1980
Total households	1/ 80.4	2/ 80.0	1/ 81.6
By income	1979 Income	1980 Income	1979 Income
0 to 9,999	23.4	20.9 *	24.3 *
10,000 to 19,999	23.7	22.8 *	25.7 *
20,000+	33.3	36.2 *	31.7 *
By urban/rural location	1970 Census Basis		
Urban	60.6	60.9	56.0
Rural	19.8	16.7	25.6
Not determined	—	2.4 *	—
Heating fuel			
Natural gas	42.9	41.3 *	44.6 *
Electricity	14.8	14.9 *	14.3 *
Fuel oil, kerosene	14.6	12.4 *	13.4 *
Wood	2.6	6.5	4.7 **
Other	5.1	3.3 *	4.7 **
None	.5	.2 \$\$	—
Not determined	—	1.4 **	—

1/ Includes Alaska and Hawaii.

2/ Excludes Alaska and Hawaii.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$\$ Relative standard error is 25.1-50 pct.

— Relative standard error is greater than 50 pct.

<u>Survey</u>	<u>Question</u>	<u>Date of survey</u>	Number of households answering "wood" Millions
1980 Census	Which fuel is used most for house heating (list shown to respondent)	April 1980	2.6
RECS	What is the main fuel used for heating this house (apartment) (list shown to respondent)	November 1981	4.7
Residential fuelwood use	What one fuel was used to provide most of the space heat in your present home during the last 12 months	September 1981	6.5

The number of households answering "wood" to the questions shown above varied considerably among the surveys, from 2.6 million households for the 1980 Census survey in April 1980 to 6.5 million for the Residential Fuelwood Use survey in September 1981. To clarify the possible reasons for these differences, we first discuss the difference between our survey and RECS.

Although our survey shows more households using wood as the main fuel, the two surveys do agree on the total number of wood burners in the United States--about 22 million. This includes households burning one-third cord or more and households burning less than one-third cord (table 6). In addition, the two surveys agree on the total number of households burning wood as a primary (main) or secondary fuel; 17 to 18 million (table 6). Our survey is different from RECS in that it shows more households using wood as a primary fuel, 6.5 million versus 4.7 million for RECS. Our higher estimate could have resulted because our questionnaire made fuelwood use seem important and encouraged wood burners to specify wood as the main fuel. It is also possible that some "secondary" wood fuel users moved to the "primary" wood user category between the RECS and our survey.

Table 6.--Comparison of survey estimates of consumption for households burning any amount of fuelwood

Item	Nationwide Residential Fuelwood Use Survey 1980-81			Residential Energy Consumption Survey 1980		
	Number of households	Fuelwood amount	Average amount	Number of households	Fuelwood amount	Average amount
	Millions	Million cords	Cords	Millions	Million cords	Cords
Number of households represented	80.0			81.6		
Burning purpose						
Primary heating fuel	6.5 *	21.7 *	3.3 *	4.7 **	—	—
Secondary heating	10.9 *	15.5 *	1.4 *	13.4 *	—	—
Subtotal	17.4 *	37.2 *	2.1 *	18.1		
Esthetic use	4.6 *	3.4 **	.7 *	—	—	—
Total	22.2 *	40.5 *	1.8 *	—		
Amount burned						
1/3 cord or more	17.8 *	39.8 *	2.2 *	14.2 *	41.9 \$	2.9 **
Less than 1/3 cord	4.4 *	.7 *	.2 *	7.3	—	—
Total/Average	22.2 *	40.5 *	1.8 *	21.5 *		
Cords burned						
Less than 1/3	4.4 *	.7 *	.2 *	7.3	^{1/} (1.2)	(.2)
1/3 to 1.49	7.4 *	6.3 *	.9 *	6.2 *	4.2 *	.7 *
1.5 to 2.49	4.3 **	8.7 **	2.0 *	2.6 *	4.9 *	1.9 *
2.5 to 3.49	2.9 *	8.1 *	2.9 *	1.8 *	5.3 *	3.0 *
3.5 to 4.49	1.7 *	6.6 **	4.0 *	1.0 \$	4.0 \$	3.9 *
4.5+	1.6 \$	10.0 \$	6.3 *	2.6 \$	23.4 \$\$	8.8 **
Total	22.2 *	40.5 *	1.8 *	21.5 *	(43.1)	(2.0)

^{1/} Values in parentheses are estimates based on an assumed 0.16 cord per household for households burning less than 1/3 cord.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

— Relative standard error is greater than 50 pct.

The 1980 Census estimated 2.6 million households used wood "most" for house heating. The fact that RECS and our survey agree on the total number of burners and the total primary-plus-secondary burners but found different numbers of households using wood as the primary fuel, leads to the possibility that the format of the 1980 Census question accounts for the lower estimate of wood burners. Another possibility is that the RECS or our survey represent a somewhat different distribution of households. In the case of our survey, we may overrepresent higher income households slightly. But overrepresentation of high-income households is not likely with the RECS. The differences among the income distributions and the three surveys are not sufficient alone to account for the wide difference in number of primary wood burners (table 5).

Amount of Fuelwood Burned

Our survey and RECS each estimated number of households and amounts burned by households burning one-third cord or more in their primary residence. They also estimated the number of households burning an amount less than one-third cord. The surveys used considerably different methods to determine amounts burned. Each survey determined about 22 million households burned wood during a 12-month period (table 6). But the RECS found 14.2 million households burned one-third cord or more. Our survey, covering a 12-month period about 10 months later, found 17.8 million households burned this much. A detailed breakdown of the number of households burning different amounts is shown in table 6. The earlier RECS shows many more households burning less than one-third cord, 7.3 million households versus 4.4 million for our survey. Conversely, our survey shows more households burning one-third to 4.5 cords. The extra number of households burning one-third cord or more shown by our survey is primarily households with incomes of \$20,000 or more. Our survey shows 32 percent of these higher income households burn one-third cord or more, versus

25 percent for the RECS. The differences between the surveys suggest an increase between surveys in the number of higher income households burning wood. The RECS shows 2.3 million households installed wood stoves in 1980, mostly by higher income households. This trend probably continued in 1981. The fact that the surveys have a similar estimate for total number of households burning wood suggests that both sample designs represent all households well, but the survey questions had difficulty in determining income and/or amounts burned accurately. It is not possible to resolve these questions with the information available.

Survey estimates of total amount burned by households burning one-third cord or more may also be compared by burning purpose, region, and income group. These comparisons are shown in table 7. Drawing conclusions about agreement or disagreement in estimates is difficult because of the problems cited above.

The RECS shows fewer households use wood as a primary heating fuel than our survey, 4.5 million households versus 6.5 million from our survey. But the surveys each show that primary wood burners use about 22 million cords. Our survey obviously included many households burning smaller amounts of wood in the primary wood-burner category. In addition, RECS found more primary wood burners burning larger amounts than our survey.

Regional estimates of amounts burned are similar between surveys, but comparison is difficult because standard errors are large for RECS estimates.

Breakdown of wood burning by income group shows each survey estimates about 6 million wood burners with income under \$20,000. But our survey shows substantially more wood burners with income over \$20,000, 11.7 million versus 7.8 million households. As a result, our survey shows more wood is burned by households with incomes over \$20,000 than does the RECS. Once again changes over time and differences in questions used by the surveys could have influenced results.

Table 7.--Comparison of survey estimates of consumption
for households burning one-third cord or more

Item	Nationwide Residential Fuelwood Use Survey 1980-81			Residential Energy Consumption Survey 1980		
	Number of households	Fuelwood amount	Average amount	Number of households	Fuelwood amount	Average amount
	<u>Millions</u>	<u>Million cords</u>	<u>Cords</u>	<u>Millions</u>	<u>Million cords</u>	<u>Cords</u>
Burning purpose						
Primary heating fuel	6.4 *	21.7 *	3.4 *	4.5 **	22.1 \$\$	4.9 \$\$
Secondary heating	8.9 *	15.1 *	1.7 *	} 9.7 *	} 19.8 **	} 2.0 **
Other	2.5 *	3.0 **	1.2 *			
Total	17.8 *	39.8 *	2.2 *	14.2 *	41.9 \$	2.9 **
Census regions						
Northeast	3.3 *	8.0 *	2.4 *	3.2 \$	12.9 —	4.0 \$\$
North Central	4.6 *	11.0 *	2.4 *	3.5 **	12.3 \$\$	3.5 \$
South	6.8 *	14.3 *	2.1 *	4.8 *	11.7 **	2.4 *
West	3.3 *	6.8 *	2.1 *	2.7 *	5.0 \$	1.8 **
Total	17.8 *	39.8 *	2.2 *	14.2 *	41.9 \$	2.9 **
Income group						
	--1980 Income--			--1979 Income--		
0 to 9,999	2.1 *	5.8 **	2.9 *	2.6 **	10.1 \$	3.9 \$
10,000 to 19,999	3.8 *	10.1 *	2.5 *	3.8 **	13.5 \$\$	3.6 \$
20,000+	11.7 *	23.9 *	2.0 *	7.8 *	18.2 \$	2.3 \$
Total	17.8 *	39.8 *	2.2 *	14.2 *	41.9 \$	2.9 **

* Relative standard error is 10 pct or less.
 ** Relative standard error is 10.1-15 pct.
 \$ Relative standard error is 15.1-25 pct.
 \$\$ Relative standard error is 25.1-50 pct.

REFERENCES

- Birch, Thomas W.; Lewis, Douglas G.; Kaiser, H. Fred. The private forest land owners of the United States. Res. Bull. WO-1, Washington, DC: USDA, Forest Service; 1982. 29 p.
- Bureau of Census. General housing characteristics. United States Summary. HC80-1-A1. Washington, DC: U.S. Department of Commerce; 1983.
- Efron, Bradley. The jackknife, the bootstrap and other resampling plans. Philadelphia, PA: Society for Industrial and Applied Mathematics; 1982.
- Energy Information Administration. Energy conversion factors inside back cover of the Monthly Energy Review Feb. 1982. Washington, DC: U.S. Department of Energy; 1982a.
- Energy Information Administration. Estimates of U.S. wood energy consumption from 1949 to 1981. DOE/EIA-0341. Washington, DC: U.S. Department of Energy; 1982b.
- Energy Information Administration. Residential energy consumption survey: consumption and expenditures, April 1980-March 1981. DOE/EIA-0321/1. Washington, DC: U.S. Department of Energy; 1982c.
- Energy Information Administration. Residential energy consumption survey: housing characteristics 1980. DOE/EIA-0314. Washington, DC: U.S. Department of Energy; 1982d.
- Graves, Henry S. The use of wood for fuel. Bull, No. 753. Washington, DC: U.S. Department of Agriculture; 1919.
- Kish, Leslie. Survey sampling. New York: John Wiley and Sons; 1965.
- Los Alamos National Laboratory. 1980 residential fuel price data base for solar heating market analysis. Unpublished data obtained from Fred Roach. Los Alamos, NM; 1982.
- Norwood, Charles H.; Warnick, Walter L. Consumption of wood fuels in the United States, 1971-1980. In: Progress in biomass conversion. Vol. 3. Edited by K. V. Sarkanen et al. New York: Academic Press; 1982.
- Oak Ridge National Laboratory. Engineering and cost analysis of residential heating systems. ORNL/Con-25; July 1978.
- Reynolds, R. V.; Pierson, Albert H. Fuelwood used in the United States, 1630-1930. Circular No. 641. Washington, DC: U.S. Department of Agriculture; 1942.
- U.S. Department of Agriculture, Forest Service. U.S. Timber production, trade, consumption, and price statistics, 1950-1980. Misc. publ. No. 1408. Washington, DC: U.S. Department of Agriculture, Forest Service; 1981.

GLOSSARY

Alternate heating fuel	The primary or secondary fuel used to heat a home as the alternative when wood is not used.
Discarded wood products	Wood products that are thrown out such as scrap lumber, pallets, crates, or wooden parts of buildings.
Fuelwood acquired	Mill waste and/or roundwood obtained by a household for burning in their primary or second home. It includes fuelwood that was purchased, self-cut or obtained as a gift.
Heating degree days	The number of heating degree days in one day is the number of degrees the day's average temperature was below 65° F. In this report we use the average number of heating degree days per year for a household's county of residence as averaged over a 45-year period by the National Oceanic and Atmospheric Administration (fig. B-2).
Household	All persons who occupy a housing unit.
Income	The combined income, before taxes are taken out, for all members of a household.
Mill waste	Wood residue from a wood products mill, such as slabs and edges, sawdust, wood chips, or planer shavings.
Nonresponse bias	A form of error in an estimate which is created when sample households who were interviewed have different characteristics than sample households that could not be interviewed and interviewed households are taken to represent all households in the population.

Participation in wood burning	The percent of households in a category that burned wood during the period September 1980 to September 1981.
Primary heating fuel	The fuel that provided most of the space heat in the home during the previous 12 months.
Primary home	A household's usual or permanent place of residence.
Relative standard error of estimate (also known as coefficient of variation)	A percentage of an estimate used to indicate a likely magnitude of error in the estimate. For example, a ± 10 percent relative standard error means if the survey were repeated with the same sampling pattern over and over, 67 percent of the repeated estimates would be within ± 10 percent of the true amount.
Respondent	An adult member of a household who answered questions for our survey.
Roundwood	Logs, bolts, or other round sections cut from trunks or branches of trees.
Roundwood self-cut	Roundwood cut or collected by households for firewood from land where it was grown. This includes roundwood to be sold, given away, or burned by the household itself. It was intended to represent residential fuelwood harvesting. Amounts of roundwood of 30 cords or more cut by a single household are excluded.
Rural location	The primary home of a household was not located in a city or village with a population of 2,500 persons or more.

Second home	A housing unit (apartment or house) owned by a household and used only occasionally for short periods, e.g. a vacation home.
Standard cord	128 cubic feet of stacked wood, bark, and air space.
Urban location	The primary home of a household was located in a city or village with a population of 2,500 persons or more.
Woodland area	Any land covered with trees, even lightly covered, that is outside city or village limits but excluding yards of homes, isolated trees on pasture or cropland, wind breaks, and fence rows. This definition is intended to be a rough approximation of the Forest Service definition of forest land.

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Table A-1.--Fuelwood consumption characteristics by timber region, 1980-81^{1/}

Timber region	Total number of households in region	Characteristic					
		Percent of households burning		Fuelwood consumption		Average amount burned	
		Any amount	1/3 cord or more	Households burning any amount	Households burning 1/3 cord or more	Households burning any amount	Households burning 1/3 cord or more
	Millions			- - Million cords - -		- - - - Cords - - - -	
Northwest	2.5	55 *	47 *	3.2 *	3.2 **	2.3 *	2.7 *
North Rocky Mountains	.8	42 *	34 **	.8 **	.8 **	2.5 *	3.0 *
South Rocky Mountains	11.8	29 *	16 **	3.1 **	2.8 **	.9 **	1.5 *
West	15.1	34 *	22 *	7.1 *	6.8 *	1.4 *	2.1 *
Lake States	6.8	28 *	24 *	4.4 **	4.4 **	2.3 *	2.7 *
Central States	15.4	25 *	21 *	7.6 **	7.5 **	2.0 **	2.3 **
North Central	22.1	26 *	22 *	12.0 *	11.8 *	2.1 *	2.4 *
Mid-Atlantic	15.7	21 *	17 **	5.9 **	5.9 **	1.8 *	2.2 *
New England	4.4	34 *	28 *	3.4 **	3.4 **	2.3 *	2.8 *
Northeast	20.1	24 *	20 *	9.4 *	9.2 *	2.0 *	2.4 *
Southeast	10.5	31 *	27 **	6.1 **	6.0 **	1.9 *	2.1 *
South Central	12.1	27 *	24 *	6.0 **	5.9 **	1.9 *	2.1 *
South	22.6	29 *	25 *	12.1 *	11.9 *	1.9 *	2.1 *
Total U.S.	80.0	28 *	22 *	40.5 *	39.8 *	1.8 *	2.2 *

^{1/} Columns may not add to totals due to rounding.
 * Relative standard error is 10 pct or less.
 ** Relative standard error is 10.1-15 pct.

Table A-2.--Fuelwood consumption characteristics by Census region, 1980-81^{1/}

Census region	Characteristic							
	Total number of households in region	Percent of households burning		Fuelwood consumption		Average amount burned		
		Millions	Any amount	1/3 cord or more	Households burning any amount	Households burning 1/3 cord or more	Households burning any amount	Households burning 1/3 cord or more
				- - Million cords	- -	- -	- - Cords	
New England	4.4	34 *	28 *	3.4 **	3.4 **	2.3 *	2.8 *	
Mid-Atlantic	<u>13.1</u>	20 *	16 *	4.7 **	4.6 **	1.8 **	2.2 **	
Northeast	17.5	23 *	19 *	8.1 *	8.0 *	2.0 *	2.4 *	
East North Central	14.7	26 *	22 *	7.6 **	7.5 **	2.0 **	2.4 **	
West North Central	<u>6.2</u>	28 **	22 **	3.5 \$	3.5 \$	2.1 **	2.6 **	
North Central	20.8	26 *	22 *	11.1 *	11.0 **	2.0 *	2.4 *	
South Atlantic	13.2	30 *	26 *	7.2 *	7.5 **	1.9 *	2.1 *	
East South Central	5.1	31 **	29 \$	3.7 \$	3.8 \$	2.4 **	2.5 **	
West South Central	<u>8.3</u>	24 \$	20 **	3.1 \$	3.0 \$	1.6 **	1.8 **	
South	26.6	28 *	25 *	14.0 *	14.3 *	1.9 *	2.1 *	
Mountain Pacific	4.0	34 *	25 **	2.2 **	1.9 **	1.6 *	2.2 *	
	<u>11.2</u>	34 *	21 **	4.9 *	4.9 **	1.3 *	2.0 *	
West	15.1	34 *	22 *	7.1 *	6.8 *	1.4 *	2.1 *	
Total U.S.	80.0	28 *	22 *	40.5 *	39.8 *	1.8 *	2.2 *	

1/ Columns may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

Table A-3.--Fuelwood consumption characteristics by state, 1980-81.

State	Households burning any amount				Households burning 1/3 cord or more				Average burned over all households
	Number of households	Percent burning	Average burned	Total burned	Percent burning	Average burned	Total burned	Total burned	
Alabama	1.324	28 \$	2.01 \$\$	0.76 \$\$	27 \$\$	2.11 \$	0.75 \$\$	0.56 \$\$	
Arizona	.963	24 \$\$	.98 \$\$	—	11 \$\$	1.97 \$\$	—	—
Arkansas	.821	42 \$\$	2.46 \$\$	.85 \$\$	42 \$\$	2.46 \$\$	.85 \$\$	1.03 \$\$
California	8.633	28 \$\$	.76 \$	1.84 \$	14 \$	1.39 \$	1.63 \$	.21 \$
Colorado	1.059	35 \$	1.05 \$\$	.39 \$\$	24 \$\$	1.44 \$\$	.37 \$\$	.37 \$\$
Connecticut	1.094	30 \$	1.34 \$	.44 \$	22 \$	1.78 \$	.42 \$	.40 \$
Delaware	.207	29 \$\$	—	—	—	1.45 \$\$	—	—	
Washington, DC	.253	—	—	—	—	—	—	—	
Florida	3.743	11 \$	1.48 \$	.62 \$	10 \$	1.58 \$\$	.61 \$\$	.17 \$
Georgia	1.872	28 \$	1.40 \$	.73 \$	21 \$	1.78 \$	.71 \$\$	.39 \$
Idaho	.323	40 \$	2.62 \$	.39 \$	38 \$	3.15 \$	.39 \$	1.21 \$
Illinois	4.051	22 \$	1.79 \$	1.58 \$	16 \$	2.38 \$\$	1.56 \$\$	.39 \$
Indiana	1.936	23 \$\$	1.90 \$\$	.86 \$\$	21 \$	2.08 \$\$	.85 \$\$	.44 \$\$
Iowa	1.056	21 \$\$	1.93 \$\$	—	17 \$\$	2.26 \$\$	.41 \$\$	—
Kansas	.870	21 \$\$	1.89 \$\$	—	18 \$\$	2.15 \$\$	—	—	
Kentucky	1.264	26 \$\$	2.50 \$\$	—	23 \$\$	2.82 \$\$	.81 \$\$	—
Louisiana	1.421	13 \$\$	1.82 \$\$	—	9 \$\$	2.63 \$\$	—	—	
Maine	.397	54 \$	3.92 \$	.84 \$	49 \$	4.34 \$	.84 \$	2.13 \$
Maryland	1.466	21 \$	1.56 \$	.49 \$\$	20 \$	1.68 \$	.48 \$\$	.33 \$\$
Massachusetts	2.027	29 \$	1.81 \$	1.07 \$	23 \$	2.25 \$	1.05 \$	.52 \$
Michigan	3.193	25 \$	2.21 \$	1.79 \$	23 \$	2.42 \$	1.76 \$	.56 \$
Minnesota	1.442	35 \$	1.92 \$	.96 \$	23 \$	2.79 \$	.93 \$	.67 \$
Mississippi	.830	27 \$\$	—	—	25 \$\$	—	—	—	
Missouri	1.792	36 \$	1.92 \$\$	1.23 \$\$	27 \$	2.52 \$\$	1.21 \$\$	.69 \$\$
Montana	.286	38 \$	2.44 \$	.26 \$	31 \$	2.94 \$	.26 \$	.91 \$
Nebraska	.572	14 \$\$	—	—	—	—	—	—	
Nevada	.305	—	2.24 \$\$	—	—	2.24 \$\$	—	—	

Table A-3.--Fuelwood consumption characteristics by state, 1980-81.

State	Households burning any amount				Households burning 1/3 cord or more			Average burned over all households
	Number of households	Percent burning	Average burned	Total burned	Percent burning	Average burned	Total burned	
	Millions		Cords	Million cords		Cords	Million cords	Cords
New Hampshire	0.324	47 \$	3.00 \$	0.46 \$	44 \$	3.19 \$	0.46 \$	1.42 \$
New Jersey	2.551	18 \$	.89 \$	.41 \$	15 \$	1.01 \$	.40 \$	.16 \$
New Mexico	.444	43 \$	1.18 \$	.23 \$	33 \$	1.46 \$	—	.51 \$
New York	6.332	18 \$	1.86 \$	2.12 \$	14 \$	2.30 \$	2.06 \$	.33 \$
North Carolina	2.047	46 \$	2.05 \$	1.92 \$	40 \$	2.31 \$	1.90 \$	.94 \$
North Dakota	.229	36 \$	1.70 \$	.14 \$	36 \$	1.70 \$	.14 \$	.61 \$
Ohio	3.837	30 \$	1.84 \$	2.09 \$	26 \$	2.07 \$	2.07 \$	.54 \$
Oklahoma	1.114	22 \$	—	.57 \$	19 \$	2.67 \$	.57 \$	.51 \$
Oregon	.993	58 \$	2.68 \$	1.55 \$	54 \$	2.87 \$	1.54 \$	1.56 \$
Pennsylvania	4.213	23 \$	2.25 \$	2.20 \$	19 \$	2.69 \$	2.17 \$	.52 \$
Rhode Island	.339	25 \$	—	—	21 \$	—	—	—
South Carolina	1.031	36 \$	1.63 \$	.61 \$	30 \$	1.94 \$	.60 \$	.59 \$
South Dakota	.244	27 \$	3.32 \$	.22 \$	23 \$	3.93 \$	—	.90 \$
Tennessee	1.615	38 \$	2.40 \$	1.47 \$	36 \$	2.50 \$	1.46 \$	.91 \$
Texas	4.945	25 \$	1.08 \$	1.32 \$	20 \$	1.27 \$	1.28 \$	.27 \$
Utah	.448	32 \$	2.03 \$	—	24 \$	2.65 \$	—	—
Vermont	.178	58 \$	3.95 \$	.41 \$	52 \$	4.38 \$	.40 \$	2.28 \$
Virginia	1.857	46 \$	2.06 \$	1.76 \$	42 \$	2.25 \$	1.74 \$	.94 \$
Washington	1.540	53 \$	2.04 \$	1.67 \$	43 \$	2.51 \$	1.65 \$	1.09 \$
West Virginia	.687	35 \$	2.67 \$	.64 \$	33 \$	2.82 \$	.64 \$	.94 \$
Wisconsin	1.653	28 \$	2.72 \$	1.28 \$	25 \$	3.04 \$	1.27 \$	.77 \$
Wyoming	.166	40 \$	2.19 \$	.14 \$	31 \$	2.72 \$	.14 \$	.87 \$

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

— Relative standard error is greater than 50 pct.

Table A-4.--Characteristics of fuelwood consumption in second homes by timber region, 1980-81^{1/}

Item	Timber region				Total
	West	North Central	Northeast	South	
Households with second homes (millions)	0.7 **	1.2 **	1.1 **	0.7 **	3.7 *
Households burning in second homes (millions)	.3 \$	.4 \$	.3 \$	.1 \$\$	1.1 **
Average amount burned (cords)	1.6 \$\$	1.3 \$\$	1.6 \$\$	1.3 \$\$	1.4 **
Total amount burned (million cords)	.5 \$\$	.5 \$\$	.5 \$\$	.2 --	1.5 \$

1/ Figures may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

-- Relative standard error is greater than 50 pct.

Table A-5.--Percent of households burning one-third cord or more by equipment used most and by income group, 1980-81^{1/}

1980 Household income	Equipment used most			Total percent burning	Total households Million
	Fireplace	Fireplace insert	Stove or furnace		
	----- Pct burning -----				
\$0-\$10,000	2	2	6	10 **	20.9
10,001- 20,000	5	4	8	18 *	22.8
20,001- 30,000	11	6	9	26 *	17.0
30,001- 40,000	15	9	10	34 *	9.3
40,001 plus	19	11	10	40 *	9.9
Total	9 *	5 *	8 *	22 *	80.0

^{1/} Columns do not add to total due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

Table A-6.--Total and average amounts burned by households burning one-third cord or more by equipment used most and by income group, 1980-81^{1/}

1980 Household income	Equipment used most						All equipment	
	Fireplace		Fireplace insert		Stove or furnace		Total	Aver- age
	Total	Aver- age	Total	Aver- age	Total	Aver- age		
	Million cords	Cords	Million cords	Cords	Million cords	Cords	Million cords	Cords
\$0-\$10,000	0.6 *	1.4 **	1.0 \$\$	3.0 \$	4.3 **	3.3 *	5.8 **	2.9 **
10,001- 20,000	2.0 *	1.6 **	2.3 \$	2.3 *	5.8 **	3.1 *	10.1 *	2.5 *
20,001- 30,000	2.2 **	1.2 *	2.1 \$	2.0 **	5.5 **	3.4 *	9.7 *	2.2 *
30,001- 40,000	1.7 **	1.3 *	1.7 \$	2.0 *	3.0 **	3.2 *	6.5 *	2.0 *
40,001 plus	2.6 **	1.4 *	2.2 \$	1.9 *	2.9 *	3.0 *	7.6 *	1.9 *
Total/Average	9.1 *	1.3 *	9.3 *	2.1 *	21.4 *	3.2 *	39.8 *	2.2 *

^{1/} Columns may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.2-50 pct.

Table A-7.--Total households, percent burning one-third cord or more, total amount burned, and average amount burned by demographic group and location, 1980-81^{1/}

Demographic characteristic	Total households	Percent burning 1/3 cord or more	Total burned ^{2/}	Average burned ^{2/}
	<u>Million</u>		<u>Million cords</u>	<u>Cords</u>
<u>Income</u>				
\$0-\$10,000	20.9	10 **	5.8 **	2.9 **
10,001- 20,000	22.8	18 *	10.1 *	2.5 *
20,001- 30,000	17.0	26 *	9.7 *	2.2 *
30,001- 40,000	9.3	34 *	6.5 *	2.0 *
40,001+	9.9	41 *	7.6 *	1.9 *
Total/Average	80.0	22 *	39.8 *	2.2 *
<u>Ownership of residence</u>				
Owner	51.7	31 *	34.7 *	2.2 *
Renter/rent free	28.3	7 **	5.1 *	2.5 **
Total/Average	80.0	22 *	39.8 *	2.2 *
<u>Dwelling type</u>				
Single-family house	55.8	30 *	38.1 *	2.3 *
2-4 Units	10.1	5 \$\$	.7 \$	1.5 \$
5+ Units	11.0	1 —	.1 —	1.0 —
Mobile home	2.5	11 \$\$	.7 \$	3.2 \$
Not determined	.2	—	.2 \$\$	—
Total/Average	80.0	22	39.8 *	2.2
<u>Number of persons in the household</u>				
1	14.7	5 *	2.0 \$	2.1 *
2	25.7	28 *	10.9 *	2.2 *
3	14.0	19 *	7.3 *	2.2 *
4	13.3	27 *	10.6 *	2.2 *
5+	11.2	32 *	8.6 *	2.3 *
Not determined	1.2	23	.5 \$\$	1.7
Total/Average	80.0	22 *	39.8 *	2.2 *

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Table A-7.--Total households, percent burning one-third cord or more, total amount burned, and average amount burned by demographic group and location, 1980-81^{1/}--cont.

Demographic characteristic	Total households	Percent burning 1/3 cord or more	Total burned ^{2/}	Average burned ^{2/}
	Million		Million cords	Cords
<u>Age of the head of household</u>				
0-24 years	5.2	8 **	0.8 \$	2.0 **
25-29	9.0	20 **	4.1 **	2.3 *
30-44	24.7	30 *	17.4 *	2.4 *
45-64	24.2	25 *	13.0 *	2.1 *
65+	14.3	12 *	3.8 **	2.2 **
Not determined	.7	—	.7 \$\$	1.9
Total/Average	80.0	22 *	39.8 *	2.2 *
<u>Education</u>				
8 years or less	7.7	15 **	3.5 **	3.0 **
9-11 years	6.9	17 **	3.4 **	2.8 **
12 years or high-school diploma	26.9	22 *	15.1 *	2.5 *
1-3 years college	15.2	21 *	6.8 *	2.1 *
4 years college or college degree	21.4	27 *	10.4 *	1.8 *
Not determined	1.9	19	.7 \$\$	2.0
Total/Average	80.0	22 *	39.8 *	2.2 *
<u>Urban/rural location</u>				
Urban	60.9	17 *	18.0 *	1.8 *
Rural	16.7	43 *	20.8 *	2.9 *
Not determined	2.4	16 \$	.9 \$\$	2.4 \$
Total/Average	80.0	22 *	39.8 *	2.2 *

Table A-7.--Total households, percent burning one-third cord or more, total amount burned, and average amount burned by demographic group and location, 1980-81^{1/}--cont.

Demographic characteristic	Total households	Percent burning 1/3 cord or more	Total burned ^{2/}	Average burned ^{2/}
			<u>Million cords</u>	<u>Cords</u>
<u>Heating degree days^{3/}</u>				
Greater than 7,000	7.1	33	7.5 *	3.2 *
5,500-7,000	22.2	21	10.0 *	2.2 *
4,000-5,499	20.3	24	11.3 *	2.3 *
Less than 4,000	16.9	22	7.2 *	1.9 *
Less than 4,000 and high cooling degree days	<u>13.4</u>	<u>17</u>	<u>3.9 **</u>	<u>1.7 *</u>
Total/Average	80.0	22	39.8 *	2.2 *

^{1/} Columns may not add to totals due to rounding.

^{2/} Households burning 1/3 cord or more.

^{3/} See figure B-2.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

— Relative standard error is greater than 50 pct.

Table A-8.--Number of households having and using wood-burning equipment in their primary home by major timber region, 1980-81^{1/}

	Timber region										U.S. total
	West		North Central		Northeast		South		U.S. total		
	Present	Used ^{2/}	Present	Used	Present	Used	Present	Used	Present	Used	
Fireplaces	Equipment/million households										
Without insert	3.3 *	3.0 *	3.0 *	3.8 *	2.6 *	2.3 *	3.5 *	3.1 *	12.3 *	11.1 *	
With insert	3/1.3 *	1.2 *	3/1.4 **	1.3 **	3/1.1 **	1.1 **	3/1.6 **	1.5 **	3/5.4 *	5.2 *	
Insert not determined ^{4/}	1.7 *	.0	1.0 **	.0	.9 *	.0	1.7 **	.0	5.4 *	.0	
Total	6.4 *	4.2 *	5.4 *	4.2 *	4.6 *	3.3 *	6.8 *	4.6 *	23.0 *	16.3 *	
Stoves											
Not airtight	.2 \$	.2 \$\$	.3 \$\$	.3 \$	.3 \$	.3 \$	.4 \$	.3 \$	1.3 **	1.2 **
Airtight	3/1.0 **	.9 **	3/1.6 **	1.5 **	3/1.5 **	1.4 *	3/1.7 **	1.7 **	3/5.8 *	5.5 *	
Airtightness not determined ^{4/}	.1 \$	.0	.1 \$	.0	.2 \$	.0	.3 \$	.0	.6 **	.0
Total	1.3 *	1.1 *	2.0 *	1.8 *	2.0 *	1.7 *	2.4 *	2.1 **	7.8 *	6.7 *	
Furnaces	.1 \$\$	(5) \$\$	.4 \$	.3 \$	.4 \$	.3 \$	.2 \$\$	.1 \$\$	1.0 **	.8 **
Any equipment	7.1 *	5.1 *	7.0 *	5.8 *	5.9 *	4.7 *	8.4 *	6.5 *	28.4 *	22.2 *	

1/ Columns may not add to totals due to rounding.

2/ Wood was burned in the equipment during the prior 12 months.

3/ Households having a fireplace insert (or airtight stove) were only counted as having an insert (or airtight stove) even if they had a second fireplace without an insert (or second stove which was not airtight).

4/ Households not burning wood were not asked if their fireplaces had inserts or if their stoves were airtight, thus most equipment in the "not determined" category was held by nonburners.

5/ Less than 0.05 million households.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-9.--Total and average amounts burned in various wood-burning equipment by major timber region, 1980-81^{1/}

Equipment	Timber region												U.S. total		
	West			North Central			Northeast			South					
	Total	Average	Million cords	Total	Average	Million cords	Total	Average	Million cords	Total	Average	Million cords		Total	Average	Million cords
Fireplaces															
Without insert	1.7 **	0.6 *	2.7 **	1.9 *	1.8 **	1.8 **	.8 *	3.7 **	1.2 *	9.8 *	.9 *				
With insert	2.2 *	1.8 *	2.7 **	2.0 **	1.7 \$	1.6 *	1.6 *	2.8 \$	1.8 *	9.5 *	1.8 *				
Total/average	3.9 *	.9 *	5.4 **	1.3 *	3.5 *	1.0 *	1.0 *	6.5 **	1.4 *	19.3 *	1.2 *				
Stoves															
Not airtight	.4 \$	1.8 \$	.9 \$	2.8 \$	.6 \$	1.9 **	.9 \$	2.4 \$	2.7 **	2.3 *			
Airtight	2.6 **	2.8 *	4.5 **	3.1 *	4.2 **	2.9 *	4.2 **	2.5 *	15.5 *	2.8 *					
Total/average	3.0 **	2.6 *	5.4 **	3.0 *	4.8 **	2.7 *	5.1 *	2.5 *	18.2 *	2.7 *					
Furnaces	.1 \$\$	3.3 **	.9 \$	3.9 *	1.1 \$	3.5 **	.5 \$\$	4.0 \$	2.9 **	3.7 *					
Any equipment	7.1 *	1.4 *	12.0 *	2.1 *	9.4 *	2.0 *	12.1 *	1.9 *	40.5 *	1.8 *					

1/ Columns may not add to totals due to rounding

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

** Relative standard error is 25.1-50 pct.

Table A-10.--Households with wood-burning equipment in their primary residences and percent using the equipment during 1980-81 by major timber region

Equipment	Households and percent using equipment											
	West		North Central		Northeast		South		Total			
	Million	Pct	Million	Pct	Million	Pct	Million	Pct	Million	Pct		
Fireplaces ^{1/}	6.3 *	67	5.4 *	78	4.6 *	73	6.8 *	67	23.0 *	71		
Stoves or furnaces ^{1/}	1.4 *	86	2.4 *	88	2.4 *	87	2.6 *	83	8.8 *	86		
Any equipment	7.1 *	72	7.0 *	83	5.9 *	80	8.4 *	77	28.4 *	78		

^{1/} Households may have both fireplaces and stoves or furnaces.

* Relative standard error is 10 pct or less.

Table A-11.--Number of wood-burning appliances present in primary residences by major timber region, 1980-81^{1,2/}

Equipment	Timber region				U.S. total
	West	North Central	Northeast	South	
- - - - - Million units - - - - -					
Fireplaces					
Without insert	3.8 *	3.5 *	3.5 *	4.1 *	14.8 *
With insert	1.3 *	1.4 **	1.1 **	1.6 **	5.4 *
Insert not determined ^{3/}	<u>2.3</u> *	<u>1.4</u> **	<u>1.4</u> **	<u>2.3</u> **	<u>7.5</u> *
All fireplaces	7.4 *	6.3 *	5.9 *	8.0 *	27.6 *
Stoves					
Not airtight	0.2 \$	.4 \$	.4 \$	.4 \$\$	1.4 **
Airtight	1.0 **	1.6 **	1.5 *	1.7 *	5.8 *
Airtightness not determined ^{3/}	<u>.3</u> \$	<u>.3</u> \$	<u>.5</u> \$	<u>.5</u> \$\$	<u>1.6</u> **
All stoves	1.5 **	2.4 *	2.3 *	2.7 **	8.9 *
Furnaces	.1 \$\$	.4 \$	.4 \$	.2 \$\$	1.0 **
Any equipment	9.0 *	9.1 *	8.6 *	10.9 *	37.5 *

^{1/} Columns may not add to totals due to rounding.

^{2/} Includes workable appliances present but not necessarily used.

^{3/} Households not burning wood in their primary home were not asked if their fireplaces had inserts or if their stoves were airtight, so most equipment in the "not determined" category was held by nonburners.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-12.--Wood-burning equipment present or used in second homes, 1980-81^{1/}

Equipment	Number of appliances	Households having one or more appliance	Households using one or more appliance ^{2/}	Percent of households using equipment
----- Millions -----				
Fireplaces				
Without insert	0.7 \$	0.6 \$	0.5 \$	
With insert	.3 \$\$	^{3/} .3 \$	^{3/} .2 \$	
Insert not determined ^{3/}	.7 \$	.5 \$	(4/) —	
All fireplaces	1.7 **	1.3 **	.8 **	58
Stoves				
Not airtight	.2 \$\$	.1 \$\$	.1 \$\$	
Airtight	.3 \$	^{3/} .3 \$	^{3/} .3 \$\$	
Airtightness not determined ^{5/}	.3 \$\$	.2 \$\$	(4/) —	
All stoves	.7 \$	.5 \$	.4 \$	68
Furnaces	.1 —	.1 \$\$	(4/) —	—
Any equipment	2.4 **	1.7 **	1.1 **	63

1/ Columns may not add to totals due to rounding.

2/ Wood was burned in the equipment during the prior 12 months.

3/ Households having a fireplace insert (or airtight stove) were only counted as having an insert (or airtight stove) even if they had a second fireplace without an insert (or second stove which was not airtight).

4/ Less than 0.05 million households.

5/ Households not burning wood in their second home were not asked if their fireplaces had inserts or if their stoves were airtight, thus most equipment in the "not determined" category was held by nonburners.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Relative standard error is greater than 50 pct.

Table A-13.--Percent of households burning wood in different types of equipment by alternate fuel used, 1980-81^{1/}

Equipment	Alternate heating fuel used					Total
	Natural gas	Fuel oil	Electricity	Other	None	
<u>Percent of households in alternate heating fuel category</u>						
Fireplaces						
Without insert	16	13	13	8	12	14
With insert	<u>4</u>	<u>8</u>	<u>10</u>	<u>9</u>	<u>15</u>	<u>7</u>
All fireplaces	20	21	22	20	27	20
Stoves						
Not airtight	1	2	2	4	9	2
Airtight	<u>3</u>	<u>10</u>	<u>9</u>	<u>11</u>	<u>49</u>	<u>7</u>
All stoves	3	12	12	15	58	8
Furnaces	(2/)	2	1	1	15	1
Any equipment ^{3/}	23	31	32	27	86	28
Number of households in alternate fuel category (millions)	42.2	13.5	17.0	5.7	1.6	80.0

^{1/} Columns may not add to totals due to rounding.

^{2/} Less than 0.5 pct.

^{3/} Percent of households using fireplaces plus the percent using stoves plus the percent using furnaces may exceed the percent burning in "any equipment" because a household may use more than one type of equipment.

Table A-14.--Number of households burning wood in different types of equipment
by alternate heating fuel used, 1980-81^{1/}

Equipment	Alternate heating fuel used					Total
	Natural gas	Fuel oil	Electricity	Other	None	
----- Million households -----						
Fireplaces						
Without insert	6.7 *	1.7 *	2.1 *	0.4 \$	0.2 \$\$	11.1 *
With insert	1.8 **	1.1 **	1.7 **	.4 \$	.2 \$\$	5.2 *
All fireplaces	8.5 *	2.8 *	3.8 *	.8 \$	.4 \$	16.3 *
Stoves						
Not airtight	.3 \$\$	.3 \$	.3 \$	.2 \$\$	.1 \$\$	1.2 **
Airtight	1.1 **	1.3 *	1.7 **	.6 \$	.8 \$	5.5 *
All stoves	1.4 **	1.6 *	2.0 *	.8 **	.9 \$	6.7 *
Furnaces	.1 \$\$	.2 \$	.1 \$\$	.1 \$\$	.2 \$\$	.8 **
Any equipment ^{2/}	10.0 *	4.1 *	5.5 *	1.5 **	1.4 **	22.2 *

1/ Columns may not add to totals due to rounding.

2/ Percent of households using fireplaces plus the percent using stoves plus the percent using furnaces may exceed the number using "any equipment" because a household may use more than one type of equipment.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-15.--Average amount burned by households burning in different types of equipment by alternate heating fuel used, 1980-81

Equipment	Alternate heating fuel used					Total
	Natural gas	Fuel oil	Electricity	Other	None	
	----- Cords -----					
Fireplaces						
Without insert	0.8 *	0.9 **	1.1 *	1.3 \$	1.4 \$\$	0.9 *
With insert	<u>1.6</u> *	<u>1.9</u> *	<u>1.8</u> *	<u>2.0</u> **	<u>3.6</u> \$\$	<u>1.8</u> *
All fireplaces	.9 *	1.3 *	1.4 *	1.6 **	2.6 \$	1.2 *
Stoves						
Not airtight	1.9 \$\$	2.1 **	2.7 \$	2.2 \$	2.6 \$\$	2.3 *
Airtight	<u>2.0</u> **	<u>3.0</u> *	<u>2.9</u> *	<u>2.5</u> **	<u>3.7</u> *	<u>2.8</u> *
All stoves	2.0 **	2.8 *	2.9 *	2.5 **	3.5 *	2.7 *
Furnaces	3.1 \$	3.8 **	3.7 **	3.3 \$\$	4.0 **	3.7 *
Any equipment ^{1/}	1.2 *	2.2 *	2.1 *	2.3 *	3.9 *	1.8 *

^{1/} Average amount per household. This may include burning in more than one type of equipment.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-16.--Total amount burned by households burning in different types of equipment by alternate heating fuel used, 1980-81^{1/}

Equipment	Alternate heating fuel used					Total
	Natural gas	Fuel oil	Electricity	Other	None	
----- Million Cords -----						
Fireplaces						
Without insert	5.0 *	1.6 **	2.4 **	0.6 \$\$	0.3 \$\$	9.8 *
With insert	2.7 **	2.1 **	3.0 **	.8 \$\$	.8 \$\$	9.4 *
All fireplaces	7.8 *	3.7 **	5.4 *	1.3 \$	1.1 \$\$	19.3 *
Stoves						
Not airtight	.6 \$\$	.6 \$	.7 \$\$	.5 \$\$	.4 \$\$	2.7 **
Airtight	2.2 \$	3.9 *	5.0 **	.8 \$	2.8 \$	15.5 *
All stoves	2.8 \$	4.5 *	5.4 *	1.1 \$	3.2 \$	18.2 *
Furnaces	.5 \$\$	.9 \$\$	.4 \$\$	.3 \$\$	1.0 \$\$	2.9 **
Any equipment	11.2 *	9.1 *	11.4 *	3.6 **	5.3 **	40.5 *

1/ Columns may not add to totals due to rounding.

* Relative standard error is 20 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-17.--Estimated net energy output of wood-burning equipment by alternate heating fuel used, 1980-81^{1/}

Equipment	Alternate heating fuel used				Total
	Natural gas	Fuel oil	Electricity	Other or none	
----- 10 ¹² Btu -----					
Fireplace					
Without insert	5.0	1.6	2.4	0.8	9.8
With insert	<u>8.2</u>	<u>6.3</u>	<u>9.1</u>	<u>4.8</u>	<u>28.4</u>
All fireplaces	13.2	7.9	11.5	5.6	38.2
Stoves					
Not airtight	3.6	3.6	4.2	5.0	16.4
Airtight	<u>21.9</u>	<u>39.2</u>	<u>49.8</u>	<u>44.2</u>	<u>155.1</u>
All stoves	25.5	42.8	54.0	49.2	171.5
Furnaces	5.0	10.0	4.0	13.4	32.4
All equipment	43.7	60.7	69.5	68.2	242.1

^{1/} Entries were computed by multiplying total cord entries in table A-16 by 20 mm Btu per cord and an estimated efficiency of the wood-burning equipment: fireplace without insert, 5 pct; fireplace with insert, 15 pct; nonairtight stove, 30 pct; airtight stove, 50 pct; and furnace, 55 pct.

Table A-18.--Estimated gross energy of alternate fuels displaced by wood burning, 1980-81^{1/}

Equipment	Alternate heating fuel used			
	Natural gas	Fuel oil	Electricity	Other or none
	----- 10 ¹² Btu -----			
Fireplace				
Without insert	8.2	2.4	2.4	0.8
With insert	<u>13.5</u>	<u>9.5</u>	<u>9.1</u>	<u>4.8</u>
All fireplaces	21.7	11.9	11.5	5.6
Stoves				
Not airtight	5.9	5.5	4.2	5.0
Airtight	<u>35.9</u>	<u>59.4</u>	<u>49.8</u>	<u>44.2</u>
All stoves	41.8	64.9	54.0	49.2
Furnaces	7.5	15.1	4.0	13.4
All equipment	71.0	91.9	69.5	68.2

1/ Entries were computed by dividing net energy output of wood-burning equipment (table A-17) by the estimated or assumed efficiency of alternate fuel use: natural gas, 61 pct; fuel oil, 66 pct; electricity, 100 pct; and other/no alternate fuel, 100 pct.

Table A-19.--Number and percent of households burning one-third cord or more
by wood-burning purpose and major timber region, 1980-81^{1/}

Wood burning purpose	Timber region									
	West		North Central		Northeast		South		Total	
	<u>Million households</u>	<u>Pct</u>	<u>Million households</u>	<u>Pct</u>	<u>Million households</u>	<u>Pct</u>	<u>Million households</u>	<u>Pct</u>	<u>Million households</u>	
Primary source of heat	1.3 *	9	1.4 **	6	1.5 *	7	2.2 **	10	6.4 *	8 *
Secondary source of heat	1.6 *	10	2.9 *	13	1.7 *	9	2.7 *	12	8.9 *	11 *
Other	.4 \$	3	.5 \$	3	.7 **	4	.8 \$	3	2.5 *	3 *
Total	3.3 *	22 *	4.8 *	22 *	3.9 *	20 *	5.7 *	25 *	17.8 *	22 *
Total households	15.1	100	22.1	100	20.0	100	22.6	100	80.0	100

1/ Figures may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

Table A-20.--Total and average amounts burned by households burning one-third cord or more by wood-burning purpose and timber region, 1980-81^{1/}

Wood burning purpose	Timber region													
	West			North Central			Northeast			South			Total	
	Total	Average	Million cords	Total	Average	Million cords	Total	Average	Million cords	Total	Average	Million cords	Total	Average
Primary source of heat	3.9 *	2.9 *	6.1 **	4.4 *	5.4 **	3.7 *	6.4 **	2.9 *	21.7 *	3.4 *				
Secondary source of heat	2.5 *	1.6 *	5.1 *	1.8 *	3.1 **	1.8 *	4.4 *	1.6 *	15.1 *	1.7 *				
Other	.4 \$	1.1 **	.7 \$	1.2 **	.8 \$	1.0 **	1.1 \$	1.4 **	3.0 *	1.2 *				
Total	6.8 *	2.1 *	11.8 *	2.4 *	9.2 *	2.4 *	11.9 *	2.1 *	39.8 *	2.2 *				

^{1/} Figures may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

Table A-21.--Number of households obtaining mill waste, roundwood, and discarded wood products by major timber region, 1980-81^{1/}

Major timber region	Households obtaining mill waste		Households obtaining roundwood		Households obtaining discarded wood products	
	Number	Percent of households	Number	Percent of households	Number	Percent of households
	<u>Million</u>	<u>Pct</u>	<u>Million</u>	<u>Pct</u>	<u>Million</u>	<u>Pct</u>
West	0.6 \$	4	4.3 *	28	2.1 *	14
North Central	.5 \$	2	5.2 *	24	2.0 **	9
Northeast	.4 \$	2	4.3 *	20	1.4 *	7
South	.7 \$	3	5.9 *	26	1.7 **	8
Total	2.3 *	3	19.7 *	24	7.3 *	9

NOTE: Columns may not add to totals due to rounding.

^{1/} Each household may have obtained more than one type of fuelwood and therefore may be counted more than once in the table.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

Table A-22.--Amount of mill waste and roundwood acquired by timber region, 1980-81

Timber region	Mill waste			Roundwood		
	Total amount	Amount	Percent of total	Amount	Percent of total	Average per household acquiring
	Million cords	Million cords		Million cords		
Northwest	4.2 *	—	—	3.8 *	—	3.3 *
Northern Rocky Mountains	1.2 *	—	—	1.1 **	—	3.7 *
Southern Rocky Mountains	3.8 **	—	—	3.5 **	—	1.3 \$
West	9.2 *	0.9 \$	9	8.4 *	91	2.1 *
Lake States	4.7 **	—	—	4.5 **	—	2.6 *
Central States	7.7 **	—	—	7.2 **	—	2.2 \$
North Central	12.4 *	.7 \$\$	5	11.8 *	95	2.3 *
Mid-Atlantic	6.3 *	—	—	5.8 **	—	2.1 *
New England	4.3 **	—	—	4.1 *	—	3.1 *
Northeast	10.6 *	.7 \$\$	7	9.9 *	93	2.4 *
South Central	5.8 **	—	—	5.6 \$	—	1.9 \$
Southeast	6.7 **	—	—	6.2 **	—	2.2 **
South	12.5 *	.8 \$\$	6	11.8 *	94	2.1 *
Total	44.8 *	3.0 **	7	41.8 *	93	2.2 *

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

— Relative standard error is greater than 50 pct.

Table A-23.--Species type of mill waste and roundwood acquired by timber region, 1980-81

Major timber region	Total				Mill waste				Roundwood			
	Hardwood		Softwood		Hardwood		Softwood		Hardwood		Softwood	
	- Million cords -	Percent hardwood										
West	3.7 *	5.6 *	40	0.2 \$\$	0.7 \$	25	3.5 **	4.9 **	42			
North Central	10.8 \$	1.6 \$	87	.6 \$\$.1 \$\$	85	10.2 *	1.5 \$	87			
Northeast	9.9 \$.7 \$	93	.5 \$\$.2 \$\$	78	9.4 *	.5 \$\$	95			
South	10.8 \$	1.6 \$	87	.6 \$\$.1 \$	84	10.1 *	1.7 \$	86			
Total	35.3 *	9.5 *	79	1.9 \$	1.1 \$	65	33.2 *	8.6 *	79			

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-24.--Number and percent of households acquiring and purchasing mill waste and roundwood by timber region, 1980-81

Timber Region	Mill waste		Roundwood	
	Total acquiring	Percent purchasing	Total acquiring	Percent purchasing
	<u>Million households</u>		<u>Million households</u>	
Northwest	—	—	1.2 *	—
Northern Rocky Mountains	—	—	.3 *	—
Southern Rocky Mountains	—	—	2.8 *	—
West	.6 \$	33	4.3 *	37
Lake States	—	—	1.7 *	—
Central States	—	—	3.5 *	—
North Central	.5 \$	48	5.2	33
Mid-Atlantic	—	—	2.9 *	—
New England	—	—	1.4 *	—
Northeast	.4 \$	38	4.3 *	39
South Central	—	—	3.0 *	—
South East	—	—	3.0 *	—
South	.7 \$	45	5.9 *	35
Total	2.3 *	41	19.7 *	36

- * Relative standard error is 10 pct or less.
- \$ Relative standard error is 15.1-25 pct.
- Relative standard error is greater than 50 pct.

Table A-25.--Amounts of mill waste and roundwood purchased and the price of the most recent purchase by major timber region, 1980-81

Major timber region	Total mill waste and roundwood purchased			Mill waste			Roundwood		
	Million cords	Million cords	Price per cord ^{2/}	Total purchased	Average amount purchased per household ^{1/}	Price per cord ^{2/}	Total purchased	Average amount purchased per household ^{1/}	Price per cord ^{2/}
West	3/ 2.4 ** (26)	3/ 0.2 \$\$ (29)	19 \$	1.7 \$	1.7 \$	19 \$	3/ 2.2 ** (26)	1.4 **	93 *
North Central	3.3 ** (27)	.4 \$\$ (55)	26 \$\$	1.2 \$\$	1.2 \$\$	26 \$\$	2.9 \$ (25)	1.8 **	70 *
Northeast	3.6 ** (34)	.3 \$\$ (46)	33 **	1.4 \$	1.4 \$	33 **	3.3 ** (34)	2.3 **	76 *
South	3.0 ** (24)	.3 \$\$ (44)	26 \$	1.4 \$\$	1.4 \$\$	26 \$	2.7 ** (23)	1.2 *	65 *
Total	12.4 * (28)	1.3 ** (42)	26 **	1.4 \$	1.4 \$	26 **	11.1 * (27)	1.7 *	74 *

1/ Average amount for most recent purchase of 1/3 cord or more.

2/ Average price for most recent purchase of 1/3 cord or more.

3/ Amounts in parenthesis are percent of total fuelwood acquired.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$\$ Relative standard error is 15.1-25 pct.

\$\$\$ Relative standard error is 25.1-50 pct.

Table A-26.--Number and percent of households acquiring hardwood or softwood roundwood by timber region, 1980-81

Timber region	Total households obtaining roundwood	Households obtaining hardwood		Households obtaining softwood	
		Number	Percent of total households	Number	Percent of total households
- - - - Number of households in millions - - - -					
Northwest	1.2	0.6 \$	49	0.6 **	51
North Rocky Mountains	.3	.1 \$\$	24	.2 **	76
South Rocky Mountains	2.8	1.4 \$	49	1.4 **	51
West	4.3	2.0 *	47	2.3 **	53
Lake States	1.7	1.5 **	89	.3 \$\$	11
Central	3.5	3.1 **	87	.4 \$\$	13
North Central	5.2	4.6 *	88	.6 \$	12
Mid-Atlantic	2.9	2.6 **	91	.3 \$\$	9
New England	1.4	1.3 *	93	.1 \$\$	7
Northeast	4.3	3.9 *	91	.4 \$\$	9
South Central	3.0	2.5 \$	85	.4 \$\$	15
Southeast	3.0	2.5 \$	84	.5 \$\$	16
South	5.9	5.0 *	85	.9 \$	15
Total U.S.	19.7	15.5 *	79	4.2 *	21

NOTE: Columns may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-27.--Amounts of hardwood and softwood roundwood acquired by timber region, 1980-81

Timber region	Total obtained amount	Hardwood		Softwood	
		Total amount	Percent of total acquired	Total amount	Percent of total acquired
	Million cords	Million cords		Million cords	
Northwest	3.8	1.6 **	43	2.2 **	57
North Rocky Mountains	1.1	.2 \$	17	.9 **	83
South Rocky Mountains	<u>3.5</u>	<u>1.7</u> \$	48	<u>1.8</u> \$	52
West	8.4	3.5 **	42	4.9 **	58
Lake States	4.5	4.1 **	92	.4 \$\$	8
Central	<u>7.2</u>	<u>6.1</u> **	84	<u>1.2</u> \$\$	16
North Central	11.8	10.2 *	87	1.5 \$	13
Mid-Atlantic	5.8	5.5 **	94	.3 \$\$	6
New England	<u>4.1</u>	<u>3.9</u> **	97	<u>.1</u> \$\$	3
Northeast	9.9	9.4 *	95	.5 \$	5
South Central	5.6	4.9 **	88	.7 \$	12
Southeast	<u>6.2</u>	<u>5.2</u> *	83	<u>1.0</u> \$\$	17
South	11.8	10.1 **	86	1.7 \$	14
Total U.S.	41.8	33.2 *	79	8.6 *	21

NOTE: Columns may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-28.--Number, size, and price of the most recent purchases of roundwood by characteristics of location, 1980-81

Selected characteristic	Purchases of any amount				Purchases of 1/3 cord or more			
	Number of most recent purchases	Percent of total	Average amount	Average price	Number of most recent purchases	Percent of total	Average amount	Average price
	Million		Cord	\$/Cord	Million		Cord	\$/Cord
Total U.S.	6.8 *	100	1.5 *	85 *	6.0 *	100	1.7 *	74 *
Major timber regions:								
West	1.5 *	23	1.1 **	110 *	1.2 *	20	1.4 **	94 *
North Central	1.6 **	24	1.7 **	78 *	1.5 **	25	1.8 **	70 *
Northeast	1.6 *	24	2.1 *	85 *	1.5 *	24	2.3 **	76 *
South	2.0 *	29	1.1 *	74 *	1.8 *	30	1.2 **	65 *
Location:								
Urban	4.9 *	72	1.4 *	92 *	4.3 *	71	1.6 *	80 *
Rural	1.7 **	25	1.9 **	60 *	1.6 \$	27	1.9 **	57 *
Not determined	.2 \$\$	3	.8 \$\$	145 \$	.1 \$\$	2	1.1 \$\$	110 \$
Heating degree days: ^{1/}								
More than 7,000	.8 *	12	3.5 **	63 *	.8 **	13	3.6 **	57 *
5,500-7,000	1.6 **	24	1.4 *	88 *	1.6 *	26	1.5 *	85 *
4,000-5,499	1.9 *	27	1.4 **	79 **	1.6 **	27	1.6 **	66 *
Less than 4,000	2.4 *	36	.9 *	95 *	2.0 *	34	1.1 *	78 *

1/ See figure B-2.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

Table A-29.--Number, size, and price of the most recent purchases of roundwood by characteristics of the purchases, 1980-81

Selected characteristic	Purchases of any amount				Purchases of 1/3 cord or more			
	Number of most recent purchases	Percent of total purchases	Average amount	Average price	Number of most recent purchases	Percent of total purchases	Average amount	Average price
Total U.S.	6.8 *	100	1.5 *	85 *	6.0 *	100	1.7 *	74 *
Total amount of last purchase:								
Less than 1/3 cord	.8	12	.2 *	193 *	--	--	--	--
1/3 cord or more	6.1	88	1.7 *	74 *	6.0	100	1.7 *	74 *
Species type:								
Hardwood	5.2 *	76	1.6 *	83 *	4.8 *	79	1.7 *	75 *
Softwood	1.1 **	15	1.1 **	96 **	.8 **	13	1.5 **	76 **
Both equal	.4 \$	6	1.4 \$	68 **	.4 \$	7	1.5 \$	62 **
Not determined	.1 \$\$	2	.8 \$	155 --	.1 \$\$	2	1.0 \$	78 \$\$
Dryness of wood:								
Dried	4.2	62	1.3 *	95 *	3.6	60	1.5 *	82 *
Green	1.8	27	1.9 *	65 *	1.7	28	2.0 *	58 *
Half each	.7	11	1.4 \$	80 **	.7	11	1.6 **	76 **
Not determined	--	1	.7 \$\$	159 --	--	1	.8 \$	89 --
Sources:								
Retail stores	.6	8	1.2 \$	138 \$	.3	5	2.0 \$	77 \$
Self-cut from land	.3	5	1.5 \$\$	23 \$	.3	5	1.5 \$\$	23 \$
Other source	5.8	85	1.5 *	83 *	5.3	88	1.6 *	77 *
Not determined	.1	2	2.0 --	96 --	.1	2	2.2 --	64 \$\$

Table A-29.--Number, size, and price of the most recent purchases of roundwood by characteristics of the purchases, 1980-81--con.

Selected characteristic	Purchases of any amount				Purchases of 1/3 cord or more			
	Number of most recent purchases	Percent of total purchases	Average amount	Average price	Number of most recent purchases	Percent of total purchases	Average amount	Average price
	Million		Cord	\$/Cord	Million		Cord	\$/Cord
Delivery:								
Included in price	5.0 *	74	1.7 *	84 *	4.7 *	78	1.8 *	79 *
Not included	1.4 \$	21	.9 **	101 *	1.0 \$	17	1.2 **	66 **
Not determined	.1 **	1	1.0 \$\$	140 \$\$	--	1	1.2	81 \$\$
Price of last purchase:								
Less than \$50 per cord	1.6	24	2.5 **	29 *	1.6	27	2.5 **	29 *
\$50-\$75 per cord	1.7	25	1.5 *	61 *	1.7	27	1.6 *	60 *
\$75-\$100 per cord	1.0	15	1.4 *	83 *	1.0	16	1.4 *	83 *
More than \$100 per cord	1.7	25	.7 *	164 *	1.3	21	.8 **	143 *
Price not determined	.7	10	1.3 \$\$	--	.5	9	1.7 \$\$	--

1/ Purchases that were self-cut by the household were excluded.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

- Relative standard error is greater than 50 pct.

Table A-30.--Total amounts of self-cut roundwood from nonwoodland and from woodland live trees, logging residue, and dead or down trees by major timber region, 1980-81

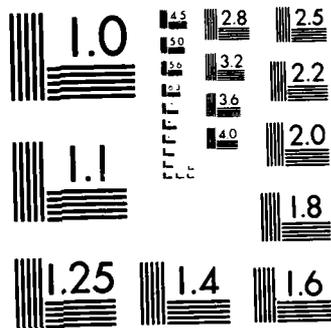
Major timber region	Roundwood self-cut from woodland									
	Total roundwood self-cut		Roundwood self-cut from nonwoodland		Standing live trees		Logging residue		Dead or down	
	Million cords	Percent of self-cut	Million cords	Percent of self-cut	Million cords	Percent of self-cut	Million cords	Percent of self-cut	Million cords	Percent of self-cut
West	6.0 *	1.3	22	.8 \$	13	1.5 \$	25	2.4 \$	40	
North Central	8.7 *	3.5	40	1.5 \$	17	.9 \$\$	11	2.8 **	32	
Northeast	6.6 **	1.6	25	2.2 \$	33	.6 \$\$	9	2.2 **	33	
South	8.9 **	2.5	28	4.0 \$	45	.7 \$	8	1.7 \$	19	
Total/average	30.2 *	8.9	29	8.5 *	28	3.7 \$	13	9.1 *	30	

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is greater than 25 pct.



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Table A-31.--Total amounts of self-cut roundwood from woodland by hardwoods and softwoods and major timber region, 1980-81

Major timber region	Total woodland self-cut	Hardwood		Softwood	
		Total	Percent of woodland self-cut	Total	Percent of woodland self-cut
West	4.7 **	1.6 **	34	4.6 \$	64
North Central	5.2 **	4.7 **	90	.5 **	10
Northeast	5.0 **	4.7 **	94	1.3 **	6
South	<u>6.4</u> \$	<u>5.6</u> \$	<u>88</u>	<u>.8</u> \$	<u>12</u>
Total	21.3 *	16.6	78	4.6	22

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

Table A-32.--Self-cut roundwood from woodland by ownership and region, 1980-81

Timber region	All ownerships	Private		Public		Ownership unknown
		Own land	Other private	National forest	Other public	
<u>MILLION CORDS</u>						
West	4.7 **	0.8 \$\$	1.1 \$	2.4 \$	.2 \$\$	.2 \$\$
North Central	5.2 **	2.2 \$	2.3 \$	.1 —	.3 —	.3 —
Northeast	5.0 \$	2.8 \$\$	1.9 \$	(1/)	.1 —	.2 —
South	6.4 \$	2.2 \$\$	3.5 \$	.4 —	.2 —	.1 —
Total	21.3 *	7.9 **	8.8 **	2.9 \$	.9 \$\$	.8 \$\$
<u>MILLION HOUSEHOLDS^{2/}</u>						
West	1.7 **	.4 \$\$	.5 \$	.7 \$	.1 \$\$	(1/) \$\$
North Central	2.2 **	1.1 \$	1.1 \$	.1 —	.1 —	(1/) \$\$
Northeast	1.9 **	1.0 \$	.9 \$	(1/)	.1 \$\$	(1/) \$\$
South	3.0 **	1.5 **	1.6 **	.2 \$\$	.1 —	(1/) —
Total	8.8 *	3.9 *	4.1 *	1.1 \$	.4 \$\$	(1/) \$

NOTE: Columns may not add to totals due to rounding.

1/ Less than 0.05.

2/ Some households acquired roundwood from more than one ownership category.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

— Relative standard error is greater than 50 pct.

Table A-33.--One-way distance traveled by households to obtain self-cut roundwood from woodland by selected characteristics, 1980-81^{1/}

Item	Distance traveled by a household		Distance traveled per cord ^{2/}		Amount self-cut from woodland	Households cutting from woodland	Average cut per household
	Median	Average	Median	Average			
	Miles	Miles	Miles	Miles	Million cords	Million	Cords
All households	5.5	28.1	6.5	24.6	21.3	8.8	2.4
Timber regions:							
West	19.0	40.0	19.0	34.6	4.7	1.7	2.8
North Central	3.5	16.7	4.5	16.1	5.2	2.2	2.4
Northeast	2.5	34.1	1.5	30.4	5.0	1.9	2.6
South	4.5	25.9	5.5	19.7	6.4	3.0	2.1
Urban/rural location:							
Urban	9.0	38.5	11.5	32.4	8.9	4.1	2.3
Rural	2.5	18.5	3.5	19.1	12.4	4.7	2.7
Species of most wood:							
Hardwood	4.5	24.2	4.5	21.3	16.7	6.7	2.5
Softwood	14.0	44.9	19.0	36.6	4.6	2.1	2.2
Land source:							
Private	4.5	25.9	4.5	22.0	17.1	7.4	2.3
Public	19.0	32.7	19.0	40.7	4.3	1.4	3.0

Table A-33.--One-way distance traveled by households to obtain self-cut roundwood from woodland by selected characteristics, 1980-81^{1/}

Item	Distance traveled by a household		Distance traveled per cord ^{2/}		Amount self-cut from woodland	Households cutting from woodland	Average cut per household
	Median	Average	Median	Average			
	<u>Miles</u>	<u>Miles</u>	<u>Miles</u>	<u>Miles</u>	<u>Million cords</u>	<u>Million</u>	<u>Cords</u>
Amount self-cut: ^{3/}							
1.7 cords or more	4.5	22.1	6.5	22.5	17.6	4.4	4.0
Less than 1.7 cords	5.5	34.2	6.5	34.2	3.7	4.4	.9
Amount self-cut: ^{4/}							
3.7 cords or more	5.5	24.2	7.5	25.2	10.6	1.7	6.2
Less than 3.7 cords	5.5	22.0	5.5	28.8	10.7	7.1	1.5
Income:							
\$20,000 or less	5.5	24.8	5.5	23.7	8.6	3.3	2.6
More than \$20,000	5.5	30.1	7.5	25.3	12.7	5.4	2.3
Heating degree days: ^{5/}							
5,500 or more	7.5	28	8.5	25.4	9.7	3.4	2.9
Less than 5,500	5.5	28	6.5	24.0	11.6	5.4	2.1

1/ One-way distance traveled by households to obtain most of the wood they cut from woodland.

2/ Distance an average cord was transported.

3/ Approximately one-half of all households cutting on woodland cut 1.7 cords or more.

4/ Approximately one-half of all wood cut by households on woodland was cut by those cutting 3.7 cords or more.

5/ See figure B-2.

Table A-34.--Total number of households and percent of these households burning one-third cord or more by urban/rural location and cost of alternate heating fuel

Cost of alternate fuel	Urban		Rural		Location not determined		All households	
	Total households	Percent burning	Total households	Percent burning	Total households	Percent burning	Total households	Percent burning
	<u>Millions</u>		<u>Millions</u>		<u>Millions</u>		<u>Millions</u>	
Dollars per million Btu's								
Less than \$5.60	14.2	16	2.5	19	.5	6	17.1	16
\$5.61 to \$8.19	16.2	14	2.2	32	.6	4	19.0	16
\$8.20 to \$10.99	13.7	18	4.1	45	.6	17	18.4	24
\$11.00 or more	13.7	18	4.0	57	.4	19	18.2	27
No alternate fuel or price not determined	<u>3.0</u>	<u>24</u>	<u>3.9</u>	<u>48</u>	<u>.4</u>	<u>39</u>	<u>7.3</u>	<u>38</u>
Total/Average	60.8	17	16.7	43	2.4	16	79.9	22

NOTE: Columns may not add to totals due to rounding.

Table A-35.--Total amount and average amount burned by households burning one-third cord or more by urban/rural location and cost of alternate heating fuel

Cost of alternate fuel	Urban			Rural			Location not determined			All households		
	Total	Average	Total	Average	Total	Average	Total	Average	Total	Average	Total	Average
	Million cords	Cords	Million cords	Cords	Million cords	Cords	Million cords	Cords	Million cords	Cords	Million cords	Cords
Less than \$5.60	3.5 **	1.5 *	0.8 \$	1.8 *	(1/)	--	4.4 **	1.6 *				
\$5.61 to \$8.19	3.4 **	1.5 *	1.6 **	2.3 *	(1/)	--	5.1 *	1.7 *				
\$8.20 to \$10.99	4.2 *	1.7 *	5.3 *	2.9 *	0.3 --	--	9.9 *	2.2 *				
\$11.00 or more	4.9 *	2.0 *	6.5 *	2.8 *	.2 \$\$	--	11.6 *	2.4 *				
No alternate fuel or price not determined	2.0 \$	2.8 *	6.5 **	3.5 *	.4 --	--	8.9 **	3.2 *				
Total/Average	18.0 *	1.8 *	20.8 *	2.9 *	.9 \$\$	2.4 **	39.8 *	2.2 *				

NOTE: Columns may not add to totals due to rounding.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

-- Relative standard error is greater than 50 pct.

Table A-36.--Average cost of alternate heating fuel by urban/rural location and cost category of alternate heating fuel

Cost of alternate fuel (category)	Urban	Rural	Location not determined	All households
- - - - - <u>Dollars per million Btu's</u> - - - - -				
Less than \$5.60	4.8	4.7	4.9	4.8
\$5.61 to \$8.19	6.4	6.3	6.8	6.4
\$8.20 to \$10.99	10.0	10.4	10.3	10.0
\$11.00 or more	<u>15.7</u>	<u>14.9</u>	<u>15.9</u>	<u>15.5</u>
Average	9.1	$\frac{1}{10.0}$	9.1	9.2

$\frac{1}{10.0}$ \$10.0/million Btu's equals 93 cents per gallon of fuel oil or \$6.60 per 1,000 cu. ft. of natural gas or 3.4 cents per kWh of electricity.

Table A-37.--Average amount of wood burned over all households by urban/rural location and cost of alternate heating fuel^{1/}

Cost of alternate fuel (category)	Urban	Rural	Location not determined	All households
<u>Dollars per million Btu's</u>			<u>Cords</u>	
Less than \$5.60	0.25 **	0.34 \$	--	0.26 **
\$5.61 to \$8.19	.21 **	.73 **	--	.27 *
\$8.20 to \$10.99	.31 *	1.30 *	--	.54 *
\$11.00 or more	.35 *	1.62 *	--	.64 *
No alternate fuel or price not determined	<u>.66</u> \$	<u>1.69</u> **	<u>--</u>	<u>1.22</u> **
Average	.30 *	1.24 *	.37 \$\$	.50 *

^{1/} Households burning less than one-third cord are assumed to have burned no wood for averages in this table.

* Relative standard error is 10 pct or less.

** Relative standard error is 10.1-15 pct.

\$ Relative standard error is 15.1-25 pct.

\$\$ Relative standard error is 25.1-50 pct.

APPENDIX B--MAPS OF TIMBER REGIONS AND
CLIMATE ZONES

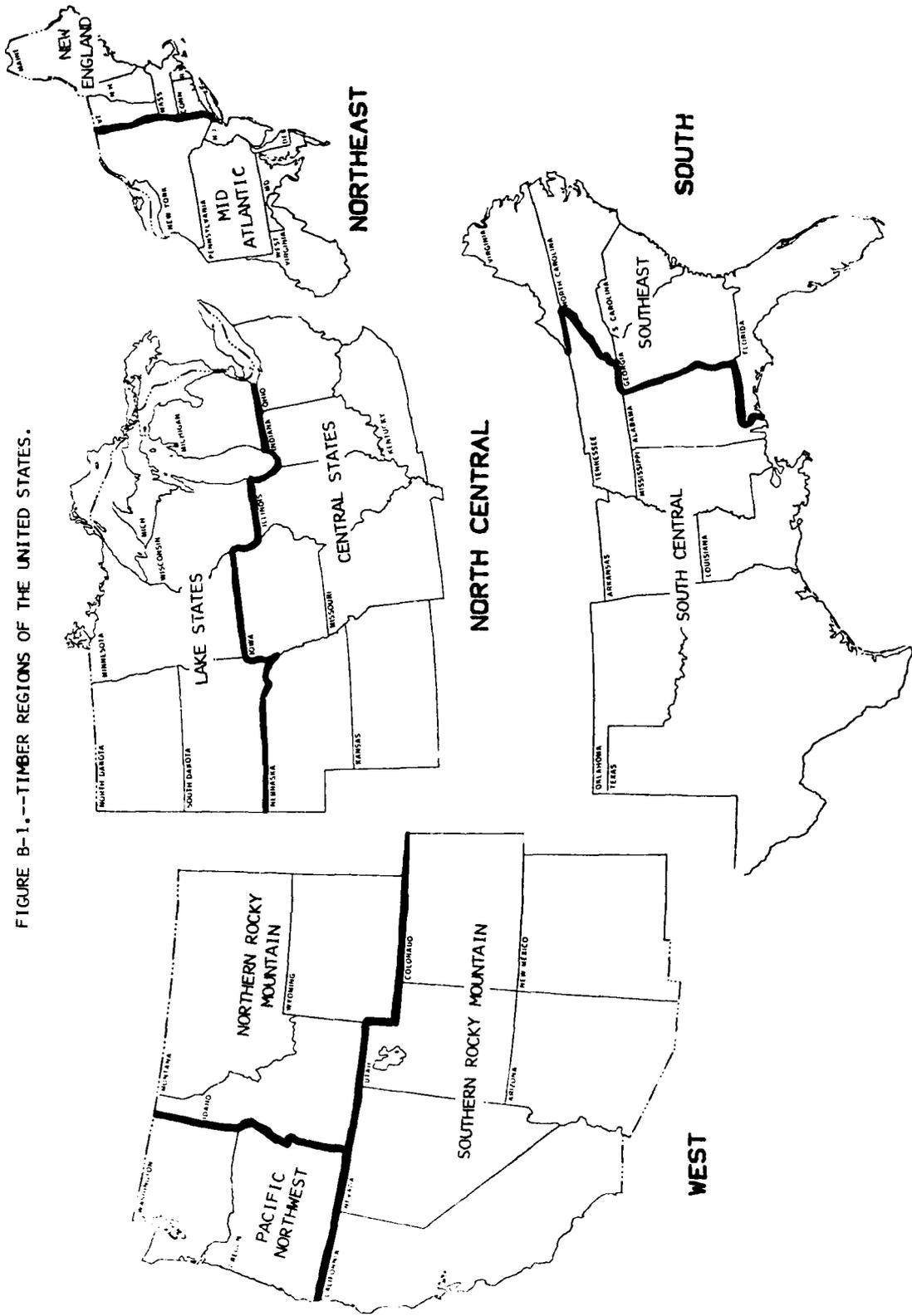
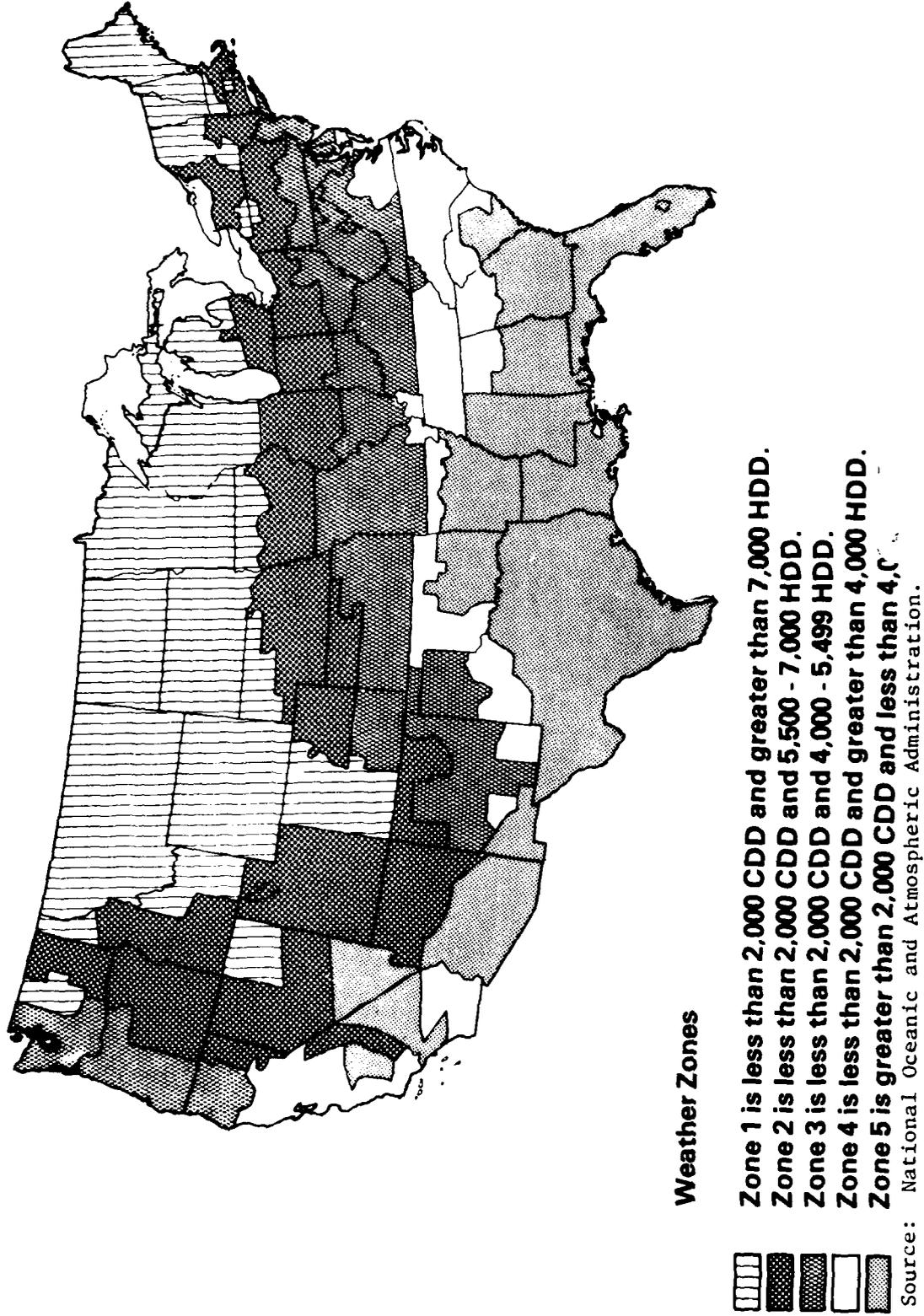


FIGURE B-1.--TIMBER REGIONS OF THE UNITED STATES.

FIGURE B-2.--UNITED STATES WEATHER ZONE MAP OF HEATING DEGREE DAYS (HDD) AND COOLING DEGREE DAYS (CDD)



APPENDIX C--HOW THE SURVEY WAS CONDUCTED

Introduction

The National Residential Fuelwood Consumption Survey was designed by the Forest Service in cooperation with the University of Wisconsin Survey Research Laboratory. Information concerning wood burning was collected through telephone interviews with adult residents of a representative national sample of households with telephones.

Our study used three telephone surveys; a pilot survey of approximately 500 respondents to test questions and aid in sample design, a main survey of 5,506 respondents, and a resurvey of 544 wood burners to check the accuracy of wood amounts estimated by respondents during the main survey.

After completion of the main survey and resurvey a procedure for estimating population characteristics was developed which adjusted for bias due to nonresponse and for errors respondents made in estimating amounts of wood.

Sample Design

The universe for our sample design was all households in the continental United States (we excluded Alaska and Hawaii). We did not sample households without telephones. However, we used our sample of households with telephones to represent all U.S. households in our estimation procedure. In 1979, 8 percent of households did not have telephones. We assumed that, as a group, urban and rural households without telephones had the same average wood-burning characteristics as households with telephones.

The primary objective of our sample design was to estimate amounts of wood burned by households in their primary homes during 1980-81 in each of nine timber regions with an accuracy

of ± 10 relative standard error in each region (see Timber Region Map, fig. B-1). To achieve this we established two strata in each timber region. The urban strata contained households with phone numbers in "free call" areas around the major cities of each SMSA in the United States. The rural strata contained all other households with telephones.

To determine the smallest sample required in each strata in each of nine regions we conducted a nationwide pilot survey of approximately 500 households to estimate the standard deviation of estimates of total amounts burned in each strata. Using this data, sample size in each region was divided between urban and rural strata in proportion to the standard deviation of the estimate of total amount burned (KISH 1965). The sample size for the entire region was made large enough to achieve the objective of ± 10 relative standard error.

The sample size calculated from pilot survey data were taken as targets for the main survey. Telephone numbers for the pilot survey and main survey were formed by affixing random four digit numbers to working three digit telephone exchange codes in each of the 18 strata. Rural strata had sample sizes much larger than their proportion of households. This is because our pilot survey showed rural households burned much more wood and the standard deviation of their estimated use was quite high. More than 20,000 phone numbers were generated for the 18 strata. Interviewers screened these numbers to find 5,506 working phone numbers in primary residences. Persons contacted at second homes were excluded from the sample. The count of completed calls is shown by strata in table C-1. Some phone numbers required up to 20 call backs to reach and interview an adult household member. Calls to some numbers ended in refusals and some numbers were never answered. As a result, we estimate 78 percent of the households in our 20,000+ number sample were interviewed. Estimated call completion rates for each strata are shown in table C-2. Since nonrespondents often have characteristics different from respondents we developed

Table C-1.--Main survey sample size by strata

Region	Urban ^{1/}	Rural	Total
Northwest	144	185	329
Northern Rocky Mountains	24	349	373
Southern Rocky Mountains	<u>542</u>	<u>177</u>	<u>719</u>
West	710	711	1,421
Lake States	342	350	692
Central States	<u>266</u>	<u>414</u>	<u>680</u>
North Central	608	764	1,372
Mid-Atlantic	537	340	877
New England	<u>320</u>	<u>334</u>	<u>654</u>
Northeast	857	674	1,531
Southeast	388	237	625
South Central	<u>367</u>	<u>190</u>	<u>557</u>
South	755	427	1,182
Total United States	2,930	2,576	5,506

^{1/} The urban strata contains households with phone numbers in "free call" areas around main SMSA cities. Households with phone numbers outside "free call" areas are in the rural strata.

a procedure to test for differences between respondents and non-respondents. We discuss the test and corrections for possible nonresponse bias in a later section.

During our main survey, we interviewed 1,874 households that had burned wood during the previous 24 months. To check the amounts of wood they said they burned, acquired, and cut, we conducted a resurvey of 544 wood-burning households. We used this resurvey data to correct errors respondents had made in estimating amounts during the main survey. This correction procedure is discussed in a later section.

Table C-2.--Main survey interview completion rates by strata

Region	Urban ^{1/}	Rural	Total
	- - - - Pct - - - -		
Northwest	81	78	79
Northern Rocky Mountains	87	79	79
Southern Rocky Mountains	75	80	76
West	77	79	78
Lake States	86	83	84
Central States	79	74	76
North Central	83	78	80
Mid-Atlantic	71	78	74
New England	77	76	76
Northeast	73	77	75
Southeast	80	75	78
South Central	77	81	78
South	79	78	78
Total United States	77	78	78

^{1/} The urban strata contains households with phones in "free call" areas around main SMSA cities. Households with phones outside free call areas of these major cities are in the rural strata.

Data Collection

The three surveys in our study were conducted by approximately 100 interviewers of the Wisconsin Survey Research Laboratory. Training sessions were held for interviewers before each survey to discuss the purpose and meaning of survey questions and procedures for conducting interviews. The pilot survey was conducted during June 1981, the main survey was conducted from August to October 1981, and the resurvey was conducted in November 1981. The midpoint of interviewing for the main survey was in September so respondent answers covering the previous 12 months cover mid-September 1980 to mid-September 1981. Interviewers used computer-assisted telephone interviewing.

Survey questions were displayed for the interviewer by a micro-computer on a video terminal, and responses were transmitted to a minicomputer for storage.

Survey Estimates

Survey estimates were developed to expand sample results to represent all households in the continental 48 states. We took the size of this universe of households to be 79,952,765 as estimated by the 1980 Census of Population and Housing.

Preliminary weights were calculated for sample households in each strata using information about the total number of random phone numbers possible in a strata, the number of random phone numbers attempted in the strata, the number of calls completed, and the estimated completion rate. The preliminary weight in a strata was computed as:

$$\frac{(\text{No. of random nos. possible in strata})}{(\text{No. of random nos. attempted in strata})} \times \frac{(\text{No. of households contacted})}{(\text{Percent of households contacted})}$$

These weights were first adjusted so to produce the correct total number of households in each of nine timber regions. Each household in a region was multiplied by the same factor to cause this adjustment.

A second adjustment of weights was made in each of the nine regions to correct for differences between respondents and nonrespondents.

Adjustment for Interview Nonresponse

Considerable effort was made to interview all households in our sample of random phone numbers. Some numbers were called as

many as 20 times to contact and interview an adult. Twenty-three percent of the households contacted required 4 calls or more. Despite these efforts we estimate 22 percent of the households in our sample of random numbers were not interviewed. These non-respondents were almost evenly divided between households which refused to be interviewed, 55 percent, and households where a phone was never answered, 45 percent.^{1/}

To determine if our respondents were representative of all U.S. households, we compared our survey estimates of number of owners and renters to the 1980 Census estimates. Table C-3 shows our survey estimated more owners than the 1980 Census. This suggested that respondents in our survey were more likely to be homeowners, and nonrespondents were more likely to be renters.

We tested to see if nonrespondents were more likely to be renters. To make this test we assumed nonrespondents were much like households that were hard to reach, taking four or more calls to reach. Under this assumption, presence of a high number of renters among hard-to-reach households would support the view that nonrespondents were renters. This view is supported by table C-4 which shows hard-to-reach households were more likely to be renters than easy-to-reach households. This result supports the view that there is an overrepresentation of owners among our respondents.

In order to correct for the excess representation of owners we increased the weight on renters in each of our nine regions and decreased the weight on owners so as to have the number of owners and renters in the region match 1980 Census counts.

^{1/} When we completed our main survey, a number of random phone numbers remained where no one had answered our calls. To determine how many of these phones were for residences (versus a business or nonworking number) we made repeated calls to a sub-sample. The fraction of residences determined in this way was used to estimate the total number of residences among the numbers never contacted in each strata.

Table C-3.--Percentage of households owning a home
according to the 1980 Census and our survey
by timber region

Timber region	1980 Census	Survey
Northwest	65.5	73.3
Northern Rocky Mountains	70.2	77.6
Southern Rocky Mountains	58.8	66.2
Lake States	71.1	73.6
Central States	67.9	74.4
Mid-Atlantic	58.9	67.1
New England	61.7	67.2
South Central	67.1	73.2
Southeast	64.5	73.9

Table C-4.--Percentage of households owning a home by callback category and timber region

Timber region	Easy to reach (one to three calls)	Hard to reach (four or more calls)
Northwest	73.8	71.7
Northern Rocky Mountains	75.6	85.6
Southern Rocky Mountains	66.4	65.2
Lake States	73.6	73.3
Central States	76.7	64.6
Mid-Atlantic	68.0	64.3
New England	65.3	72.1
South Central	75.2	64.3
Southeast	73.4	75.0

The effect of increasing the representation of renters is to decrease estimates of amounts of wood burned (table C-5). This results because renters burn much less wood than owners on average.

Even though we have corrected the imbalance between owners and renters in our sample, nonrespondent owners and renters may still burn different amounts of wood than respondent owners and renters. To evaluate this possibility we once again used hard-to-reach respondents to represent nonrespondents. Table C-6 shows hard-to-reach owners and hard-to-reach renters were in fact more likely to burn wood. In a separate calculation we found hard- and easy-to-reach wood burners burned about the same amount of wood. These facts combined indicate the average hard-to-reach owner or renter burned more wood.

If we trust our assumption that hard-to-reach respondents are like nonrespondents, this result means greater weight should be placed on hard-to-reach respondents to have them represent all of the nonrespondents. We made this increase in weights on hard-to-reach respondents in each region but wanted to test it before we accepted it. We evaluated the adjustment by comparing 15 previous state-level fuelwood consumption survey estimates of wood burned with our estimates for those 15 states. We compared our estimates with and without an increased weight for hard-to-reach households. The increased weight on hard-to-reach respondents actually increased (very slightly) the aggregate difference between state estimates. Nationwide the increased weight on hard-to-reach households increased estimated wood burning by less than 3 percent. Because the adjustment made little difference in matching previous surveys and had little overall effect, we rejected it in an effort to minimize the complexity of corrections. Without the adjustment, estimated percent of households burning wood and amounts burned are somewhat lower.

Table C-5.--Amount burned in primary homes during 1980-81 before
and after adjusting for homeowner/renter balance

Region	Unadjusted estimate	Adjusted estimate
	- - - - Million standard cords - - - -	
Northwest	3.3	3.2
Northern Rocky Mountains	.9	.8
Southern Rocky Mountains	3.3	3.1
Lake States	4.4	4.4
Central States	7.9	7.6
Mid-Atlantic	6.4	5.9
New England	3.6	3.4
South Central	6.3	6.0
Southeast	<u>6.1</u>	<u>6.1</u>
Total United States	42.2	40.5

Table C-6.--Percentage of households burning wood in 1979-80 or 1980-81 by tenure and callback category

Region	Owners		Renters	
	Easy to reach (one to three calls)	Hard to reach (four-plus calls)	Easy to reach (one to three calls)	Hard to reach (four-plus calls)
Northwest	68.8	76.7	31.3	40.4
Northern Rocky Mountains	50.8	68.7	17.6	61.5
Southern Rocky Mountains	47.8	33.1	10.1	13.4
Lake States	34.2	52.6	9.0	16.8
Central States	31.5	47.4	8.4	14.1
Mid-Atlantic	31.2	45.3	4.1	6.4
New England	50.0	56.4	8.1	15.1
South Central	33.0	40.7	8.6	30.9
Southeast	36.1	50.4	18.7	11.6

Adjustment for Item Nonresponse

Item nonresponse refers to interviews where an answer was not obtained from a respondent for a particular question. In these cases the record shows the respondent "didn't know" an answer or the answer was "not ascertained." Imputations were made for most questions to eliminate item nonresponse. Table C-7 shows variables that were often imputed.

Two methods were used for imputation. The "hot-deck" procedure requires sorting the file of households by key characteristics related to the item to be imputed. A missing value is imputed by selecting a "donor" interview with the same characteristics as the "donee" household. The desired characteristic in the "donor"

Table C-7.--Survey answers often imputed

Item	Cases imputed	Percent of interviews	Method of imputation
1980 family income	813	14.8	Hot-deck
Own/rent	42	.7	Hot-deck
Amount burned, 1979-80	34	.6	Mean value
Amount burned, 1980-81	29	.5	Mean value
Roundwood acquired	32	.5	Mean value
Wood self-cut	22	.3	Mean value
Wood self-cut from woodland	17	.3	Mean value
Mill waste acquired	5	.1	Mean value

household is used to replace the missing "donee" item. A second method was used to replace missing amounts of wood. Mean values of amounts of wood (burned, acquired, etc.) were computed in each of nine regions for each of six categories of wood-burning equipment used most. An interview missing an amount used the mean value from among the 54 values that matched its region and equipment.

Adjustment for Respondent Error in Estimates of Amounts of Wood Burned, Acquired, and Self-Cut

To obtain accurate estimates of amounts of wood from respondents we used both the main survey and a resurvey. In each survey we took steps to aid respondents in providing accurate answers. We believe our resurvey provided more reliable answers about amounts of wood and used it to correct estimates from the main survey.

While designing questions about amounts of wood burned, acquired, and cut, we realized respondents could easily make

errors in estimation. We believed their tendency to overestimate or underestimate could be influenced by several controllable factors which include:

- The degree to which common measuring units--standard cords and face cords--are clearly defined.

- The degree to which respondents are allowed flexibility in responding in nonstandard units they know best, such as pickup truck loads.

- The degree to which interviewers probed when a respondent did not seem to understand a question.

The first two factors were guides in designing our questions, the third factor was a guide in training interviewers. An additional key to obtaining uniformly good estimates from wood burners was the requirement for uniformly detailed questions. All information provided to respondents should be written into questions. Too much information would be confusing; too little would require too much probing by the interviewer and lead to greater error. The question form we developed for the main survey is shown in question 1 of the main survey in appendix E.

In order to evaluate possible respondent errors during the main survey, we conducted a resurvey of 544 wood burners. The resurvey questions about wood amounts contained some improvements over those used in the main survey:

- For every respondent a standard cord was further defined to be approximately equal to one half-ton pickup truck load.

- Responses of "1 cord" were questioned further since "1 cord" is a convenient response when a respondent actually used much less.

- Respondents were given greater flexibility and encouragement to use measurement units they knew best.

See question 1 of the resurvey in appendix E.

In addition to using improved questions for the resurvey, we used only the most experienced interviewers in a further effort to obtain better amount estimates.

We designed the resurvey sample size and stratification so we might detect differences of 10 percent in total amount burned between surveys in each of nine strata using paired T-tests at the 90 percent confidence level. Our strata were formed by dividing our main survey sample into three regions--West, North, and South--and three household groups--those burning 0 to 2.9 cords, 3 to 9.9 cords, and 10+ cords, over the last 12 months.

Table C-8 shows the size of samples in each strata and indicates we sampled a greater fraction of the heavy wood burners than the light wood burners. We attempted to resurvey all households estimating 10+ cords burned during the main survey.

A Comparison of Main Survey and Resurvey Results

Comparison of amounts burned in 1980-81.--In general, resurvey estimates of amounts burned in 1980-81 were significantly lower than main survey estimates. Table C-9 shows average amounts burned by households for each strata and each survey. For households using 1 to 2.9 cords separate comparisons were made for households burning mostly in ordinary fireplaces and those using other equipment. Heavier users were grouped as stove users or nonstove users. These equipment categories were chosen because there was considerable difference in resurvey/survey ratios for different equipment groups.

Since we concluded that the resurvey estimates were more accurate than main survey estimates, we proceeded to evaluate two ways to adjust the main survey data. One method would be to develop linear regressions relating resurvey amount burned to main survey amounts burned for each resurvey strata (or for groups of strata). As an alternative, we could adjust by using ratios between average resurvey response and average main survey response in each strata. We evaluated the regression method by estimating linear regressions for each category in table C-9. The regression intercept term was not significantly different

Table C-8.--Number of wood burners in the main survey sample and resurvey sample by strata

Strata (region and cords burned)	Main sample completed (cases)	Resurvey sample completed (cases)	Resurvey sample rate <u>Pct</u>
West			
0-2.9	432	88	20
3-9.9	176	100	57
10+	9	6	67
North			
0-2.9	588	106	18
3-9.9	258	112	43
10+	35	26	74
South			
0-2.9	249	76	31
3-9.9	93	26	28
10+	6	4	67
Amount not determined	<u>28</u>	<u>--</u>	<u>--</u>
Total	1,874	544	--

Table C-9.--Paired resurvey and main survey results--amount burned
in 1980-1981

Strata (region and cords burned)	Average main survey (standard cords)	Average resurvey (standard cords)	Resurvey ÷ main survey (ratio)	Paired T-test p value ^{1/}	Number of cases
				<u>Pct</u>	
<u>West</u>					
0-2.9 (ordinary fireplace)	0.604	0.354	0.59	0.0	46
0-2.9 (other equipment)	1.096	1.339	1.22	11	34
3-9.9 (stove)	4.263	4.375	^{2/} 1.03	69	55
3-9.9 (other equipment)	4.130	3.674	.89	8	33
10+	10.085	2.574	.26	0.0	6
<u>North</u>					
0-2.9 (ordinary fireplace)	.723	.681	^{2/} .94	48	48
0-2.9 (other equipment)	1.130	1.377	1.22	11	45
3-9.9 (stove)	4.540	3.986	.88	1	77
3-9.9 (other equipment)	4.683	3.166	.68	0.0	35
10+	13.534	8.804	.65	0.0	26
<u>South</u>					
0-2.9 (ordinary fireplace)	.806	.755	^{2/} .94	56	42
0-2.9 (other equipment)	1.378	1.335	^{2/} .97	79	31
3-9.9 (stove)	3.714	3.270	.88	17	13
3-9.9 (other equipment)	4.672	3.654	.78	16	13
10+	12.900	4.081	.32	.2	4

^{1/} Probability that survey and resurvey population averages are equal,
given the average difference in sample paired values.

^{2/} Resurvey is less than 10 pct different from the main survey.

from zero (95 pct level) except for one case. In the case where it was significant, the intercept was extremely small--0.04 cord. We chose to use the ration adjustment method for all categories to maintain simplicity of calculations. Ratio adjustments were made to main survey amounts burned in 1980-81 if the difference between surveys exceeded 10 percent.

Comparison of amounts acquired and amounts self-cut.--Resurvey estimates of amounts acquired and self-cut used the same question design as for amount burned. Resurvey estimates for amounts acquired and cut were significantly lower than main survey estimates (table C-10). Paired T-test significance levels and regression estimates of resurvey amounts were examined as guides to choose either the ratio or regression method to adjust main survey estimates. As a result, ratios were judged to be an acceptable means to adjust main survey results. Adjustments were made to main survey data if the resurvey differed from the main survey by 10 percent or more.

Adjustment of Amounts Cut From Woodland

Our resurvey did not ask for estimates of amounts cut from woodland. To adjust amounts cut from woodland we assumed errors were similar to errors in estimating all self-cut wood and used adjustment factors shown in table C-10.

Table C-10.--Paired resurvey and main survey results--amount acquired and amount self-cut in 1980-1981

Strata (region and cords burned)	Resurvey ÷ main survey (ratio of averages)	
	Amount acquired	Amount self-cut
<u>West</u>		
0-2.9 (ordinary fireplace)	0.71	0.83
0-2.9 (other equipment)	1.15	^{1/} .97
3-9.9 (stove)	1.15	^{1/} 1.00
3-9.9 (other equipment)	^{1/} 1.03	.70
10+	.31	.27
<u>North</u>		
0-2.9 (ordinary fireplace)	.71	.83
0-2.9 (other equipment)	1.20	1.15
3-9.9 (stove)	.82	.74
3-9.9 (other equipment)	.73	.53
10+	.71	.50
<u>South</u>		
0-2.9 (ordinary fireplace)	.87	.80
0-2.9 (other equipment)	.84	.63
3-9.9 (stove)	.87	.75
3-9.9 (other equipment)	.68	.81
10+	.31	.39

^{1/} Resurvey is less than 10 pct different from the main survey.

APPENDIX D--ESTIMATION OF RELATIVE STANDARD
ERRORS OF SURVEY ESTIMATES

Relative standard errors^{1/} would be difficult to compute for our survey using parametric techniques because of our stratified sampling design and the fact that many estimates use data from all strata. As an alternative we chose to use two nonparametric techniques, termed jackknife and bootstrap procedures, to calculate standard errors. Each procedure involves sampling our survey data repeatedly to represent many more surveys. Estimates are made from each of these samples, and the standard deviation of these many estimates is an estimate of the standard error of estimate for our survey estimate. The relative standard error is calculated by dividing the standard error by the estimate.

A jackknife procedure was used to calculate errors in percentages of a group of households which fall into particular categories; such as the second column in table A-34. Our jackknife procedure follows a method given by Efron (1982) for grouped jackknife calculations. Given our sample of n household values, X_1, X_2, \dots, X_n , we divide households into g random groups of $n/g = h$ each. We compute g estimates of the percentage of households falling in different categories by excluding, in turn, one of the h groups, then computing the percentages. Let p_i be a percentage computed for the i th sample. Our estimated standard error for the percentage is the standard deviation of the estimates p_1, p_2, \dots, p_h . Standard errors were computed for $g = 10, 20, 30, 40$, and 90 groups. The largest standard error was taken as the most conservative estimate of error.

The bootstrap procedure was used to compute errors for other estimates. Once again we follow a method given by Efron (1982).

^{1/} A relative standard error of, say, 10 percent means that if our survey were repeated over and over with an identical sample design then 67 percent of these repeated estimates would be within ± 10 percent of the true amount.

We created new estimates for particular variables by sampling from our interviews with replacement. We took 50 samples of 5,506 cases each from our set of 5,506 interviews and computed 50 estimates (mean values). The standard deviation of these 50 estimates is an estimate of the standard error of estimate. We followed this procedure twice to compute two estimates of standard error and chose the larger estimate as our estimate of standard error.

Our error estimates do not include estimates of nonsampling error that was not corrected by our adjustment for nonresponse or by our adjustment for errors in amounts of wood. That is, our error estimates assume our adjustments for nonresponse and error in amounts of wood were perfect. This, of course, is not the case. As a result, the true error of our estimates may be somewhat larger than those calculated by our jackknife or bootstrap procedures.

To underscore our uncertainty about errors we chose only to indicate the range of error for data items. We chose the following categories for relative standard error:

- * 10 percent or less
- ** 10.1 percent to 15 percent
- \$ 15.1 percent to 25 percent
- \$\$ 25.1 percent to 50 percent
- 50 percent or more

APPENDIX E--MAIN SURVEY AND RESURVEY QUESTIONNAIRES

Office Number
Project 1321
August, 1981

University of Wisconsin-Extension
Wisconsin Survey Research Laboratory

National Woodburning Survey
LONG AND SHORT INTERVIEW: Woodburners

1. I want to assure you that all of the information you give us is confidential, and that none of it will be released in any way that would permit identification of you or your family. We don't even need to know your name. Your participation, of course, is voluntary.

1b. The first questions are about the amount of wood your household burned over the last 12 months in your usual residence--not in a second home you may have. A standard cord is a stack of wood four feet high, four feet deep, and eight feet wide. A face cord is a stack of stove length pieces four feet high and eight feet wide.

1c. How many standard cords or face cords were burned in your usual place of residence since (PRESENT MONTH), 1980? (IF NECESSARY: A regular half-ton pickup truck carries about one-half of a standard cord.)

Known total or fraction of STANDARD CORD: # _____ (TO Q 2)
Known total or fraction of FACE CORD: # _____ (TO Q 1g)

Both STANDARD AND FACE CORDS: # _____ STANDARD CORD
_____ FACE CORDS
(TO Q 1g)

/None/ (TO Q 2) /Don't know/ (TO Q 1i) /Less than one cord/ (TO Q 1h)
/fraction unknown/ (SKIP TO Q 2)

1g. Would you say that the length of the pieces of wood in these face cords--on the average--was about 12 inches, 16 inches, 18 inches, or 24 inches?

/1. 12"/ (GO TO Q 2) /2. 16"/ (GO TO 2) /3. 18"/ (GO TO 2) /4. 24"/

Other (SPECIFY) _____ (TO Q 2) /7. Don't know/ (TO Q 2)

1h. Would you say that over the last 12 months you burned 150 or fewer stove length pieces of wood, about 300 pieces, about 450 pieces--that's how much a half-ton pickup truck can carry, or about 900 pieces--the amount in two pickup truck loads?

/1. 150 or/ (GO TO Q 2) /2. 300/ (GO TO Q 2) /3. 450/ (GO TO Q 2) /4. 900/ (GO TO Q 2) /7. Don't know/ (TO Q 1i)
/fewer/ /pieces/ /pieces/ /pieces/

Interviewer: _____ Sample #: _____

Date: _____ Time Started: _____

11. Could you tell me about how much you burned over the last 12 months by the number of truck loads, car trunk loads, or so forth?

AMOUNT UNIT (SEE UNIT CODES)

_____ _____ OTHER: _____

_____ _____ /Don't know/

2. How many standard cords or faces cords did your household burn in your usual residence the year before--from (PRESENT MONTH), 1979, to (PRESENT MONTH), 1980?

Known total or fraction of
STANDARD CORD:

(TO Q 3)

Known total or fraction of
FACE CORD:

(TO Q 2d)

Both STANDARD AND FACE CORDS: # _____ STANDARD CORD

/Did not have own/
/ household then /

_____ FACE CORDS
(TO Q 2d)

(TO Q 3)

/None/
(TO Q 3)

/Don't know/
(TO Q 2f)

/Less than one cord fraction unknown/
(TO Q 2e)

2d. On the average, would you say that the pieces of wood in the face cords you burned two years ago were about 12 inches in length, 16 inches, 18 inches, or 24 inches?

/1. 12"/
(GO TO Q 3)

/2. 16"/
(GO TO Q 3)

/3. 18"/
(GO TO Q 3)

/4. 24"/
(GO TO Q 3)

Other (SPECIFY): _____
(TO Q 3)

/Don't know/
(TO Q 3)

2e. Two years ago, did you burn 150 or fewer pieces of wood, or about 300, 450, or 900 pieces--the amount in two pickup truck loads?

/1. 150 or/
/ fewer /
(GO TO Q 3)

/2. 300/
/ pieces/
(GO TO Q 3)

/3. 450/
/ pieces/
(GO TO Q 3)

/4. 900/
/ pieces/
(GO TO Q 3)

/7. Don't know/

2f. Could you tell me about how much wood you burned in your home two years ago by the number of truck loads, car trunk loads, or so forth?

AMOUNT UNIT (SEE UNIT CODES)

_____ _____ Other: _____

_____ _____ /Don't know/

7. Was most of the waste mill wood you got over the last 12 months hardwood-- such as maple, oak, or poplar, or was it softwood--evergreens like pine, spruce, or fir?

/1. Hardwood/ /2. Softwood/evergreen/ /3. Both equal/ /7. Don't know/

8. And, what percentage of all the waste mill wood you got over the last 12 months did you buy rather than get for free?

/None bought/ % Buy: _____ /Don't know/
(TO Q 9)

8a. How much waste mill wood did you get the last time you bought it--please give us the amount in either standard cords or tons or whatever was used to haul it?

AMOUNT: _____, UNIT CODE: _____

Other: _____ /Don't know/

8b. How much did this waste mill wood cost?

TOTAL COST: \$ _____ /Don't know/

ALL RESPONDENTS

9. Over the last 12 months, did you get any discarded wood products for burning... such as scrap lumber, wooden parts of buildings, crates, or pallets?

/1. Yes/ /2. No/ /7. Don't know/

10. Over the last 12 months, did you get any logs or splitwood for burning in your home (or your second home)? This includes any logs or splitwood your household purchased, cut yourselves, or were given for your own use. Don't include wood from mills.

/1. Yes/ /2. No/ /7. Don't know/
(SKIP TO Q 32)

11. Please estimate the number of standard cords or face cords of logs or splitwood you got over the last 12 months.

Known total or fraction of
STANDARD CORD: # _____
(TO Q 12)

Known total or fraction of
FACE CORD: # _____
(TO Q 11d)

Both STANDARD AND FACE CORDS: # _____ STANDARD CORD

_____ FACE CORDS
(TO Q 11d)

/None/
(GO BACK TO Q 10)

/Don't know/
(TO Q 11f)

/Less than one cord fraction /
unknown
(TO Q 11e)

11d. On the average, were the pieces in these face cords you got over the last 12 months about 12 inches in length, 16 inches, 18 inches, or 24 inches?

/1. 12"/ /2. 16"/ /3. 18"/ /4. 24"/
(TO Q 12) (TO Q 12)

Other (SPECIFY): _____
(TO Q 12)

/7. Don't know/
(TO Q 12)

11e. Was it about 150 or fewer pieces of wood, or about 300, 450, or 900 pieces--the amount in two pickup truck loads?

/1. 150 or/ /2. 300/ /3. 450/ /4. 900/ /7. Don't know/
/ fewer / /pieces/ /pieces/ /pieces/
(GO TO Q 12) (GO TO Q 12)

11f. Could you tell me about what amount of logs or splitwood you got over the last 12 months by the number of truck loads, or car trunk loads, or so forth?

AMOUNT UNIT (SEE UNIT CODES)

_____ Other: _____

_____ /Don't know/

12. Were most of the logs and splitwood you got over the last 12 months hardwood-- such as maple, oak, or poplar, or was it softwood--evergreens like pine, spruce, or fir?

/1. Hardwood/ /2. Softwood/evergreens/ /3. Both equal/ /7. Don't know/

13. Of all the logs and splitwood you got over the last 12 months--both hardwood and softwood--what percentage did you buy rather than get for free? (Your best estimate will do.) (NOTE: PAYMENT FOR A PERMIT TO CUT IS A PURCHASE.)

/None bought/ % Buy: _____ /Don't know/
(SKIP TO Q 19)

14. How much logs or splitwood did you get the last time you bought it--give us the amount in either standard or face cords, or whatever was used to haul it?

AMOUNT: _____; UNIT CODE: _____

Other: _____ /Don't know/

15. How much did this last purchase of logs or splitwood cost?

TOTAL COST: \$ _____ /Don't know/

16. Were most of the logs and splitwood you last bought hardwood--such as maple, oak, or poplar, or was it softwood--evergreens like pine, spruce, or fir?

/1. Hardwood/ /2. Softwood/evergreens/ /3. Both equal/ /7. Don't know/

17. Was most of this wood already dried--or seasoned--for burning when you bought it?

/1. Dried/seasoned/ /2. Green/ /3. Half of each/ /7. Don't know/

18. Where did you buy these logs and splitwood?

/1. Retail store: supermarket, gas station, hardware, garden center, etc./

/2. Cut/collected by household from land/
(TO Q 19a)

/3. Somewhere else: neighbor, friend, vendor, farmer, etc./

/7. Don't know/

- 18a. Did the purchase price include delivery to your home?

/1. Yes/ /2. No/ /7. Don't know/

- 18b. How long, in inches or feet, were most of the logs or splitwood you bought most recently?

Inches: _____, or # Feet: _____ /Don't know/
(TO Q 19) (TO Q 19)

- 18c. Were most of the logs or splitwood less than eight feet long?

/1. Yes/ /2. No/ /7. Don't know/

19. Over the last 12 months, did your household cut or collect any firewood from land where it was grown? Please include wood you cut to be sold, given away, or for your own use.

/1. Yes/ /2. No/ /7. Don't know/
(SKIP TO Q 32)

- 19a. Is there a strong chance that you would stop burning wood for fuel if you could no longer cut wood from your usual land source?

/1. Yes/ /2. No/ /7. Don't know/

NOTE: IF R'S HOUSEHOLD WORKED WITH OTHERS TO COLLECT WOOD, ASK Q'S ABOUT THAT PORTION TAKEN HOME, RETAINED, OR OWNED BY R'S HOUSEHOLD.

20. Please estimate the number of standard or face cords you cut or collected from the land over the last 12 months.

Known total or fraction of STANDARD CORD: # _____ (TO Q 21) Known total or fraction of FACE CORD: # _____ (TO Q 20d)

Both STANDARD AND FACE CORDS: # _____ STANDARD CORD
_____ FACE CORDS (TO Q 20d)

/Don't know/ (TO Q 20f) /Less than one cord fraction unknown/ (TO Q 20e)

20d. On the average, were the pieces in these face cords about 12 inches in length, 16 inches, 18 inches, or 24 inches?

/1. 12"/ (TO Q 21) /2. 16"/ (TO Q 21) /3. 18"/ (TO Q 21) /4. 24"/ (TO Q 21)

Other (SPECIFY): _____ (TO Q 21) /7. Don't know/ (TO Q 21)

20e. Did this firewood you cut or collected over the last 12 months amount to 150 or fewer pieces, or about 300, 450, or 900 pieces--the amount in two pickup truck loads?

/1. 150 or/ (GO TO Q 21) /2. 300/ (GO TO Q 21) /3. 450/ (GO TO Q 21) /4. 900/ (GO TO Q 21) /7. Don't know/

20f. Could you tell me about how much firewood you cut or collected over the last 12 months by the number of truck loads, or car trunk loads, or so forth?

AMOUNT UNIT (SEE UNIT CODES)

_____ Other: _____
_____ /Don't know/

21. We are interested in knowing if any of the wood you cut or collected came from trees on any of the following places: from pasture or crop land, from windbreaks or fence rows, from inside city or village limits, or from woodland areas. First, did any come from trees on pasture or crop land?

/1. Yes/ /2. No/ /7. Don't know/

22. ...from trees in a windbreak or fence row outside city or village limits?

/1. Yes/ /2. No/ /7. Don't know/

23. ...from trees inside city or village limits?

/1. Yes/ /2. No/ /7. Don't know/

24. ...from woodland areas? A woodland area is any land covered--even lightly--with trees, outside cities or villages but not including the yards of homes. Did you cut or collect any wood from a woodland area?

/1. Yes/ /2. No/ /7. Don't know/
 (TO Q 25) (SKIP TO Q 32)

25. Please estimate the number of standard cords or face cords of woodland firewood you cut or collected over the last 12 months.

Known total or fraction of Known total or fraction of
 STANDARD CORD: # _____ FACE CORD: # _____
 (TO Q 26) (TO Q 25d)

Both STANDARD AND FACE CORDS: # _____ STANDARD CORD
 # _____ FACE CORDS
 (TO Q 25d)

/None/ /Don't know/ /Less than one cord fraction unknown/
 (BACK TO Q 24) (TO Q 25f) (TO Q 25e)

25d. On the average, were these woodland face cords about 12 inches in length, 16 inches, 18 inches, or 24 inches?

/1. 12"/ /2. 16"/ /3. 18"/ /4. 24"/
 (TO Q 26) (TO Q 26)

Other (SPECIFY): _____ /7. Don't know/
 (TO Q 26) (TO Q 26)

25e. Was the amount of woodland firewood you cut or collected over the last 12 months 150 or fewer pieces, or about 300, 450, or 900 pieces--the amount in two pickup truck loads?

/1. 150 or/ /2. 300/ /3. 450/ /4. 900/ /7. Don't know/
/ fewer / /pieces/ /pieces/ /pieces/ (TO Q 25f)
 (TO Q 26) (TO Q 26)

32f. Of all the wood you burned at your (past/present) home since (PRESENT MONTH) last year, what percentage was used in a fireplace?

#: _____ /Don't know/

(INTERVIEWER: IF PAST HOME, USE PAST TENSE)

33. How many--if any--workable woodburning stoves (do/did) you have in your (usual) home?

/0. None/, or #: _____
(TO Q 34)

33a. (Is/Was) it (Are/Were any of them) airtight--where the doors are sealed tight when closed?

/1. Yes/ /2. No/ /7. Don't know/

33b. INTERVIEWER: WAS WOOD BURNED IN PAST YEAR? (SEE Q 1c)

/1. Yes/ /2. No/
(TO Q 34)

33c. Of all the wood you burned at your (past/present) home over the last 12 months, what percentage was burned in the stove?

#: _____ /Don't know/

34. (Did/Does) your (usual) home have a workable woodburning furnace that is connected to air distribution duct work or hot water piping?

/1. Yes/ /2. No/ /7. Don't know/
(TO Q 38) (TO Q 38)

34a. INTERVIEWER: WAS WOOD BURNED IN PAST YEAR? (SEE Q 1c)

/1. Yes/ /2. No/
(TO Q 35)

34b. Of all the wood you burned at your (past/present) home over the last 12 months, what percentage was burned in the furnace?

#: _____ /Don't know/

38. What one fuel was used to provide most of the space heat in your (past/present) home during the last 12 months? (CHECK ONE)

/1. Fuel oil/ /2. Natural gas/ /3. Electricity/ /4. Propane/LP gas/
/5. Coal/ /6. Solar/ /7. Kerosene/ /8. Wood/

Other: _____ /0. None/
(TO Q 40)

47. How many standard cords or face cords did you burn in your second home the year before--from (PRESENT MONTH), 1979, to (PRESENT MONTH) 1980?

Known total or fraction of STANDARD CORD: # _____ (TO Q 48)
Known total or fraction of FACE CORD: # _____ (TO Q 47d)

Both STANDARD AND FACE CORDS: # _____ STANDARD CORD
_____ FACE CORDS /No 2nd home then/ (TO Q 47d) (TO Q 48)

/None/ (TO Q 48) /Don't know/ (TO Q 47f) /Less than one cord fraction unknown/ (TO Q 47e)

47d. Would you say that the length of the pieces of wood in the face cords you burned at your second home two years ago was about 12 inches, 16 inches, 18 inches, or 24 inches?

/1. 12"/ (GO TO Q 48) /2. 16"/ (GO TO Q 48) /3. 18"/ (GO TO Q 48) /4. 24"/ (GO TO Q 48)

Other (SPECIFY): _____ (TO Q 48) /7. Don't know/ (TO Q 48)

47e. Two years ago, did you burn 150 or fewer pieces of wood at your second home, or about 300, 450, or 900 pieces--the amount in two pickup truck loads?

/1. 150 or fewer/ (GO TO Q 48) /2. 300/ (GO TO Q 48) /3. 450/ (GO TO Q 48) /4. 900/ (GO TO Q 48) /7. Don't know/

47f. Could you tell me about how much wood you burned two years ago at your second home by the number of truck loads, or car trunk loads, or so forth?

AMOUNT UNIT (SEE UNIT CODES)

Other: _____

/Don't know/

48. How many workable woodburning fireplaces--if any--do you have in your second home?

/0. None/, or #: _____ (TO Q 49)

48a. Do you have an air-circulating device or special energy efficient insert in (any of) your fireplace(s) there?

/1. Yes/ /2. No/ /7. Don't know/

48b. Of all the wood burned at this second home over the last 12 months, what percentage was used in a fireplace?

?: _____ /Don't know/

49. How many--if any--workable woodburning stoves do you have in your second home?

/0. None/, or #: _____
(TO Q 50)

49a. Is it (Are any of them) airtight--where the doors are sealed tight when closed?

/1. Yes/ /2. No/ /7. Don't know/

49b. Of all the wood burned at this second home over the last 12 months, what percentage was burned in the stove?

%. _____ /Don't know/

50. Does this second home have a workable woodburning furnace that is connected to air distribution duct work or hot water piping?

/1. Yes/ /2. No/
(TO Q 51)

50a. Of all the wood burned in your second home over the last 12 months, what percentage was burned in the furnace?

%. _____ /Don't know/

51. At any time since January, 1972, did you either install any new woodburning equipment in your second home, or modify equipment you already had?

/1. Yes/ /2. No/
(TO Q 52)

51a. What things like this did you do? (CHECK ALL THAT APPLY)

- /1. Installed fireplace/ /2. Modified fireplace/
- /3. Installed wood stove/ /4. Modified wood stove/
- /5. Installed wood furnace/ /6. Modified wood furnace/

Other: _____

51b. In what year did you last do this? 19 _____ /7. Don't know/

52. What one fuel was used to provide most of the space heat in your second home during the last 12 months? (CHECK ONE)

- /1. Fuel oil/ /2. Natural gas/ /3. Electricity/ /4. Propane/LP gas/
- /5. Coal/ /6. Solar/ /7. Kerosene/ /8. Wood/

Other: _____ /0. None/
(TO Q 54)

103a. Since 1972, has your household moved to a new home where you were the first occupants--no one had lived there before?

/1. Yes/

/2. No/
(TO Q 103d)

103b. In what year did you move to a brand new home? 19 _____

103c. What woodburning equipment--if any--was in this new home?
(CHECK ALL THAT APPLY)

/1. Fireplace/ /2. Wood stove/ /3. Wood furnace/

Other: _____ /0. None/

103d. In the place you lived before your current residence, was any new woodburning equipment installed, or any change made to woodburning equipment while you were living there?

/1. Yes/

/2. No/
(TO Q 104)

/7. Don't know/
(TO Q 104)

103e. What things like this were done at your last home?

/1. Installed fireplace/

/2. Modified fireplace/

/3. Installed wood stove/

/4. Modified wood stove/

/5. Installed wood furnace/

/6. Modified wood furnace/

Other: _____

103f. In what year was this (last) done? 19 _____ /7. Don't know/

104. What one fuel was used to provide most of the space heat in your present home during the last 12 months? (CHECK ONE)

/1. Fuel oil/ /2. Natural gas/ /3. Electricity/ /4. Propane/LP gas/

/5. Coal/ /6. Solar/ /7. Kerosene/ /8. Wood/

(GO BACK TO Q 1)

Other: _____ /0. None/
(TO Q 106)

105. What fuels were used as secondary sources of heat for your home?

- /1. Fuel oil/ /2. Natural gas/ /3. Electricity/ /4. Propane/LP gas/
 - /5. Coal/ /6. Solar/ /7. Kerosene/ /8. Wood/
- (GO BACK TO Q 1)

Other: _____ /0. None/

106. Do you expect to burn firewood at your place of residence this next winter?

- /1. Yes/ /2. No/ /3. Depends/ /7. Don't know/
- (TO Q 107)

106a. If the cost of heating your home is 25 percent higher this coming winter than last winter, is there a strong chance you would start burning wood?

- /1. Yes/ /2. No/ /3. Depends/ /7. Don't know/

106b. Is there a strong chance you would start burning wood if you found someplace where you could cut wood at low cost?

- /1. Yes/ /2. No/ /3. Depends/ /7. Don't know/

107. Just a few background questions remain. First, do you own your home outright, are you buying, or do you rent?

- /1. Own outright/ /2. Buying/ /3. Rent/ Other: _____
- (TO Q 108) (TO Q 108) (TO Q 108)

107a. Does your rent payment include heat, or do you pay that separately?

- /1. Includes/ /2. Pay separately/ /7. Don't know/

108. Do you live in a single family home, is your home in a building with two to four housing units, a building with five or more units, a mobile home, or what?

- /1. Single/ /2. 2-4/ /3. 5+/ /4. Mobile/ Other: _____

109. Is your home located in a city or village with a population of 2,500 or more?

- /1. Yes/ /2. No/

110. In what state and county is your home located?

STATE: _____; COUNTY (How do you spell that?) _____

111. What is your postal zip code? ZIP: _____

112. Does your household own a second home that you live in part of the year?

/1. Yes/

/2. No/
(TO Q 113)

112a. Am I calling you now at this second home? /1. Yes/ /2. No/

112b. In what state and county is your second home located?

STATE: _____; COUNTY (how do you spell that?) _____

112d. What is this home's postal zip code? ZIP: _____

112e. How many--if any--workable woodburning fireplaces does this second home have?

#: _____

112f. How many--if any--workable woodburning stoves does it have? #: _____

112g. And, does this second home have a workable woodburning furnace that is connected to air distribution duct work or hot water piping?

/1. Yes/

/2. No/

112h. INTERVIEWER: DO ANSWERS TO LAST THREE QUESTIONS SHOW ANY WOODBURNING EQUIPMENT IN SECOND HOME?

/1. Yes/

/2. No/
(TO Q 113)

112i. At any time since January, 1972, did you either install any new woodburning equipment in your second home, or modify equipment you already had?

/1. Yes/

/2. No/
(TO Q 113)

112j. What things like this did you do? (CHECK ALL THAT APPLY)

/1. Installed fireplace/

/2. Modified fireplace/

/3. Installed wood stove/

/4. Modified wood stove/

/5. Installed wood furnace/

/6. Modified wood furnace/

Other: _____

/0. Nothing since 1972/
(TO Q 113)

112k. In what year did you last do this? 19 _____ /7. Don't know/

ALL RESPONDENTS

113. How many children and infants 17 or younger live in your household?

17 or younger: _____

114. Counting yourself, how many persons 18 or older live in your household?

18 or older: _____

115. What is the highest grade of school or academic year of college completed by the head of your household?

/8 or less/ /9/ /10/ /11/ /12th grade/ YEAR OF COLLEGE: _____
 (TO Q 116) (GO TO Q 116) /or GED/ (TO Q 115b)



115a. Did the household head earn a high school diploma or its equivalent?

/1. Yes/ /2. No/ /7. Don't know/
 (TO Q 116) (TO Q 116) (TO Q 116)

115b. What is the highest college degree--if any--earned by this household head?

/0. None/ /1. 2 year/Associate/ /2. Bachelors/
/3. Graduate degree/ /7. Don't know/

116. What is the present age of the head of your household? Age: _____

117. Finally, we would like a classification of your total household income. Please estimate the combined income of all household members from all sources such as wages, salaries, social security or other retirement benefits, unemployment compensation, help from relatives, rent, and so forth. Was your total household income in 1980 more than \$10,000?

/1. Yes/ /2. No/
 (TERMINATE)

118. Was it more than \$20,000?

/1. Yes/ /2. No/
 (TERMINATE)

119. ...more than \$30,000?

/1. Yes/ /2. No/
 (TERMINATE)

120. ...more than \$40,000?

/1. Yes/ /2. No/
 (TERMINATE) (TERMINATE)

INTERVIEWER SUPPLEMENT

A. Time Interview Ended: _____

B. Sex of Respondent: /1. Male/ /2. Female/

COMMENTS: _____

5. When would be the best time to phone (your household/DESIGNATED R) (and whom should we ask for when we call again)?

R ID	APPT?	WHEN TO CALL			COMMENTS
		MO	DAY	TIME	
	/Yes/				
	/Yes/				
	/Yes/				

999. CALL INFORMATION. DO NOT MAKE MORE THAN SIX CALLS WITHOUT SPECIFIC APPROVAL OF A FIELD SUPERVISOR.

I #	CALL NO.	MO.	DAY	TIME CALL...		RESULT CODE	COMMENTS
				STARTED	ENDED		
	1						
	2						
	3						
	4						
	5						
	6						

DO NOT MAKE MORE THAN SIX CALLS WITHOUT SPECIFIC APPROVAL OF A FIELD SUPERVISOR.

	7						
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National Woodburning Survey
AMOUNT CHECK RESURVEY: WOODBURNERS

1. I want to assure you that all of the information you give us is confidential, and that none of it will be released in any way that would permit identification of you or your family. Your participation, of course, is voluntary.

1a. First, we would like to check the amount of wood your household burned in your usual residence--not in a second home you may have. We want to talk about wood burned from (MONTH OF FIRST INTERVIEW), 1980, to (MONTH OF FIRST INTERVIEW), 1981. So do not include wood burned since our first interview with you.

A standard cord is about two half-ton pickup truck loads or a stack of wood four feet high, four feet deep and eight feet wide.

1b. Would you say you burned less than a standard cord in your usual home from (MONTH OF FIRST INTERVIEW), 1980, to (MONTH OF FIRST INTERVIEW), 1981?

<u>/0. None burned/</u> (TO Q 2)	<u>/1. One standard/</u> <u>/cord or less /</u>	<u>/2. More than one/</u> <u>cord /</u> (TO Q 1d)	<u>/7. Don't/</u> <u>/ know /</u> (TO Q 1d)	<u>/9. N.A./</u> (TO Q 1d)
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1c. Would you say that over the last 12 months you burned 150 or fewer stove length pieces of wood, about 300 pieces, about 450 pieces--that's how much a half-ton pickup truck can carry, or about 900 pieces--the amount in two pickup truck loads?

<u>/1. 150 or/</u> <u>/ fewer /</u> (GO TO Q 2)	<u>/2. 300/</u> <u>/pieces/</u> (GO TO Q 2)	<u>/3. 450/</u> <u>/pieces/</u> (GO TO Q 2)	<u>/4. 900/</u> <u>/pieces/</u>	<u>/7. Don't know/</u>	<u>/9. N. A./</u>
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1d. Could you please estimate how much you burned over the last 12 months by the number of pickup truck loads, car trunk loads, or so forth? We are interested in the way of measuring the wood you know the best.

AMOUNT: _____ UNIT CODE: _____

(RECORD BELOW IF R CANNOT ANSWER WITH UNIT CODE)

Dimension of wood pile: _____ x _____ x _____
(NOTE FEET AND INCHES, ~~IN~~ NOT ROUND)

COMMENTS/OTHER: _____

Interviewer: _____ Sample #: _____

Date: _____ Time Started: _____

2. We also would like to check the amount of logs and splitwood you obtained for burning from (MONTH OF FIRST INTERVIEW), 1980, to (MONTH OF FIRST INTERVIEW), 1981. Over those 12 months, did you get any logs or splitwood for burning in your home (or a second home)? This includes any logs or splitwood your household purchased, cut yourselves or were given for your own use. Excluding any wood you've obtained since our first interview with you.

- /1. Yes/
(TO Q 3)
- /2. No/
(TO Q 3)
- /7. Don't know/
(TO Q 3)
- /9. Not ascertained/
(TO Q 3)

2a. As I mentioned a moment ago, a standard cord is about two half-ton pickup truck loads. Would you say you obtained less than one standard cord of splitwood and logs over those 12 months?

- /1. One standard/
cord or less /
↓
- /2. More than one/
cord /
(TO Q 2c)
- /7. Don't know/
(TO Q 2c)
- /9. N.A./
(TO Q 2c)

2b. Would you say that over those 12 months, you obtained 150 or fewer stove length pieces of wood, about 300 pieces, about 450 pieces, the amount in one half-ton pickup load, or about 900 pieces--the amount in two pickup truck loads?

- /1. 150 or/
fewer /
(GO TO Q 3)
- /2. 300/
/pieces/
(GO TO Q 3)
- /3. 450/
/pieces/
(GO TO Q 3)
- /4. 900/
/pieces/
(GO TO Q 3)
- /7. Don't/
know /
(TO Q 3)
- /9. N. A./
(TO Q 3)

2c. Could you estimate how much logs and splitwood you obtained over the last 12 months by the number of pickup truck loads, car trunk loads, or so forth? We're interested in the way of measuring the wood you know the best.

AMOUNT: _____ UNIT CODE: _____

(RECORD BELOW IF R CANNOT ANSWER WITH UNIT CODE)

Dimension of wood pile: _____ x _____ x _____
(NOTE FEET AND INCHES, DO NOT ROUND)

COMMENTS/OTHER: _____

3. Our last questions are about firewood cut by your household. Over the same 12 months we have been talking about, did your household cut or collect any firewood from land where it was grown? Please include wood you cut to be sold, given away, or kept for your own use. Exclude any wood cut since our first interview.

- /1. Yes/
(TO Q 3a)
- /2. No/
(TERMINATE)
- /7. Don't know/
(TERMINATE)
- /9. Not ascertained/
(TERMINATE)

3a. Would you say you cut or collected less than a standard cord from (MONTH OF FIRST INTERVIEW), 1980, to (MONTH OF FIRST INTERVIEW), 1981?

- /0. None cut/
(TERMINATE)
 - /1. One standard/
cord or less /
 - /2. More than one/
cord /
 - /7. Don't/
know /
 - /9. N.A./
(TO Q 3c)
- (TO Q 3c) (TO Q 3c)

3b. Did this firewood you cut or collected over those 12 months amount to 150 or fewer pieces, or about 300, 450--the amount in one pickup truck load, or 900 pieces--the amount in two pickup truck loads?

- /1. 150 or/
fewer /
 - /2. 300/
pieces /
 - /3. 450/
pieces /
 - /4. 900/
pieces /
 - /7. Don't/
know /
 - /9. N. A./
- (TERMINATE) (TERMINATE)

3c. Could you estimate how much logs and splitwood you obtained over those 12 months by the number of pickup truck loads, car trunk loads, or so forth? We are interested in the way of measuring the wood you know the best.

AMOUNT: _____ UNIT CODE: _____

(RECORD BELOW IF R CANNOT ANSWER WITH UNIT CODE)

Dimension of wood pile: _____ x _____ x _____
(NOTE FEET AND INCHES, DO NOT ROUND)

COMMENTS/OTHER: _____

***** TERMINATE *****

A. Time Interview Ended: _____

B. Sex of Respondent: /1. Male/ /2. Female/

COMMENTS: _____

Fuel Wood Measurement Codes and Conversion Factors

Standard	Cords	Code	Unit
.500		1	Half-ton pickup truck full
.500		2	Three-quarter ton pickup truck full
.333		3	Small pickup truck full (Datsun, Toyota, LUV, etc.)
.167		4	Full-size car trunk full
.100		5	Small-size car trunk full
.250		6	Full-size station wagon full
.167		7	Small-size station wagon full
.500		8	Suburban (carry all) full
.125		9	Small lift-back (Citation, Corolla, etc.)
.667		10	Tons: dry
.500		11	Tons: wet
.250		12	12-inch face cord
.333		16	16-inch face cord
.375		18	18-inch face cord
.500		24	24-inch face cord
1.000		48	Standard cord
.006		49	Cubic feet: thrown
.008		50	Cubic feet: standard
.033		51	5-inch tree
.166		52	10-inch tree
.400		53	15-inch tree
.800		54	20-inch tree
1.250		55	25-inch tree
.030		60	Bundles (of kindling wood)

END

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9-83

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