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WOOD FUEL PLENTIFUL IN WEST VIRGINIA

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Abstract. Biomass estimators applied to West Virginia timber resource data indicate that 34 million tons of wood is potentially available for fuel each year. This tonnage is the annual forest growth in excess of that now harvested for roundwood products. One-half of this excess can supply more than all of the State's energy needs in the residential and commercial sectors, or 44 percent in the industrial sector.

A century ago, fuelwood was the primary source of energy in America; nearly 3 cords were consumed for each ton of coal mined (Reynolds and Pierson 1942). Now, as then, there is great interest in using wood for energy. Many rural and suburban dwellers are heating with wood to reduce the high cost of heating with oil, natural gas, and electricity. Numerous wood industries are finding that wood wastes are a low-cost alternative to coal, gas, and oil for generating steam and electric power. At least two municipal utilities now generate electricity from wood at a lower cost than that generated from other fuels. While cost reduction is a big factor in the switch to wood, so is the feeling of self-reliance and independence that comes from using a locally supplied fuel that can provide heat and power without interruption due to storms, strikes, and embargoes.

However advantageous the use of wood for energy may be, the increase in consumption of wood for fuel raises concern about the adequacy of wood supplies. Fortunately for residents of the Northeast and the Appalachian Region, forests and woodlots are abundant. West Virginia, for example, is 75 percent forested: these timberlands, if managed properly, have the potential to produce sustained crops of wood indefinitely. Nevertheless, potential wood fuel users, particularly, are concerned about wood supplies, and they question how much wood is available for energy, especially after allowing for that harvested for industrial products.

THE STUDY

Forest lands in the United States are inventoried periodically by the Forest Service in cooperation with the states. Timber volumes are reported in traditional units, the cubic foot and board foot. Reporting forest inventories as biomass (weight of complete trees including roots, stump, stem, limbs, branches, and leaves) is not yet a standard practice. However, this is expected to change as timber harvests are increased to meet users' needs for more wood for fiber products and for energy.

The heating value of wood, like coal, is more conveniently expressed in units of weight than in units of volume. Tree-weight data, therefore, allow us to assess the energy potential of forests and forest growth. Equations and tables by Wiant (1977), Wartluft (1977), Green and Grigal (1978), and Young et al. (1976) allow one to estimate tree weights for Appalachian hardwoods and softwoods 1 inch in diameter breast height (dbh) and larger. Estimates include weight of wood and bark of trunk, limbs, branches, and twigs, but exclude roots, a 6-inch stump, and leaves. For the purpose of estimating harvestable wood for energy, these estimators are quite practical.

In this study, I applied tree weight estimators to the latest forest inventory data for West Virginia (Bones 1978) to obtain tonnage of wood available for energy—over and above the tonnage now harvested for other products.

METHODS

The tonnage of wood potentially available for energy in West Virginia is defined as that portion of annual forest growth in excess of the amount harvested for wood products. In addition, trees killed by insects, fire, and disease, and the wastewood from logging operations and other removals are potentially available for energy. The total amount of wood for energy from West Virginia's forests can be expressed as: Energy wood = (Net growth − Timber cut) + (Mortality + Logging Residue and Other Removals).

Before this equation could be solved, it was necessary to convert inventory volume tables from cubic feet to tons. This was done for each component of the forest: growing-stock trees, saplings, and rough and rotten trees. Survey data[1] (Bones 1978) for these tree classes include numbers of trees by species and dbh class. These were combined by species group (Table 1), and appropriate tree-weight equations (Wiant 1977; Green and Grigal 1978), and tabular values (Wartluft 1977), or both, were applied to compute wood tonnages for species groups by dbh class. In this manner, inventory estimates in tons were obtained for growing-stock trees, saplings, and rough and rotten trees by species group (Table 1).

Net annual growth and mortality tonnages were calculated by applying growth and mortality rates from Bones (1978) to the inventory data (Table 2). Tonnages of harvested wood plus logging residues and other removals (as defined by Bones 1978) were determined by applying average cubic-foot weight factors (Timson 1975; U.S. Forest Service 1975) for wood and bark of hardwoods and softwoods (Table 3).

RESULTS AND DISCUSSION

The estimated weight, or biomass, of the aboveground portion of all forest trees on 11.5 million acres of commercial forest land in West Virginia is 981 million tons (Table 1). In 1974, this huge stock of hardwoods and softwoods produced a net increment of 32.9 million tons of wood and bark (Table 2). And these forests will continue to produce this growth year in and year out as long as the inventory of trees is maintained.

In 1974, 6.2 million tons of timber was removed from the forest through harvesting and other operations (Table 3). Another 5.3 million tons of timber was killed by insects, fire, and disease (Table 2). The net annual production in excess of timber removals was 26.7 million tons.

If we assume that all dead timber plus all logging residues and other removals (7.4 million tons) can be salvaged, then the total *annual* excess of wood and bark increases to 34.1 million tons. This quantity of forest biomass is potentially available for energy, chemical conversion, or wood and fiber products. Further, thinnings and improvement cuttings to capture part of the excess annual growth will result in faster growing, higher

[1]Personal communication from Joseph E. Barnard, U.S. Forest Service, Northeastern Forest Experiment Station, Broomall, PA.

Table 1.—Net aboveground biomass of the forest resource in West Virginia, by tree class and species group, 1975

Species group	All tree classes	Growing-stock trees (5.0 to 29.0+ dbh)	Saplings (1.0 to 4.9 dbh)	Rough and rotten trees (5.0 to 29.0+ dbh)
	Million tons, green weight			
Red oaks	—	159.0	78.2	180.8
White oaks	—	155.4		
Hard hardwoods	—	247.1		
Soft hardwoods	—	101.7		
All hardwoods	922.2	663.2	78.2	180.8
Softwoods	58.8	48.7	4.7	5.4
Total	981.0	711.9	82.9	186.2

Table 2.—Current annual net growth and mortality of whole trees on commercial forest land in West Virginia, by tree class and species group, 1974[a]

Species group	All tree classes		Saplings and growing-stock trees (1.0 to 29.0+ dbh)		Rough and rotten trees (5.0 to 29.0+ dbh)	
	Net growth	Mortality	Net growth	Mortality	Net growth	Mortality[b]
	Million tons, green weight					
Hardwoods	29.5	4.7	24.6	3.3	4.9	1.4
Softwoods	3.4	0.6	3.1	0.5	0.3	0.1
Total	32.9	5.3	27.7	3.8	5.2	1.5

[a]Based on trend between inventories.
[b]Mortality rate of rotten trees assumed to be three times the rate of that for sound trees.

Table 3.—Timber removals from commercial forest land, by species group and item, West Virginia, 1974

Species group	Round-wood products[a]	Logging residues and other removals	Total
	Million tons, green weight		
Hardwoods @ 55 lb/ft^3 [b]	3.8	2.0	5.8
Softwoods @ 51 lb/ft^3 [b]	0.3	0.1	0.4
Total	4.1	2.1	6.2

[a]Includes products harvested from growing stock and rough, rotten, and salvable dead trees.
[b]Weight per cubic foot of wood and bark.

quality timber suitable for high-value veneers, lumber, and cooperage.

It would be simplistic to say that all of the 34.1 million tons of excess *annual* wood production is truly available for immediate use. There are too many environmental, social, and economic factors that limit or prevent the harvest of West Virginia timber on many ownerships. We might allow for these factors by halving the potential *annual* excess to 17 million tons.[2] At 8.6 million Btu per ton, 17

[2]This quantity is midrange of the *available* timber volumes estimated for West Virginia by Birch and Kingsley (1978). Readers are referred to Birch and Kingsley's paper for a full discussion of the topic: How much timber *is* available in West Virginia?

Table 4.—Energy consumption in West Virginia, by consuming sector and fuel, 1975[a]

Consuming sector	Coal	Natural gas	Petroleum	Hydro-power	Total fuel inputs	Electricity purchased	Total energy consumed (three sectors)
	Trillion Btu						
Industrial	215.99	68.87	15.07	—	299.93	31.24	331.17
Residential and commercial	4.80	78.51	13.92	—	97.23	26.60	123.83
Transportation	0	14.51	121.90	—	136.41	0	136.41
Electric utilities	611.15	0.37	4.12	4.85	620.49		
Total fuel inputs	831.94	162.26	155.01	4.85	1,154.06		

[a]U.S. Department of Energy 1978.

million tons will yield about 146 trillion Btu of available wood energy—the equivalent of 24.8 million barrels of home heating oil annually.

One hundred and forty-six trillion Btu is equivalent to about one-eighth of the total fuel consumed in 1975 by all sectors of the West Virginia economy (Table 4). In that year, two-thirds of the fuel input was consumed for electric power generation and transportation, sectors where wood is not likely to have a significant impact. But in the residential and commercial sectors where wood fuels can be used, 146 trillion Btu could supply more than all of the energy consumed. In the industrial sector, where many plants can be converted to wood fuels, 146 trillion Btu could supply 44 percent of the energy needed.

Additional sources of wood fuel in West Virginia include sawmill and woodworking plant wastes, trees growing on nonforest lands, and salvable urban wood wastes. These sources are significant in volume, and often are more available to urban users than wood in the forest.

In conclusion, West Virginia has a huge unused supply of wood suitable for fuel. On the basis of energy use in 1975, enough wood fuel is available annually to supply about one-eighth of the State's needs: and this without depleting the forest capital.

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