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Should Wood Be a Source of Commercial Power?

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Abstract

Because of rapid inflation in fossil fuel prices and severe problems in nuclear-power programs, wood has been suggested as a primary fuel for steam-electric plants. The estimated total 1970 volume of unused mill residues and logging residues (in pieces above 4 inches in diameter) would have been sufficient to meet about 10 percent of the annual fuel requirements for steam-electric plants in the United States. Costs of collecting, transporting, and preprocessing logging residues generally would result in a fuel price much higher than the average $0.70 per million British thermal units paid for coal by U.S. steam-electric plants in June 1974. Use of waste bark and wood by forest products plants for onsite processed steam and power production probably will increase substantially, reducing potentials for use in commercial steam-electric facilities.

BETWEEN JUNE 1973 AND JUNE 1974, electric utilities in the United States suffered fuel price increases of 42 percent for natural gas, 74 percent for coal, and 175 percent for oil (3). Proposals for deregulation of natural gas prices, severe environmental and safety problems in coal mining, and a continued firm stance by petroleum-exporting countries make rollbacks to pre-1973 cost levels unlikely.

Prospects for massive infusions of power from nuclear-generating stations have dimmed. A survey by National Economics Research Associates indicated that 46 percent of the nuclear capacity additions originally scheduled for 1974 to 1983 had been cut back or delayed as of October 1974 (7). In the previous 18 months, plans for 14 nuclear plants were canceled or postponed indefinitely, and plans for 65 were deferred 6 months to 6 years.

These problems naturally have led to investigating exotic sources of energy such as solar and tidal power, tar sands and shale oil, and more prosaically, wood. The practicality of wood as fuel for large-scale power generation is not primarily a question of engineering technology. Instead, it is the materials-supply aspects that pose the greatest problems. These problems involve price (humorously illustrated in Fig. 1) and quantity (Fig. 2).

Fuel Requirements on National Basis

In 1971, electric utilities in the United States had a total installed capacity of 367,000 megawatts. Three-fourths of this capacity was in steam-electric plants, of which there were 956 (5). These plants generated 1.3 trillion kilowatt-hours, net, using 327 million tons of coal, 351 million barrels of oil, and 3.8 trillion cubic feet of gas. Total fuel consumption was approximately 13.4 quadrillion Btu's or the equivalent of about 602 million tons of coal. In 1971, the average steam-electric plant had a capacity of about 300 megawatts, and used the equivalent of 630,000 tons of coal per year.

To consider the full impact wood might make on energy supplies in the United States, let us compare the tonnage of industrial roundwood consumed in the form of forest products with that of coal consumed for generating electric power. In 1971, we consumed forest products equivalent to about 13.3 billion cubic feet of roundwood. Assuming an average dry weight of 30 pounds per cubic foot, this would require about 200 million dry tons of wood or perhaps 300 million tons of green wood. As Figure 2 shows, this much green material could have supplied between one-fourth and one-fifth of the total energy requirements of steam-electric plants in 1971. This assumes net Btu production of 10 million Btu's per ton of wood as fired (compared to 22 million Btu's per ton of coal).

Obviously the entire annual timber supply would not be available for electric utilities. But reported large volumes of logging and mill residues might be at least potentially usable for fuel.

Growing stock as defined by the U.S. Forest Service essentially includes volume of sound, live trees of commercial species, 5.0-inch diameter at breast height and larger to a 4.0-inch top diameter. Residues of growing stock from 1970 harvesting have been estimated at 1.6 billion cubic feet and unused primary manufacturing residues (wood and bark) at another 1.6 billion (4,9). Tops and branches and other nongrowing stock materials, all more than 4 inches in diameter, might have totaled an

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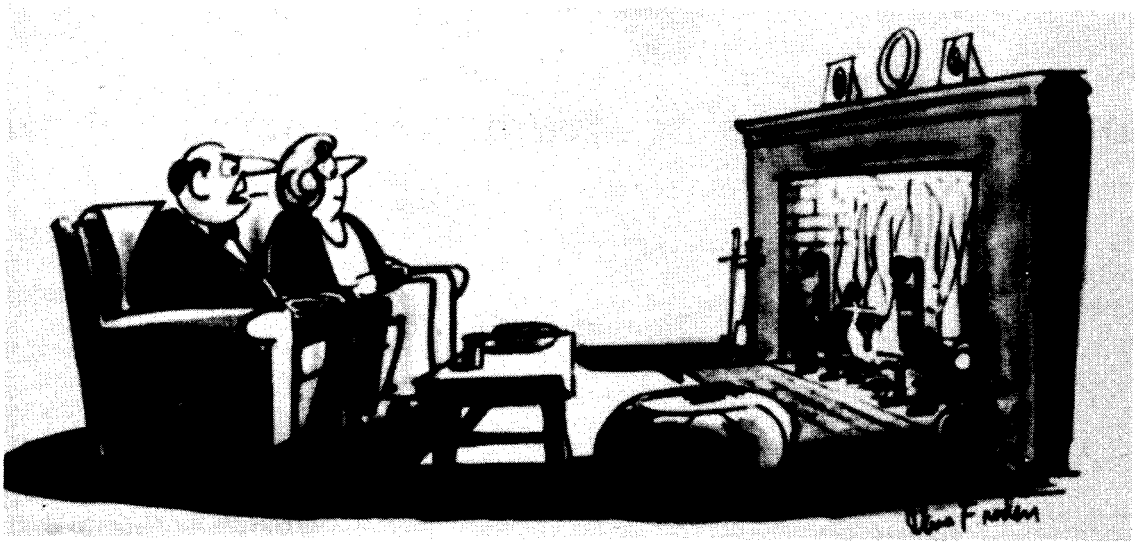


"I'll tell you what I see in the dancing flames. I see logs that cost ninety-five dollars a cord, that's what I see."

Drawing by Dana Fradon; c 1974 The New Yorker Magazine, Inc.

Figure 1. - The gentleman scores a well-taken point on wood for fuel.

Figure 2. - Comparison of 1971 fuel consumption by steam-electric plants with approximate fuel values of roundwood (required to supply all forest products consumed) in 1971 and of mill and logging residues produced in 1970.

additional 2 billion cubic feet. If all of this waste had been collected, it might have supplied as much as 7 percent of the United States' fuel requirements for steam-electric utilities (Fig. 2). An even larger potential probably existed in unrecovered roots and stumps and in stems and branches less than 4 inches in diameter. However, costs of collection, transportation, and preprocessing would have had to average less than $3.60 per green ton to have been competitive with coal. Average cost of coal to steam-electric plants in 1971 was $0.36 per million Btu's (6). Very little logging residue would have been available at such low cost, although some mill residues would have been.

With utilities paying an average almost twice as much for coal in June 1974 as they had in 1970, wood residues were more appealing. However, demand for chip logs and manufacturing residues for pulp increased significantly in 1974 with residue chip prices reported $40 to $50 per bone-dry ton in the Pacific Northwest during the spring.[1] Much of the material that would have been left on the ground in the 1960s (Fig. 3), was taken to chipping facilities in 1974 (Fig. 4 A and B). Increasing use of wood and bark residues for onsite heat and steam production at forest products plants undoubtedly will reduce further the volumes of mill residues potentially available to utilities.

[1]Slinn, R. J. 1974. Availability of residuals in the U.S. pulp and paper industry. Presented at 77th national meeting of Amer. Instit. Chem. Eng., Pittsburgh, Pa.

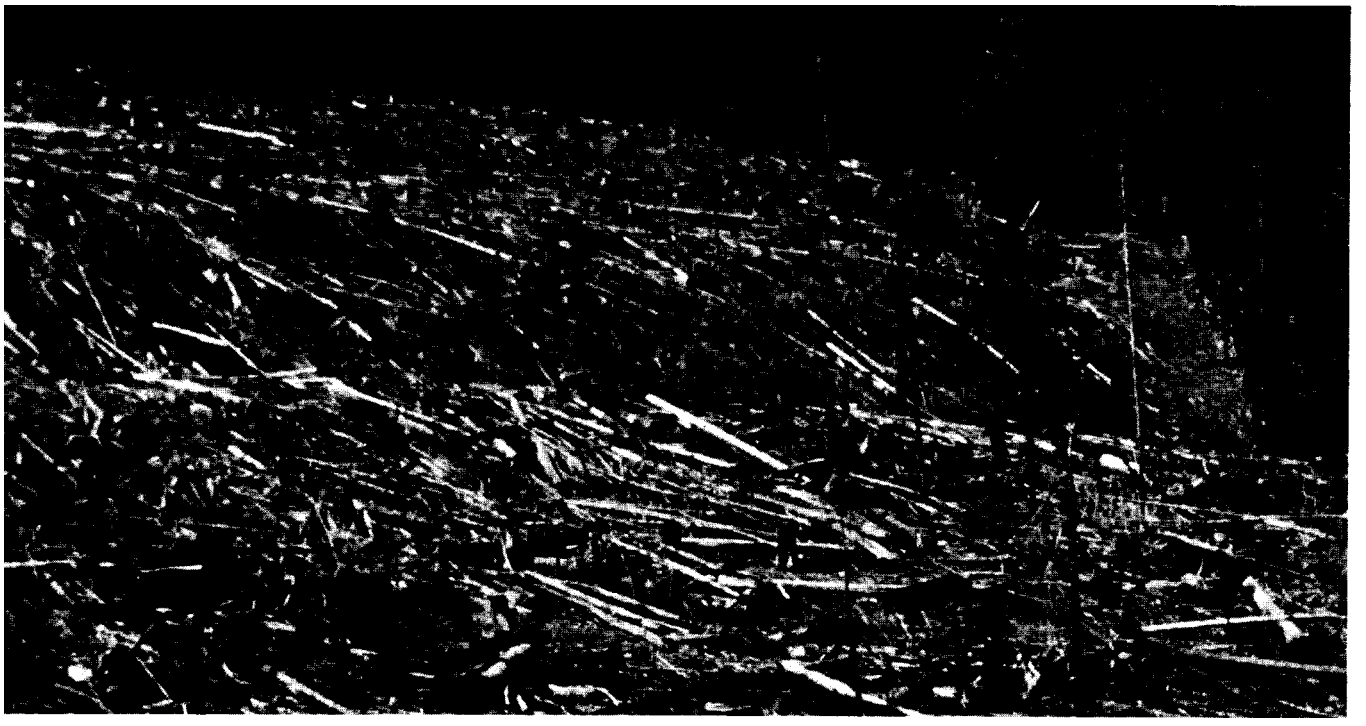


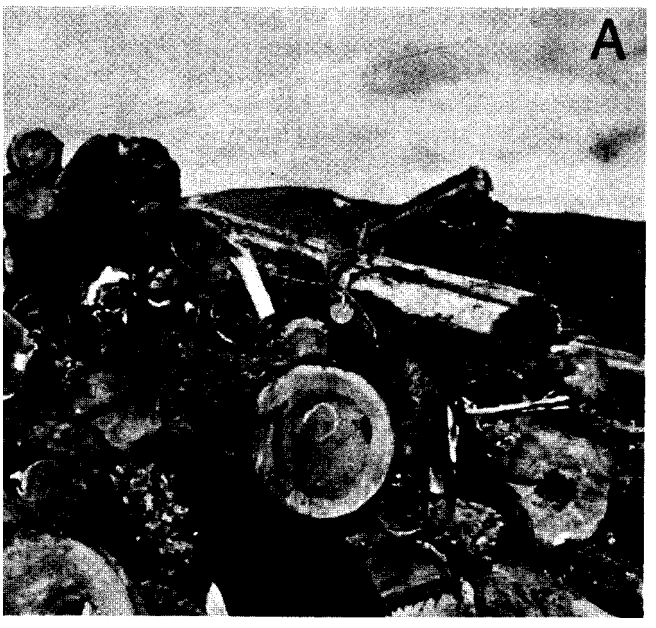
Figure 3. - Residue on 1967 logging unit on the Willamette National Forest. Proponents of fuels from logging residues may have in mind the kind of utilization typical of the Douglas-fir region in the 1960s.

Energy Plantations

Another possibility proposed for wood as a source of energy is "energy plantations." Kemp and Szego[2] estimated that a 400-megawatt electric plant could be supplied at a cost of $1.25 to $1.45 per million Btu's by a 260-square-mile plantation of hybrid poplar. If this were correct, a 1 percent addition to current electrical generating capacity still would require 2,600 square miles or 1.7 million acres. It seems highly unlikely that such extensive areas would be available at reasonable costs.

Evans (2) estimated that as few as 65 square miles of managed red alder stands on Vancouver Island, B.C., might supply the 620,000 tons of forest fuel required by a 150-megawatt steam-electric facility. He concluded, however, that plantations of 240 to 1,000 square miles

[2]Kemp, C. C., and G. C. Szego. 1974. The energy plantation. Presented to symposium on energy storage. 168th Amer. Chem. Soc. national meeting, Atlantic City, N. J.



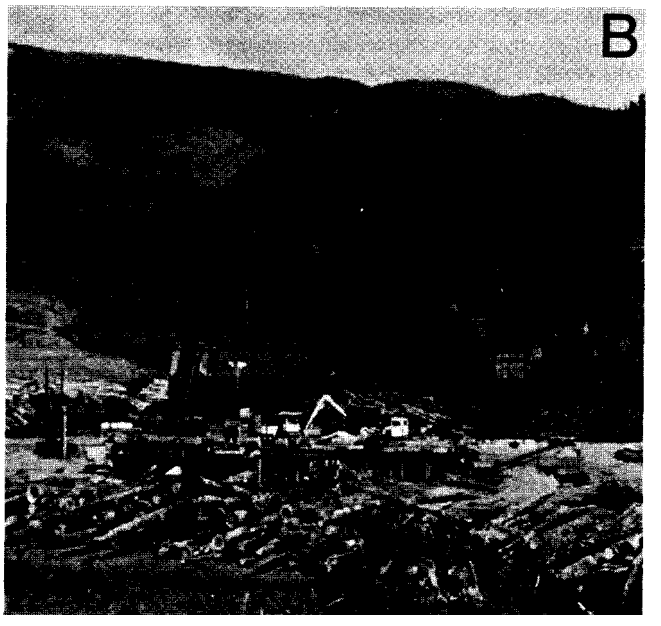


Figure 4. - *A,* Defective logs, such as these, a slash disposal problem in 1967, are now a source of pulp chips for chip-producing plants, such as the one shown here, *B,* In Oakridge, Oreg.

would be required for such a plant in most forested regions of North America.

Feasibility of Individual Facilities

In this work, the potential significance of wood-fired electrical plants has been discussed primarily on a national scale. The feasibility of individual facilities, however, depends on other factors, such as long term cost and availability of wood at a specific location. Plants as small as 25 megawatts have been evaluated in connection with mill residues. A Forest Service research group concluded that there were few locations in the Pacific Coast states where sufficient mill residue volumes would likely be available to fuel even a plant that size (8).

The possibility of burning mill residues at a plant that also uses municipal solid wastes has been evaluated for the Eugene-Springfield area of Oregon by Matthews (6). His study indicated that there should be a sufficient volume of waste fuel in that area to support a 680,000-pound-per-hour steam load and generate 115 megawatts of electrical power. But it was estimated that the value of waste wood at the time of the plant startup in 1977 would be a negative value of –$0.16 per unit, delivered, rising to a positive $2.50 per unit by 1987. Matthews reported that millowners were unwilling to make firm commitments for supplying wood wastes to this kind of plant.

Having suffered threatened or actual curtailments of fuel supplies during recent periods of high demand for lumber and plywood, many mill managers undoubtedly have embarked on their own versions of "Project Independence." As Edel (1) has noted, millsite use of hogged bark and wood residues appears highly advantageous. Not only does this type of fuel appear competitive at current rates for gas and oil but perhaps, more importantly, its supply is assured.

Conclusions

It is unlikely that steam-electric utilities, with current prices paid for coal, could afford to buy logging residues for fuel. Mill residues have been available at relatively low cost in past years, but few areas are likely to have long term assured volumes sufficient to encourage utilities to invest in wood-fired plants. Increasing use of mill residues for pulping, particleboard, and onsite process steam generation, probably will further reduce possibilities for large-scale supply of wood fuels. Land requirements of energy-plantations apparently are excessively large for most areas of North America.

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