TREE BIOMASS AS SOURCE OF ENERGY

by Teja Singh

A recent study of the Society of American Foresters (1979) shows that forest biomass can contribute the equivalent of approximately 9.5 quads to U.S. energy requirements. (One quad equals 10^{15} or one quadrillion Btu.) This value excludes the wood required for conventional products. With intensive management, it is believed that this estimate could be increased to 18.9 quads by the middle of the next century.

Total U.S. energy needs are presently estimated to be approximately 75 quads per year; thus, nearly one-eighth of that requirement could be met from existing forest biomass. Since one quad represents about 50 million cords of wood, it means that approximately 475 million cords of forest biomass are potentially available to meet U.S. energy needs at present.

CANADA HAS UNUSED BIOMASS

In Canada, the unused residues from forest harvesting amount to some 112 million oven-dry tonnes per year, which is about three times as much as the current usable and marketable material that is produced. Besides this, an estimated 108 million oven-dry tonnes of other forms of unused biomass is potentially available on productive forest lands. On a sustained yield basis, the available tree biomass in Canada is estimated to be 219 million oven-dry tonnes. This potentially available biomass equals nearly half of Canada's current energy production.

The major commercial use of forests in Canada is for supplying tree boles (stems) that are used primarily for lumber and pulp. All the non-stem portions and the upper unused stems below certain specified diameter limits are left in the forest as harvesting residues. Such residues are now recognized as a potential source of energy from tree biomass.

BIOMASS CALCULATIONS

Oven-dry weight is the universally accepted unit of measurement for quantifying tree biomass. Weight tables, analogous to the traditionally used volume tables, are needed for determining the biomass that is available from forest trees and their components. These are usually computed from the biomass equations which relate the two basic dimensions of a tree: the diameter at breast height and the total height of the tree.

An alternative approach is to use suitable factors such as ratios and wood densities to convert volume estimates to weight estimates. Because these relationships and conversion factors differ for various tree portions, they are often obtained separately for each tree component such as merchantable stem, nonmerchantable stem, branches, and foliage. If prediction equations are additive, their coefficients can be added to obtain equation coefficients for a combination of components such as total stem biomass and total branch and foliage biomass.

The major tree species in the Canadian boreal forest region include: jack pine, lodgepole pine, white spruce, black spruce, alpine fir, balsam fir, tamarack or eastern larch, trembling aspen, balsam poplar, and white birch. The biomass equations, wood densities, and the weight tables for these boreal tree species are now available. They are also available for the major tree species in the coastal and other regions of Canada.

HEAT OF COMBUSTION

The heat of combustion or calorific values differ among tree species. These values, in million Btu/air-dry cord, for wood in different tree species are:

Softwoods: Tamarack or eastern larch, 26.5; jack pine, 20.6; lodgepole pine, 20.1; black spruce, 19.1; white spruce, 16.2; and balsam fir, 15.5.

Hardwoods: White birch, 23.4; trembling aspen, 17.7; and balsam poplar, 15.5.

The bark component has slightly higher values.

The information on heat of combustion values is used for determining the energy potential of forest trees as a renewable resource. The generally accepted heat of combustion value, on an oven-dry basis, is 8500 Btu/lb for hardwoods and 9000 Btu lb for softwoods. Because of variation in the field moisture conditions, the green biomass heat of combustion values are lower for high moisture content compared with low moisture content.

A RENEWABLE ENERGY SOURCE

Reliable data in the form of biomass inventories will help in the realization of forests as a dependable source of energy. The national biomass inventory for Canada is expected to be completed in 1984.

As the nonrenewable oil and gas resources get gradually depleted, the search for alternative sources of energy will intensify. Research has only recently focussed on estimating the biomass available from forest trees in North America. The overall conclusion from the ~~work done~~ so far is that forest biomass represents an immense and as yet nearly untapped renewable source of energy on a sustained basis in both the United States and Canada.

REFERENCES

InterGroup Consulting Economists Ltd. 1982. Availability and cost of forest biomass in Canada. Winnipeg, Manitoba.

Micko, M.M., and E.I.C. Wang. 1983. Wood for energy. University of Alberta. Edmonton, Alberta.

Reed, F.L.C., and R.P. Overend. 1981. Forests and energy in Canada. IFS-News 1(2): 19-28.

Society of American Foresters. 1979. Forest biomass as an energy source. Study Report of a Task Force. Supplement to Journal of Forestry, Vol. 77(8).

Dr. Teja Singh is a forester and Research Officer at the Northern Forest Research Centre, Canadian Forestry Service, Edmonton, Alberta. He is also Canadian Editor for National Woodlands.