# U.S. BILLION-TON UPDATE

## Forest Biomass and Wood Wastes*

### Summary of Findings

The 2011 *Billion-Ton Update* estimates potential supplies of forest biomass and wood wastes under different yield and feedstock farmgate prices. Over a price range of $20 to $80 per dry ton at roadside, quantities of forest residue biomass potential vary from about 33 to 119 million dry tons currently, to about 35 to 129 million dry tons in 2030. This is somewhat less than the 2005 *Billion-Ton Study* (2005 *BTS*) due to the removal of used resources and the decline in pulpwood and sawlog markets. Primary forest biomass is the single largest source available for new uses—accounting for nearly half of the estimated total—including integrated operations, other removals (e.g., land clearing), and thinnings on other forestlands. Integrated operations are a composite category that includes logging residues from roundwood harvests and fuel treatment operations on timberland. Since both of these residue sources include the removal of sawlogs and pulpwood for merchantable products, they were combined to avoid double counting and were constrained by sawlog and pulpwood harvests. Over time, quantities increase by the rate of growth in projected demand for sawlogs and pulpwood. Urban wood wastes, which include the woody components in municipal solid waste (MSW) and construction and demolition wastes, are the second largest potential source available for new uses. Other removals (i.e., timberland clearing and precommercial thinnings) and thinnings on other or noncommercial forestland are much smaller. There are relatively large amounts of mill residue generated each year; however, most of these materials are used, leaving relatively small amounts available for new uses. As shown below, large amounts of forest residue biomass and processing residues, such as mill residues and pulping liquors, are currently used by the forest products industry.


Photo courtesy of Han-Sup Han, Humboldt State

**Estimated supply of forest biomass and wood waste at $80 per dry ton or less in 2012**

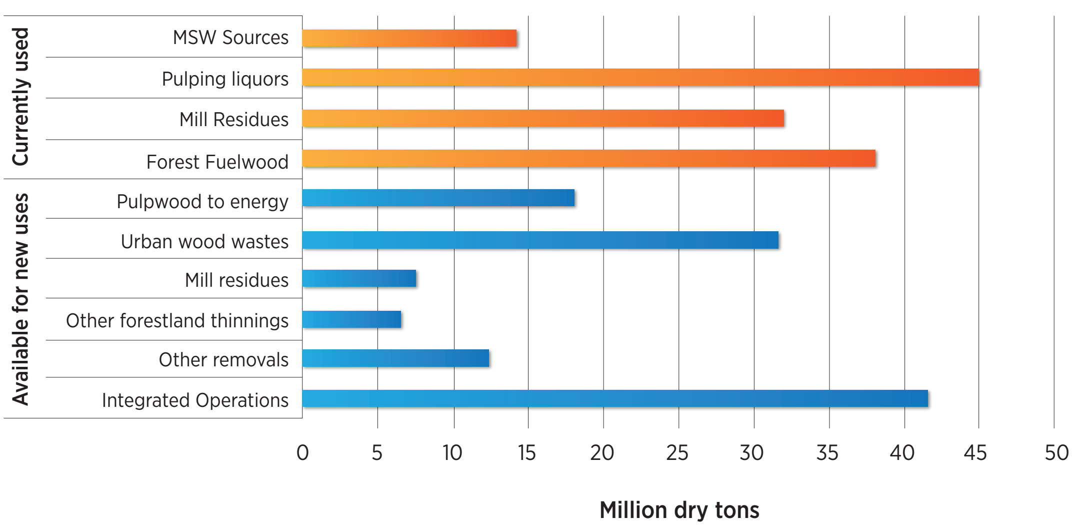


Illustration courtesy of BCS Inc.

*This fact sheet refers to the following document: U.S. Department of Energy. 2011. *U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry.* R.D. Perlack and B.J. Stokes (Leads), ORNL/TM-2011/224. Oak Ridge National Laboratory, Oak Ridge, TN. 227p. Download the full report at eere.energy.gov/biomass/pdfs/billion_ton_update.pdf. View the report, explore its data, and discover additional resources at bioenergykdf.net.

## Additional Information

Primary forest residue biomass consists of a composite estimate from two sources—removal of a portion of what is called logging residue that is currently generated during the harvesting of timberlands for sawlogs and pulpwood and removal of excess biomass from fuel treatment thinning operations.

These thinning operations, which consist of removing merchantable whole trees and excess small trees, are designed to reduce risks and losses from catastrophic fires and improve forest health. The tops and branches of merchantable trees, cull trees, and excess small trees can be used for bioenergy applications. The merchantable trees can be used for sawlogs and pulpwood. While the sustainability of harvesting traditionally merchantable sawlogs and pulpwood has been studied at great length, the additional harvest of logging residues and small-diameter trees for bioenergy creates new concerns over forest ecosystem sustainability. In this update, sustainability was addressed by excluding administratively reserved forestlands (i.e., wilderness and national parks) and roadless areas identified as possibly qualifying for wilderness or other conservation protections. For lands where residue removal is permissible a number of restrictions were imposed. For logging residue, 30% of the biomass was assumed left onsite. For treatment thinnings, onsite retention was determined as a function of slope and ranged from 30% for slopes less than 40%, 40% for slopes between 40% and 80%, and no residue removal on slopes greater than 80%.

In addition to the integrated operations, two other primary resources are considered in this update. Thinnings from other forestland (non-commercial) are conducted to improve forest health by removing excess biomass on low-productivity land. Other removal residue is unused wood that is cut during the conversion of timberland to non-forest uses and unused wood cut in silvicultural operations, such as precommercial thinnings. The processing of sawlogs, pulpwood, and veneer logs into conventional forest products generates significant quantities of bark, mill residues (coarse and fine wood), and pulping liquors. With the exception of small quantities of mill residues, secondary forest products industry residues are currently used in the manufacture of forest products or for heat and power production. In addition, valuable chemicals are recovered from pulping liquors. Finally, conventionally-sourced wood, which is defined as separate, additional operations to provide pulpwood-sized roundwood for bioenergy applications, was included.

Although a significant amount of effort went into the analysis, the estimates are still only as good as the underlying data and dependent on the underlying assumptions. This issue is further compounded when developing comprehensive cost estimates at county levels. The Forest Inventory Analysis (FIA) database brings significant amounts of detail to the analyses. However, there are limitations concerning its use for biomass, since the primary FIA focus is on merchantable inventory. The use of the data and some of the issues associated with using FIA data at the county level are discussed in the report. In addition to the FIA, the update used data from the Timber Product Output database and the Resource Planning Act reports for future projections.

### Baseline vs. High-yield Scenarios

The baseline assumes a continuation of the U.S. Department of Agriculture 10-year forecast for the major food and forage crops and extends to 2030. The average annual corn yield increase is assumed to be slightly more than 1% over the 20-year simulation period. The baseline also assumes continued trends toward no-till and reduced cultivation and an annual increase of 1% in energy crop yields. The 1% change in annual yield reflects learning or experience in planting energy crops and limited gains from breeding and selection of better varieties. The high-yield scenario is more closely aligned to the assumptions in the 2005 *BTS*. This scenario assumes higher corn yields and a much larger fraction of crop acres in reduced and no-till cultivation. Under high yield, the projected increase in corn yield averages almost 2% annually over the 20-year simulation period. The energy crop productivity increases are modeled at three levels: 2%, 3%, and 4% annually. These gains are due not only to experience in planting energy crops but also to more aggressive implementation of breeding and selection programs.

No high-yield scenario was evaluated for forest resources except for the woody crops. Forest residues come from existing timberlands, and there is no obvious way to increase volumes other than reducing the amounts of residues retained on site for environmental sustainability or decreasing the merchantable utilization requirements; neither option was considered.

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