

THE U.S. Department of Agriculture Forest Service conducts a variety of analyses to estimate the quantity of woody residuals in the United States. Its Forest Products Laboratory in Madison, Wisconsin does research to estimate the types and amounts generated, and what portion of those tonnages are available for recovery. The data from these analyses are very useful to wood recycling enterprises. They help in identifying sources to process, and markets for services that help foresters clear and process the downed woody debris that otherwise poses a significant fire threat. This article provides highlights of the data collected.

Major sources of solid waste wood generated in the U.S. that are analyzed by the Forest Products Laboratory include municipal solid waste (MSW), construction and demolition debris, primary timber processing mill residues, and logging residues. The next step is to estimate what is recoverable. Recoverability is defined as total waste generated, less amounts currently recovered, combusted or considered unusable. Table 1 summarizes the findings of each of the sources of solid waste wood.

MSW SOURCES

Two categories of MSW contain solid wood — wood and yard trimmings. Total MSW generated in 2001 was 234 million tons, according to U.S. EPA data used in this analysis. Combined, wood and yard trimmings account for about 17 percent of all MSW or 40.7 million tons. Yard trimmings include herbaceous material and woody trimmings.

QUANTIFYING THE FLOW

TAKING INVENTORY OF WOODY RESIDUALS

**USDA Forest Service analysis finds
104 million tons of woody residuals available
for recovery in the U.S., with wood in
MSW and C&D debris streams
comprising 28 million tons.**

David McKeever

Table 1. Waste wood generated, recovered combusted or not usable, and available recovery in the United States, 2001

Source	Generated (Mil. Tons)	Recovered Combusted, Not Usable (Mil. Tons)	— Available For Recovery — Amount (Mil. Tons)	% Total Waste Wood
Municipal solid waste				
Wastewood	12.8	6.6	6.2	6
Woody yard trimmings	16.1	12.7	3.4	3
Total	28.9	19.4	9.6	9
Construction and demolition waste				
Construction	9.0	2.1	6.9	7
Demolition	27.4	16.2	11.2	11
Total	36.4	18.3	18.1	17
Primary timber processing residues				
Barkresidues	22.6	22.0	0.6	1
Wood residues	58.7	57.4	1.3	1
Total	81.3	79.4	1.9	2
Logging residues & other removals ¹				
Loggingresidues	60.4	6.0	54.4	52
Other removals	22.4	2.2	20.1	19
Total	82.8	8.3	74.5	72
Total waste wood	229.4	125.4	104.0	100

¹Volume of wood cut or knocked down during harvest. Consists of material sound enough to chip. Includes dead and cull trees. Excludes stumps and limbs. ²Growing stock and other sources cut and burned or otherwise destroyed in the process of converting forest land to nonforest uses. Also includes growing stock removal in forestry cultural operations. Consists of material sound enough to chip. Includes dead and cull trees Excludes stumps and limbs.

Little information is available on the composition of MSW yard trimmings, therefore an assumption was made that about two-thirds are woody material or 16.1 million tons. The amount of solid wood in the MSW stream is 12.6 million tons.

Of the 16.1 million tons of solid wood in the yard trimmings stream, about 12.7 million tons already are either recovered for recycling, combusted or unusable. (The greatest portion of recovered wood is recycled.) Thus the total amount of recoverable wood is 3.4 million tons Of the 12.8 million tons of wood in the MSW stream, a much smaller amount — 0.5 million tons — is currently recovered for recycling, but about half (6.1 Million tons) is combusted or unusable, leaving 6.2 million recoverable tons. Therefore, the total amount of recoverable wood available in the MSW stream in 2001 was 9.6 million tons.

CONSTRUCTION AND DEMOLITION SOURCES

Because each originates from distinctly different sources, has different characteristics and differs in ease of recoverability, construction and demolition (C&D) waste streams are analyzed separately. (Published waste generation rates typically combine the two streams because of similar disposal practices.) Construction waste consists of contemporary building materials with little contamination. Major wood waste sources include new residential construction, new

ASSESSMENT OF FOREST BIOMASS

IN April 2003, the USDA Forest Service, in partnership with the Western Forestry Leadership Coalition, published "A Strategic Assessment of Forest Biomass and Fuel Reduction Treatments in Western States." The objective of the assessment was to characterize, on a regional scale, forest biomass that can potentially be removed to implement the fuel reduction and ecosystems restoration objectives of the National Fire Plan for the western U.S. The assessment found that in the 15 western states, there are at least 28 million acres of forest that could benefit from some type of mechanical treatment to reduce hazardous fuel loading. It is estimated that about 60 percent of this area could be operationally accessible for treatment with a total biomass treatment volume of 345 million tons. Two-thirds of this forest area is on public lands.

According to the assessment, most

of the volume is in trees six inches diameter and greater that have conventional utilization opportunities. Transportation cost and distance to markets, however may preclude recovery. Treatment costs are increased by the need to treat large numbers of low volume stems less than four inches in diameter. Gross costs can range from \$35 to over \$1,000/acre depending on the type of operation, terrain and number of trees involved. The full report, which includes sections on markets for the recovered biomass, is available at www.fs.fed.us/research/infocenter.html (go to publications available).

Another branch of the Forest Service, the Forest Inventory and Analysis Program (FIA), conducts a national inventory of downed forest fuels of the United States. The inventory — the Down Woody Materials (DWM) Indicator — is a subsample of FIA forest inventory

plots where downed fuels are sampled for regional-scale estimation of fuel complexes. The indicator is the measurement of fallen trees, dead branches and large fragments of wood on the forest floor. Small branches less than three inches in diameter are measured as fine woody debris, while larger branches and down trees are measured as coarse woody debris.

DWM inventories serve a number of functions, such as an indicator of forest health; fuel loadings by a variety of estimates; and, when combined with soil indicators, helping to estimate carbon pools (useful for analyzing the role of forest carbon dynamics in climate change). The inventory program began in 2001 and has been implemented in 38 states. Field data, organized both by fuel and sampling design components, are available on a national website (www.ncrs.fs.fed.us/4801/dwm/).

nonresidential budding construction and repair and remodeling of existing buildings. Because national estimates of this waste stream are not available, the Forest Products Laboratory bases its data on residential waste generation rates from specific case studies, national measures of building activity and U.S. Forest Service wood use studies.

Construction Debris: In 2001, about 65 million tons of wood were used for construction of houses, apartments and nonresidential buildings and structures, and for their repair and remodeling. Of that amount, about nine million tons were waste, of which about 6.9 million tons were available for recovery. It is interesting to note that the majority of the recoverable solid wood tonnage is from residential construction versus nonresidential (less than one million tons for the latter).

Demolition Debris: Demolition waste, a heterogeneous mixture of material from demolishing buildings and structures, includes building materials no longer being used, e.g. asbestos siding. This stream is difficult to separate and is often contaminated, e.g. with lead-based paint. Overall generation of demolition waste fluctuates widely, more so than any other major waste type. National estimates of demolition waste are based on the following: Per capita C&D generation rates from limited case studies; population estimates; construction waste estimates; demolition debris disposal rates and

composition; and average recovery rates.

In 2001, about 69 million tons of demolition waste were generated. Approximately 27.4 million tons were solid wood. Of that tonnage, about 16.2 million tons were recovered, combusted or not usable, leaving 11.2 million tons available for recovery.

PRIMARY TIMBER MILLS

The third category surveyed is primary timber processing mills, which include sawmills, structural panel mills and other round wood processors. Residues of these operations include bark, slabs and edgings, sawdust and peeler cores. In 2001, 81.3 million tons of residues were generated from this industrial sector. This includes 58.7 million tons of wood and 22.6 million tons of bark.

Of the tonnages generated, 79.4 million tons — close to 98 percent — were recovered for recycling. This included 57.4 million tons of wood and 22 million tons of bark. Therefore just under two million tons of residues were available for further recovery.

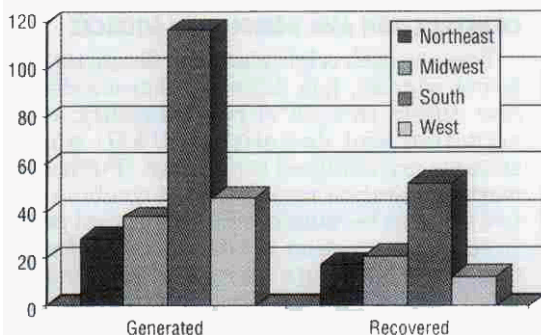
LOGGING RESIDUES AND OTHER REMOVALS

The logging residues stream includes sound tops of harvested trees and trees cut or knocked down and left on site, including dead and cull trees. Excluded from this fraction are stumps and limbs. To be quantified as recoverable, the residues must be sound enough to chip.

In 2001, 60.4 million tons of residues were generated. An additional 22.4 million tons of "other removals" were generated. Other removals are defined as growing stock and other sources cut and burned or otherwise destroyed in the process of converting forest land to nonforest uses. They also include growing

Figure 1. Regional solid wood waste, 2001

(In millions of tons)



stock removed in forestry cultural operations.

A very small fraction — 6.0 million tons or less than ten percent — of the logging residues generated are recovered, combusted or not usable, leaving 54.4 million tons available for recovery. Of the "other removals" fraction, 2.2 million tons or about ten percent are being recovered, leaving 20.1 million tons available for recovery. Additional analysis shows that of the recoverable logging residue, roughly 30 percent are softwood and 70 percent are hardwood. This is useful data for enterprises that manufacture furniture, floor boards and other products out of recovered solid wood.

OTHER SOURCES OF WOODY RESIDUALS

There are a variety of other sources of solid wood waste. These include the following: Chemically treated wood from railroads, utility poles, piers and docks and mine timbers; brush and limbs from utility right-of-ways; and other industrial wood sources. Typically, the volumes of these sources generated are fairly small. For example, railroads generate less than 500,000 tons/year of solid wood waste.

Another source is solid wood recovered from the deconstruction of single family houses, commercial and industrial buildings, military bases and other structures. The Forest Products Laboratory has been involved in a number of deconstruction projects, including

Wood pallets may be the biggest recycling success story, saving about five million tons/year.

research to develop a grading system for the deconstructed wood. The availability of solid wood from this source is dependent on the age and type of structure, which can affect the value of the products manufactured.

REGIONAL ANALYSIS

Figure 1 provides a regional view of the solid wood waste generated and recoverable in 2001. Of the 104.1 million tons identified to be recoverable, more than half — 52.6 million tons — are in the South. The Midwest comes in a fairly distant second with 21.2 million tons, followed by the Northeast (17.7 million tons) and the West (12.6 million tons).

In the MSW category, the South possesses 3.4 million or 36 percent of the total recoverable wood (9.6 million tons), while the Midwest and West are tied for second at 2.2 million tons and the Northeast comes in third with 1.8 million tons. In terms of the 6.9 million tons (total) of recoverable wood in the construction waste stream, the South has 2.5 million tons, followed by the West (1.8 million tons), the Midwest (1.5 million tons) and the Northeast (1.0 million tons). On the demolition side — with 11.2 million recoverable tons in the U.S. — the South again has the most (4.0 million tons), with pretty much a tie between the Midwest and West (2.6 million tons and 2.5 million tons respectively) and the Northeast not far behind (2.1 million tons).

As noted earlier, there is a very small amount of primary timber processing

residues that are available for recovery (a total of 1.9 million tons). The South has 700,000 of those tons and the other three regions each have 400,000 tons. Of the 54.4 million tons of recoverable logging residues, more than half (24.8 million) are in the South. The Northeast accounts for 12.2 million tons, the Midwest has 11.8 million tons and the West has 5.6 million tons. In terms of "other removals," the South has 17.1 million tons (85 percent) of the total 20.1 million tons of recoverable material nationwide. The Midwest has 2.8 million tons available.

THE BIGGEST PICTURE

With 74.5 million tons available, logging residues and other removals represent the largest fraction of solid waste wood generated in the U.S. available to be recovered (out of a total of 104 million tons). Currently this material remains in the forest and contributes to the down woody material currently being studied extensively by the Forest Service. Construction and demolition solid wood are the next largest category, with 18.1 million tons, followed, by 9.6 million tons of recoverable solid wood in the MSW stream. Primary timber processing has less than two million tons.

Advances are being made in collection of recoverable solid wood waste, processing and utilization; however, technical and economic obstacles to improved utilization exist. Cur-

RELATED *BIOCYCLE* ARTICLES OF INTEREST

PREVIOUS articles by David McKeever are useful to reference for comparison purposes, and to track trends in the data. The following articles are available through the *BioCycle* archive service (<http://pqasb.pqarchiver.com/jgpress/> or www.biocycle.net and click on the archive link): "Wood Residual Quantities In The United States," January, 1998 and "How

Woody Residuals Are Recycled In The United States." December 1999. In July 2002, *BioCycle* published the results of a national survey conducted for the Forest Service that identifies composting facilities that can assist in managing forest fire by-products, including downed trees and other residues (see "Role Of Composting In Forest Fire Management and Prevention.") —N.G.

rent used markets for recovered wood include furniture and consumer goods; a supplemental furnish used by panel manufacturers; and mulch and garden products. Use in wooden pallets is perhaps the biggest solid wood recycling success story. Prior to 1990, nearly all pallets were made from virgin material. Today, about 42 percent are made from recycled pallet parts, resulting in about five million tons of material being saved.]

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