

RECLAIMING LUMBER PRODUCTS FROM WASTE WOOD

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Introduction

The United States population uses a tremendous quantity of wood and paper products. For example, in 2005 the total consumption of timber products in the U.S. was 21.3 billion cubic feet, roundwood equivalent¹ (Howard 2007). This equates to about 71 cubic feet per person per year—or 255 board feet of lumber products and 730 lbs of paper products per capita in the U.S. To picture this amount of material, the typical semi-truck trailer is 4,000 cubic feet, so it takes the timber product purchases of about 56 Americans to fill one semi-truck trailer. Fortunately, not all of the paper and lumber products consumed are ‘lost’ from future product streams.

As described in a 2008 Dovetail Partners report (Bratkovich et al.), paper and paperboard recovery and reuse has steadily increased in the U.S. from nearly 39% in 1993 to over 56% in 2007. Also, the U.S. paper industry has set a benchmark of attaining a 60% recovery rate by 2012.

Unfortunately, accurate data is not available on the amount of solid wood products reclaimed in the U.S. The good news however is that the reuse and recycling of reclaimed solid wood is of growing interest in the United States. Also, reclaiming solid wood² is important given the quantities (and quality) of “waste wood” available for reuse and recycling.

This report provides the latest information on reclaiming lumber products from two primary sources—municipal solid waste and construction and demolition waste.³ A short case study and testimonial is included to demonstrate the growing interest in and importance of reclaiming waste wood.

Why Reclaim Lumber from Waste Wood?

Forest products manufacturers—including both primary and secondary processors—often seek new sources of raw materials to complement or replace existing supplies of logs, lumber or value-added material. “Waste wood” provides an additional source of raw material to innovative manufacturers and marketers, especially those dealing in specialty or niche products. The

¹ Roundwood equivalent is defined as the volume of logs or other round products required to produce given quantities of lumber, plywood, wood pulp, paper, or similar products. Roundwood includes all wood waste produced during manufacture.

² Solid wood products account for about 67% of industrial roundwood consumption (with the remaining 33% going into paper and paperboard products); lumber is by far (over 80%) the single largest use for solid wood. (Statistics derived from Howard 2007, Table 11A)

³ This report does not address timber harvesting and processing residues or urban “green” waste such as trees or woody yard trimmings. For an update on urban tree utilization see Dovetail Partners’ January 23, 2008 report: <http://www.dovetailinc.org/reports/pdf/DovetailUrban0108sig.pdf>.

reclamation of lumber products from waste wood not only conserves landfill space but also reduces the pressure to source the raw material (logs) from our forests.

Waste wood reclamation efforts also provide additional benefits. These include the reduction of environmental impacts of producing new products, carbon storage (through the reuse/recycling of existing wood products), job creation, and, in many cases, cost reduction through avoided purchase/disposal costs.

How Much Waste Wood is Out There?

Any individual, firm, or organization considering starting or expanding a solid wood reclamation program will likely ask, “How much wood waste is out there?” This question is best answered by examining the two main streams of supply for lumber reclaiming firms to tap into—municipal solid waste (MSW) and construction and demolition (C&D) waste.

MSW

MSW, known as trash or garbage, is made up of the things we use and throw away.⁴ MSW includes product packaging, food scraps, grass clippings, newspapers, appliances, bottles, old furniture, and more. MSW does not include C&D materials, municipal wastewater treatment sludges, and non-hazardous industrial wastes.

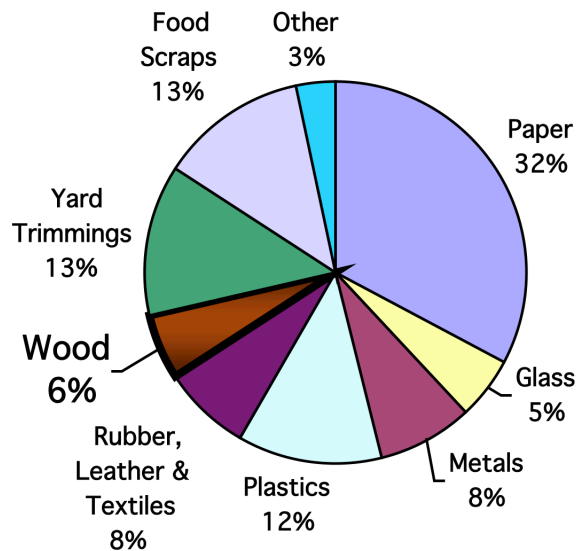
According to the Environmental Protection Agency (EPA), in 2007 Americans generated about 254 million tons of trash, the equivalent of 4.6 pounds per person per day. The trash generation rate today is more than double the rate in 1970 (121 million tons).

The solid wood component of MSW includes “waste” such as furniture and cabinets, pallets and other wooden containers, scrap lumber, wood panels, and discarded wood from industrial facilities. The wood component is estimated at 5.6% of the total MSW stream (see Figure 1). Although the percentage of wood waste is small compared to other trash materials, the 5.6% equates to 14.2 million tons per year. In 2007, only 9.3% or 1.3 million tons of wood waste was recovered from the MSW stream (primarily pallets that were chipped for uses such as mulch or bedding material⁵).

⁴ The things we use and throw away come from four sources: *residential*, *commercial* (e.g., restaurants), *institutional* (e.g., schools), and *industrial* (e.g., packaging and administrative wastes, not process wastes).

⁵ The recovery rate for the category of wood packaging—mostly wood pallets—was 16%. Also, many wood pallets are reclaimed *prior* to reaching the MSW stream.

Figure 1. Total MSW Generation (254 million tons) in 2007 (by material) before Recycling.



Source: U.S. EPA, 2008.

A 2004 publication (Falk and McKeever) reported that about 46% of the wood contained within MSW is actually available for recovery after subtracting wood waste combusted for energy (about 23%), wood waste unsuitable for recovery⁶ (about 23%), and wood waste currently recovered (over 9%). Applying these estimates to 2007 data, approximately 6.5 million tons of wood waste from the MSW stream is available for further recovery annually in the U.S. (46% of 14.2 million tons).

C&D Waste

The U.S. EPA defines C&D waste as debris generated during construction, renovation, and demolition of buildings, roads, and bridges. C&D debris often contains bulky, heavy materials such as concrete, metals, glass, wood, and related building components.⁷

Building-related C&D wood waste is often considered a single stream of waste because both are typically discarded together in landfills. However, it is useful to analyze them separately since they are distinct in their origins, characteristics, and recyclability. Falk and McKeever (2004) used the following definitions for C&D building-related wood waste:

⁶ Wood waste deemed unsuitable for recovery is wood with excessive contamination; wood commingled with other waste; wood waste with size or distribution of material issues; or other reasons.

⁷ See <http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/index.htm>.

“*Construction* waste originates from the construction, repair and remodeling of residential and nonresidential structures. It consists of fairly clean, contemporary building materials, which can be readily separated at the job site.”

“*Demolition* wood originates when buildings or other structures are demolished. Demolition waste is often contaminated with paints, fasteners, adhesives, wall covering materials, insulation, and dirt, and typically contains a diverse mix of building materials. Some of these materials may no longer be in use or may presently be considered hazardous, making recovery more difficult. On-site separation of demolition waste is time-consuming and costly.”

The “C” in C&D

Traditional 2 by 4 wood-frame building technology is used in most new single-family and low-rise multi-family residential structures in the U.S. The estimates presented below for construction waste are based on this type of construction.⁸

New single-family housing starts rose from 895,000 living units in 1990 to over 1.7 million units in 2005. Since then housing starts have dropped dramatically, plunging to a seasonally adjusted annual rate of 441,000 single-family units in November, 2008 (National Association of Home Builders). Because the beginning of the 21st century represents somewhat of an “average” for housing starts during the past two decades, and since an analysis of data is available for 2002 from the USDA Forest Service - Forest Products Laboratory, the year 2002 is used in the following analysis.

In 2002, 1.3 million new single-family houses were built in the U.S. Home size averaged 2,325 square feet. There were also 0.3 million multi-family living units built in 2002 with an average floor area of about 1,120 square feet. Total wood use in 2002 for new residential construction was estimated at 38 million tons.⁹ Using average wood waste generation and recoverability rates, an estimated 4.1 million tons of wood waste was generated in 2002 with 3.6 million tons recoverable for all new residential construction. This equates to about 11% wood waste for all wood used to build new residential housing.

Repair and remodeling of residential structures in 2002—both single-family and multifamily—required an additional 32.3 million tons of wood products. Repair and remodeling often includes both construction and demolition activities; consequently, more waste wood is generated in remodeling than in new construction. In 2002, an estimated 6.5 million tons of wood waste was generated from all repair and remodeling activities. An estimated 4.2 million tons were deemed recoverable.

⁸ The 2002 data presented in this section (construction) and the following section (demolition) relies heavily on the work of Falk and McKeever (2004) and McKeever (2004). See reference section for complete citations.

⁹ The original data source for these figures was calculated in metric tons. The data presented in this report is given in short tons (1 ton = 2,000 lbs.).

Also, an estimated 1.0 million tons of wood waste was generated in the construction of smaller, low-rise non-residential buildings and structures. Nearly 0.9 million tons was considered available for recovery.¹⁰

Waste wood generation for all new construction in 2002 totaled 11.6 million tons. With approximately 3.0 million tons currently either recovered, combusted or not usable, the total amount estimated to be available for additional recovery is 8.6 million tons. This represents 75% of the total construction waste wood generated (Table 1).

Table 1. Wood Products Used and Waste Wood Generated, Recovered, Combusted, or Not Usable, and Available for Recovery from Construction in the U.S., 2002.

Construction Type	Total Wood Use (million tons)	Amount Waste Generated	Recovered, Combusted or Not Usable	Amount Waste Available for Recovery	% Waste Available for Recovery
Residential	38.0	4.1	0.5	3.6	88
Repair and Remodeling	32.3	6.5	2.3	4.2	64
Nonresidential	7.5	1.0	0.1	0.9	85
Total	77.8	11.6	3.0*	8.6	75

*Column does not 'total' due to rounding of numbers.

The "D" in C&D

As noted earlier in this report, demolition waste is a heterogeneous mixture of building materials and other building-related items generated when a building or other structure is demolished. In addition to wood, concrete, paper, metal, glass and other materials, demolition waste—especially from older structures—can also contain hazardous materials such as asbestos, lead-based finishes, mercury, and polychlorinated biphenyl compounds.

The EPA developed estimates of demolition waste for 1996 (EPA 1998) and concluded that 1.32 lbs. of demolition waste were generated per person per day in the U.S. (annual total of 64.8 million tons). Based on a larger population, Falk and McKeever (2004) updated this estimate for the year 2002 (69.3 million tons). For a January 2009, U.S. population of 305.6 million (Census Bureau 2009), the total annual generation of demolition waste can be pegged at an estimated 73.6 million tons.

EPA case studies indicate that approximately 40% of C&D waste entering C&D landfills is wood. Thus, the current (2009) annual generation rate for demolition waste wood is approximately 29.4 million tons.

¹⁰ Most large or high-rise nonresidential structures do not use wood as a primary building material so estimates for their wood use and wood waste are excluded from this report.

Demolition wood is not easy to recover and recycle as compared to construction waste. Sometimes entire loads of demolition waste are rejected by recycling operations if contaminated. Based on cases studies, an initial 30% recovery rate was assumed achievable in 1990 with an improvement to approximately 42% in 2002. Applying the 42% recovery rate to the current volume of demolition wood waste (29.4 million tons) results in a recoverable estimate of 12.3 million tons.

There are efforts underway today to avoid past practices by “deconstructing” buildings in lieu of demolition. According to researchers at the Forest Products Laboratory, the deconstruction or manual disassembly of wood-framed buildings and other structures could significantly reduce the amount of demolition wood generated in the future (see sidebar).

Total Wood Waste

Overall, 55.2 million tons of wood waste is estimated to be generated on an annual basis in MSW and C&D waste streams (Table 2). About 53% originates in demolition activities followed by MSW (26%) and construction (21%). Nearly 50% of this material—27.4 million tons— is of acceptable size, quality, and condition to be considered available for recovery. About an equal amount—27.8 million tons—is already being recovered, combusted, or deemed not usable.

To put the amount of waste wood available for recovery in perspective, 27.4 million tons is roughly 14% of annual industrial wood product production in the U.S.¹¹ Also, MSW and C&D waste wood statistics typically do not include data from other sources of potential recoverable wood such as railroad ties, telephone and utility poles, and pier and dock timbers.¹² Clearly, the amount of waste wood available for recovery in the U.S. is a substantial figure.

¹¹ Derived from Howard 2007, Table 9.

¹² Although not covered in this report, the “other” category of wood waste can be substantial. Using utility poles as an example, 4.5 million utility poles were deemed available for recycling annually during the late 1990s (Leichti et al. 2005).

Deconstruction in lieu of Demolition...

A deconstruction trend is gaining momentum in the U.S. Bob Falk of the USDA Forest Service Forest Products Laboratory wrote in the Forest Products Journal in 2002:

“The sounds are much like those found at any building site. Hammers pounding. Saws whining. Lumber in motion. However, everything here seems to be in reverse...windows and doors are being unhung rather than set in place, nails are being pounded out of boards instead of into them, lumber is being stacked up, banded and hauled away rather than delivered and unstacked. This is the scene at a wood-framed building deconstruction site.”

Falk and Brad Guy published a directory in 2005 of companies involved in wood-framed building deconstruction and dismantling and reused building parts, with an emphasis on those that use, resell, or remanufacture salvaged wood. The purpose of the directory is to provide a consumer and business resource for locating companies that offer a variety of products and services including building removals with a focus on wood materials recovery and reuse; brokering, buying, or selling salvaged wood building materials; producing, buying, or selling specialized salvaged wood products, such as remilled flooring; and construction and timber framing using reclaimed wood. The 113-page directory is available at:

http://www.fpl.fs.fed.us/documnts/fplqtr/fpl_qtr150.pdf.

Table 2. Wood Waste Generated, Not Available for Further Recovery, and Available for Further Recovery, by Source.

	Waste Generated (million tons)	Not Available for Further Recovery (1)	Available for Further Recovery
Wood Waste Source			
MSW (2)	14.2	7.7	6.5
Construction (3)	11.6	3.0	8.6
Demolition (4)	29.4	17.1	12.3
<i>TOTAL</i>	55.2	27.8	27.4

(1) Recovered, combusted, or not usable.

(2) 2007 estimate.

(3) Based on 2002 data.

(4) Based on January 2009 U.S. population estimate.

Lumber From Demolition Projects is Where Much of the Action Is

Of the different waste streams reviewed above, lumber and related wood products reclaimed from demolition wood is where much of the current activity is centered. This is especially true (as described in the earlier textbox) when deconstruction or “unbuilding” practices are used instead of the traditional demolition practices (wrecking ball mentality). Deconstruction provides an excellent opportunity to maintain the recoverable quantity and quality of the wood resource.

An EPA report from the 1990s states that the equivalent of 250,000 single-family homes are disposed of each year in the U.S. (EPA 1998). This equates to about 1.8 million cubic meters of salvageable structural lumber annually (equivalent to nearly 3% of U.S. softwood lumber production in 2005¹³). And some would argue that the best part is that much of this lumber was originally harvested from old-growth forests and is essentially unavailable from other sources. A substantial quantity of this wood is prized for its high structural and aesthetic qualities—higher density, slower grown, fewer defects, etc.—when compared to lumber produced today.

Recovered wood from demolition/deconstruction projects can be used as lumber or timbers or remanufactured into other products. For example, large timbers often are used in timber frame construction. If quality is high enough, adding value through remanufacture can be an economical option. Flooring is a common end-use product from re-milled old timbers. Paneling, millwork, and siding are examples of other re-milled value-added products.

Duluth Timber Company: 30 Years of Reclaiming Lumber

One example of a firm that has capitalized on the niche market of reclaimed lumber and related wood products is the Duluth Timber Company. Its largest holding is beside the Lake Superior Harbor in Duluth, Minnesota. The second, in Edison, Washington, overlooks both the San Juan

¹³ Derived from Howard 2007, Table 28.

Islands and Mount Baker. The company employs 15 people and most have been with the company 10 years or more.

The company's general manager, Peter Krieger, said, "We've been in business 30 years. Our business is an outgrowth of the demolition industry." He explained that 25 years ago you could visit a demolition site and see good wood about to be thrown away. At Duluth Timber Company, the reaction was, "Hey, can we have that stuff?" Today, the company pays top prices for the "stuff".

Krieger noted, "When Max Taubert [owner] started out in the '70s, he saw Duluth Timber as being in the used wood business. We could sell our product cheaper than new wood." During the 1980s and early 1990s, the company was seen by many as being in the old growth business due to the age and quality of material they were recovering. "When we moved into the 21st century," Krieger said, "we were seen as being in the green building business."

Regardless as to how outsiders view the Duluth Timber Company, recycling and reuse of wood is what the company is all about. Old factories, warehouses, and other industrial buildings across North America provide the raw material needed by the company. According to Krieger, "We don't do old houses, barns or 'sinkers' from the bottom of lakes. Instead, we focus on big industrial buildings."

Products offered by Duluth Timber Company include flooring, custom trim, matched millwork for restoration projects, and resawn and raw beam stock. Ninety percent of the company's production ends up in the high-end residential market. "Our customers are people looking for an environmentally friendly product with high quality characteristics," explained Krieger.

For example, Duluth Timber Company markets products manufactured from 700 year old Douglas fir and 2000 year old redwood harvested 75 to 100 years ago. As with most consumer products, a segment of the population is willing to pay higher prices to get exactly what they want. Krieger explained, "If someone really wants a 1955 Roy Rogers lunch box and sees one in an antique store for \$100, they'll buy it even though a 'new' lunch box costs much less.

Available Resources

A host of resources and opportunities are available to individuals and industries interested in the field of reclaimed wood products. Here are three examples.

[The Building Materials Reuse Association](#) is a nonprofit educational organization whose mission is to facilitate the salvage and reuse of building materials. For additional information, visit www.bmra.org

[Habitat for Humanity ReStores](#) are retail outlets where quality, used and surplus building materials are sold.

Approximately 30% of sales are wood-based materials (Gresock et al. 2006). Proceeds from ReStores help local affiliates fund the construction of Habitat houses within the community. Materials sold by ReStores are usually donated from building supply stores, contractors, demolition crews or individuals who wish to show their support for Habitat.

For additional information, visit www.habitat.org/env/restores.aspx

Unbuilding: Salvaging the Architectural Treasures of Unwanted Houses was published by Taunton Press in 2007. Authored by Bob Falk and Brad Guy, this 256-page hardcover book is written for the individual who wants to dismantle a single wall or completely unbuild an entire house. For more information: <http://store.taunton.com/onlinestore/item/unbuilding-bob-falk-070872.html>

The same is true for lumber products. Some folks will pay more for my 700 year old Douglas fir product compared to someone else's cheaper 60 year old Douglas fir.”

The reclaimed lumber business has its ups and downs just like any other lumber enterprise. For Duluth Timber Company, 2008 sales and revenue were down due to the depressed housing market. Prices paid to acquire demolition wood are up from earlier times when the wood was viewed as waste. Krieger also noted that rising freight costs are another headache for the company. But overall he remains optimistic and upbeat about the reclaimed lumber business. He said, “One of our advantages is that we’ve been doing this kind of work longer than most people. We’re moving forward on many fronts including green building. We’re a founding member of the Reclaimed Wood Council. The Council is working to develop a specific certification system for reclaimed wood as well as working on a common vocabulary for grading reclaimed lumber.”

For additional information on Duluth Timber Company, visit <http://www.duluthtimber.com/>.

Reclaimed Wood, Certification and Green Building

As mentioned in the previous case study, one of the new incentives for reclaimed wood is the potential for recognition in green building programs or certification standards. For example, the Forest Stewardship Council (FSC) has a standard for sourcing reclaimed wood that allows materials to be included in FSC labeled certified products.¹⁴ The standard is relatively new, being introduced to new FSC applicants in January 2008, and the policy became a requirement for existing FSC chain-of-custody certificate holders in January 2009. The policy specifically recognizes municipal as well as construction and demolition sources of reclaimed material.

Examples of Reclaimed Wood Recognized by FSC:

- Post-consumer wood sources;
- Municipal Sources;
- Commercial (Retail, Office, Small Business);
- Construction and Demolition Debris;
- Defibrillated and solid wood recovered from landfills, transfer stations, and Material Recovery Facilities (MRFs);
- Industrial Packaging and Administrative wastes (does not include process wastes);
- Institutional (schools, prisons);
- Residential (Single Family Homes, Multi- Family Dwellings);
- Commercial Transport Packaging including pallets, crates, cases, cable drums at the end of their useful life;

¹⁴ FSC Standard for Sourcing Reclaimed Material for Use in FSC Product Groups or FSC-certified Projects, FSC-STD-40-007 (Version 1-0) EN

- Construction and Demolition Debris including doors, flooring, old cabinets, moldings, and dimensional lumber, discarded wood packaging e.g. pallets and cable drums;
- Wood reclaimed through "Deconstruction" e.g. salvaged dimensional lumber and architectural elements;
- Damaged Stock and Rejected Products manufactured from post-consumer wood products, including deconstructed building materials, or wood reclaimed from construction and demolition (C&D) debris;
- Used telephone poles, railroad ties, building materials, furnishings, cabinets, shop fittings, shelving etc. that have been used for their intended purpose by residential, commercial, or industrial consumers.

A way to increase lumber reclamation opportunities, particularly in regard to deconstruction, is to consider the use or development of construction methods that make disassembly and reuse of building components easier. This is one area of innovation where wood product engineers, green builders, architects and others could make a major contribution to lumber recycling and reuse.

Green building programs also recognize the potential environmental benefits of using reclaimed wood. Many programs recognize certified wood, so if the reclaimed wood is FSC-certified, that is one avenue to gaining credit. The programs, including the Leadership in Energy and Environmental Design (LEED) standards developed by the United States Green Building Council (USGBC), also have credits that are specific to the use of recycled and reclaimed materials in building projects.

Bottom Line

As a nation, the U.S. uses a large amount of wood and generates a significant volume of wood waste in the MSW and C&D waste streams. Interest is growing in utilizing this wood waste for a myriad of lumber and related products. The efficient reuse and recycling of wood waste presents an opportunity to extend our timber resource, reduce consumption of new resources, conserve landfill space, reduce costs through avoided purchase/disposal fees, preserve carbon storage, reduce energy and environmental burdens of producing 'new' products, and create 'green' jobs.

Markets continue to develop for reclaimed lumber products. The green building and certification movements present excellent opportunities for growth and development of this niche product.

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