Urban Tree Utilization and Why It Matters

Dr. Steve Bratkovich

Dr. Jim Bowyer

Kathryn Fernholz

Alison Lindburg

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Dovetail Partners, Inc.

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Introduction

Most analyses related to U.S. timberland and timber production focus on forest land that is producing, or is capable of producing, more than 20 cubic feet per acre per year of industrial wood crops under natural conditions, is not withdrawn from timber use, and is not associated with urban or rural development. It's quite reasonable to focus our research and attention on these commercial forest lands due to their size and economic, social and environmental importance. However, there are other categories of forested areas in the U.S. that tend to "fall through the cracks," and that are rarely researched or discussed regarding their potential to provide wood-based products. Urban forests of the United States are such an example.

It's estimated that today there are nearly 4 billion urban trees[1] in the U.S., with another 70 billion trees growing in metropolitan areas[2]. As urban land in the U.S. expands, so do the urban forests. Urban land in the lower 48 states increased from 2.5% of total land area in 1990 to 3.1% in 2000, an area about the size of Vermont and New Hampshire combined. Researchers from the U.S. Forest Service project that urban land in the coterminous U.S. will nearly triple in size to over 8% by 2050, an area larger than the state of Montana (Nowak 2005).

Utilization of urban trees for wood and paper products is still in its infancy. However, the idea is drawing more attention from researchers, community officials, arborists, tree care firms, and wood-using industries including bio-energy producers.

Questions that often arise when discussing the potential for urban tree utilization include:

- How much wood is in our urban areas?
- What are the major constraints to utilizing this wood?
- Are there viable examples of urban tree utilization industries?
- Can bio-energy play a role in urban tree utilization?

This report addresses these questions and concerns.

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[1] Urban areas as defined by the Bureau of the Census include (1) urbanized areas with a population of 50,000 or more and a minimum density of 1000 people /sq. mi, (2) places that contain some urbanized areas within their boundaries, and (3) places with at least 2,500 people and located outside of urbanized areas. Also, areas totally surrounded by urbanized areas but not within an urbanized area are considered to be an urban area (Nowak et al. 2001).

[2] Metropolitan areas as defined by the Office of Management and Budget defines metropolitan areas by county, not places (except in the six new England states). Metropolitan areas have one or more large core populations that are socially and economically linked to adjacent counties. For example, the New York metro area—the largest in the country—covers 36 counties in New York, Connecticut, New Jersey, and Pennsylvania (Sherrill 2003).

How Much Wood is in Our Urban Areas?

Various researchers have addressed this question in different ways since the early 1990s. Following are different perspectives on the volume of urban trees removed on an annual basis from across the U.S.

In 1994 the NEOS Corporation of Lakewood, Colorado, conducted the first national inventory of urban tree residues. A mail and telephone survey was conducted of "generators" of urban tree residues. The list of generators included commercial tree care firms, municipal/county park and recreation departments, municipal tree care divisions, county tree care divisions, electric utility power line maintenance, landscape maintenance/landscaper/nursery firms, and excavator/land clearance firms. Results of the study, when extrapolated across the U.S., indicated an annual urban tree residue volume—chips, logs, tops, brush and stumps—of over 192 million cubic yards. This figure converts to over 38 million green tons (or about 25 million tons dry basis) of residue[3]. Interestingly, survey respondents said that 70% of the wood residue was either given away, landfilled, or left on site, with only 25% reported as recycled or sold/used for a product. Since the survey included firms that work in rural areas as well as urban (electric utility power line maintenance for example), the results could be interpreted as including more than just urban or metropolitan area trees.

A 2003 report issued by the USDA Forest Service, Forest Products Laboratory, estimated that in 2002, urban wood residues in the municipal solid waste stream totaled 14.8 million metric tons (16.2 million short tons of chips, logs, stumps, tree tops and brush). About 8.5 million metric tons were recovered, mainly for compost and mulch. Of the remaining 6.3 million metric tons, 1.5 million were sent to combustion facilities, 1.6 million were deemed unusable, and 3.2 million metric tons were available for further processing (in other words, "good wood" seeking a market). Interestingly, the total of 14.8 million metric tons was greater than the total estimated weight of timber harvested from U.S. National Forests during this same time period.

A report from the U.S. Environmental Protection Agency (EPA) (2007) estimated that in 2006 "yard trimmings" in the municipal solid waste (MSW) stream totaled 32 million tons. This estimate includes grass clippings, leaves and other non-woody residue. The urban tree and woody residue portion of the yard trimmings amount is estimated at nearly 19 million tons.[4]

A different approach to estimating the volume of urban trees removed on an annual basis is to look at urban tree inventories and apply an estimate of annual removal rates. This method eliminates the need to depend on survey respondents to quantify how much residue they divert from, or contribute to, the municipal solid waste stream.

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[3] This figure was derived by assuming 5 cubic yards of urban tree residue equals 1 ton of material (CIWMB 2007); converting green weight to dry weight basis assumed a green moisture content of 50 percent.

[4] Using 2000 EPA data, McKeever and Skog (2003) estimated that 58% of yard trimmings were urban tree and woody yard residue. This same percentage was applied to the 2006 data to approximate the 19 million tons.

Nowak and Crane (2002) reported on carbon storage and sequestration by urban trees in the U.S. Using high resolution radiometer data to estimate urban tree cover, and combining this information with biomass equations adjusted for trees growing in an urban setting, an estimate of carbon storage in urban trees in the coterminous U.S. was obtained. Using this method, urban trees were estimated to contain over 704 million metric tons of carbon (dry weight basis). Conversion of Nowak and Crane's carbon storage data to above-ground 'green' biomass of living trees results in an estimate of over 1.7 billion tons of 'standing biomass' in our urban communities (lower-48 states)[5]. At a conservative one percent annual removal rate for urban trees (due to storms, pest attacks, construction, etc.), the standing urban tree biomass removed on a yearly basis is estimated at approximately 17 million tons.

Consequently, regardless of the method used, the volume of urban tree removals is a substantial number. The estimates range from over 16 to 38 million green tons (short tons) per year. As mentioned, even the lower range of the estimate is comparable to total annual harvests from America's National Forests. By including metropolitan area trees, and arguably most of these trees are more rural than urban by definition, the volume would increase by at least a factor of 17 in the Nowak and Crane example. However, it is the metropolitan areas that will absorb the majority of the predicted urban growth during the next half-century.

What are the Major Constraints to Utilizing Urban Wood?

There is a long list of reasons that urban trees aren't always utilized to their best and highest value. Some of these reasons or constraints are justified, others fall into more the excuse category. Here's a quick look at some of the more common constraints.

Wood Quality – Urban trees are typically more open grown than trees growing in a natural forested setting; this results in shorter trunks and more branches. Throw in the possibility of imbedded materials—nails, cables, and other hardware—and many timber buyers are frightened away. In addition, among both urban wood generators and many in the traditional wood products industry, there is a perception that urban trees have 'zero' value.

Wood Quantity – With the exception of storm events or a large pest outbreak, most *individual* urban tree removal projects generate small quantities of wood. Most existing wood industries can't afford to scurry around town picking up one or two logs. Also, many urban tree projects involve pruning (branch removal) and other maintenance activities rather than main stem (trunk) removal.

Markets – Most timber sales in rural forests involve multiple tree species. This 'product variety' enables a range of potential buyers and markets to be interested in the sale. In urban areas, especially after an invasive species attack (i.e., emerald ash borer or Dutch elm disease), the

[5] The math and assumptions are as follows: 704 million metric tons is approximately 774 million short tons (2000 lbs/ton); since trees are about 50% carbon, multiplying 774 million x 2 = 1.5 billion tons of biomass (dry weight); at 50% moisture content the weight is 2.3 billion green tons (1.5 billion x 1.5); converting this estimate to "above ground" biomass excluding leaves, roots and dead trees equals 1.7 billion tons (i.e., 2.3 billion x .74 shoot-to-root ratio).

availability of a single species or two is more the norm, limiting the number of potential buyers, utilization options, and markets. Urban tree removals also generate many species that are not conventionally valued in traditional timber markets.

Inventories – Tree inventories in urban areas often lack the scope and specificity (such as log volume and grade) needed by wood-using industries to set-up an effective utilization program.

Utilization Plans – In addition to tree inventories lacking specificity for utilization objectives, most urban forestry programs have weak or non-existent utilization plans. This lack of planning includes a poor understanding of local markets and potential products, a reluctance to engage timber buyers and existing wood-using industries, and a general lack of knowledge of how to create a viable utilization plan.

Community Support – Community leaders are often short-staffed and struggling with tight budgets. Asking them to develop and/or incorporate new ideas for how they dispose of urban tree removals is often difficult, even if it will result in savings for the city. In many cases, communities don't care what happens to the wood, as long as it is removed from public areas in a timely manner.

When the added expense of working in an urban environment is considered in the light of a general lack of enthusiasm by many wood industry firms, the constraints of utilizing the urban wood resource seem daunting. Surprising to many, however, is that a movement is afoot to minimize these constraints, and develop viable markets for wood from our urban forests. As more cities are creating strategies to "green" their communities, urban tree utilization planning has the potential to be included in these plans.

Are there Examples of Urban Tree Utilization Industries?

The short answer is, yes, and their numbers are growing. Most of the firms that utilize urban trees are small (less than 5 employees), or the firms are part of a larger business (ex: a large tree service firm that creates a wood utilization business line). The green building movement, storm-related tree cleanup, and pest outbreaks are examples of opportunities for urban tree utilization. Today, a large number of businesses involved in urban tree utilization are focused on lumber and related value-added businesses (furniture, flooring, cabinets, etc.).

Horigan Urban Forest Products in Skokie, Illinois, a suburb of Chicago, is one example of a company focused on lumber and value-added products. Bruce Horigan started in the tree service business in the 1970s and has observed many years of wasted opportunities. He acknowledged in a recent *Sawmill and Woodlot* magazine article (Bratkovich 2008) that he tired of seeing high quality logs with lumber potential dumped at a landfill. Even after landfilling of logs was outlawed, Horigan observed sawlog quality material either chipped or bucked into firewood. In 2003 he took his business in a different direction. Along with his wife Erika, Horigan Urban Forest Products was founded. Using a portable band saw and two small dry kilns, the Horigans began milling and drying lumber from logs sourced from tree service companies, municipalities and homeowners. Today, their two lumber warehouses stock hardwood lumber that caters to furniture makers, flooring and remodeling contractors, and individual homeowners and

hobbyists. Additional information about Horigan Urban Forest Products can be found at http://www.horiganufp.com/. See sidebar for two other examples of small but innovative urban tree utilization businesses.

Sometimes a disaster such as a major storm or pest outbreak is the impetus for creating an urban tree utilization program. The discovery of the exotic emerald ash borer (EAB) in Detroit in 2002 is a case in point. Many small businesses including sawmilling operations were started to deal with the volumes of ash wood being removed as the EAB moved across the urban and rural landscape. Federal and State dollars were critical in jump-starting some of these firms. The Southeast Michigan Resource Conservation and Development Council played a key role in working with start-up businesses, administering grant programs, developing educational and training programs, and, in general, promoting utilization efforts. The Council's "Ash Utilization Options Project" has been an extremely helpful program and serves as an outstanding model for other urban areas (http://www.semircd.org/ash/). Also, the discovery of EAB in Michigan, and subsequently in seven other states (plus Ontario), highlights the importance of communities being pro-active and developing urban tree utilization programs before a crisis occurs.

An interesting spin-off of the EAB utilization effort in Detroit as well as other projects around the country is the interest from the green building industry in using reclaimed urban wood. Community recycling and reuse centers, LEED projects, and other green building efforts have provided new markets for lumber and related products from urban trees. As an example, the ReUse Center in Ann Arbor, Michigan, stocks locally produced lumber from urban sawmills (see http://urbanwood.org/). Also, CitiLog in New Jersey has supplied lumber to commercial LEED green building projects. In the future, the green building sector will likely continue to grow as a market for urban wood products.

East and West Coast Urban Tree Utilization Businesses

CitiLog, based in Pittstown, New Jersey, has built its urban tree utilization business model on contracted services. Sourcing logs from Manhattan and surrounding urban areas, CitiLog contracts with the Pennsylvania Amish to saw and dry the lumber from its urban logs, as well as craft furniture and other value-added products. Often, the finished products are purchased by the original source of the logs. CitiLog promotes this as their "full circle recycling" program. For example, a recent project with the University of Pennsylvania took trees removed from campus that will be returned to the school as finished bookcases and tables. *For more information see* http://www.citilogs.com/ .

The business model of **Pacific Coast Lumber** in San Luis Obispo, California, stands in contrast to the CitiLog model. Although both firms source their raw material from urban trees, Pacific Coast Lumber employees mill and fabricate various products including small out-buildings, sheds, and cabins, as well as Adirondack furniture, benches, and picnic tables. Also, custom milling accounts for about 30% of their business. Don Seawater of Pacific Coast Lumber said, "Our sales have increased since we started in 1998. However, not all urban wood is useable for milled products. Renewable energy is the next product market we're looking at." *For more information see* http://www.pacificcoastenterprises.com/.

As illustrated in the above examples, urban tree utilization efforts are alive and well. Although the amount of wood being utilized for lumber and related products is still relatively small, the potential is great.[6] Another industry in a position to use large volumes of urban tree biomass can be found in the bio-energy sector.

How Does Urban Tree Utilization Relate to Bio-Energy?

An example of the synergy between bio-energy and urban trees can be found in downtown St. Paul, Minnesota. Located about one-half mile from the State Capital building, District Energy St. Paul operates a combined heat and power plant serving the commercial, industrial and residential downtown area. The energy output of the steam powered turbine is 25 MW; "waste" energy created in the process is used to heat the downtown area. Completed in 2003, the plant was built as a multi-fuel unit, capable of burning coal, natural gas, or biomass in the form of woodchips. In 2005, 60% of the fuel used to fire the heat and power plant was wood chips. The long-term goal is to have 75% or more of the fuel for the plant to be biomass. Currently, the plant consumes up to 300,000 tons of wood chips per year, primarily sourced from urban tree removals. Mike Burns, Project Engineer for District Energy noted, "We're using a clean, renewable resource in urban wood. It's enabled us to reduce CO2 emissions by 280,000 tons per year."

To put the District Energy St. Paul example in perspective, consider the earlier referenced estimate of 17 million tons of urban tree removals per year in the lower-48 states. With District Energy's 25 MW plant using upwards of 300,000 tons of wood per year, the volume of urban tree removals—17 million tons annually—could theoretically support 57 similar size bio-energy plants! Of course, all 17 million tons of the annual removals will not be available for use, and siting an energy plant the size of District Energy in other urban areas may be challenging. However, the sheer magnitude of the "potential" of urban tree removals to generate renewable energy should not be overlooked. Many of the constraints noted above to urban tree utilization (tree quality and quantity, single species markets, etc.) are greatly diminished when "energy" is the final product. The fact that an infrastructure—including trained workers—already exists in urban areas to remove trees and convert them into chips is a plus for a local energy market.

In addition, urban trees are not the only urban wood resource that can be tapped for energy. When combined with construction and demolition wood, discarded wood pallets and related shipping containers, and other forms of recyclable urban wood, the potential for urban areas to serve as local wood baskets (or supplement existing wood baskets) for industrial energy-producing applications is compelling.

[6] One estimate of the potential annual lumber recovery from "unchipped logs" is 3.8 billion board feet (Bratkovich 2001). This estimate is based on the annual volumes of urban tree removals as reported by the NEOS Corporation 1994.

The Bottom Line

Urban areas, and adjacent "metropolitan land", will continue to grow throughout the United States, consequently expanding the size of the urban forest. The estimated volume of urban trees removed annually varies by study, time frame, and method of analysis; regardless, the total volume is significant. Urban forests contain a wood fiber resource that is in its infancy in being utilized for wood and paper products; however, based on the examples provided above, the future looks promising. More attention—including research, education, and technology transfer—should be given to this resource in light of its ability to provide useful products including lumber and bio-energy, conserve landfill space, and generate economic opportunities.

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612-333-0430

DOVETAIL PARTNERS, INC.

528 Hennepin Ave, Suite 202
Minneapolis, MN 55403
Phone: 612-333-0430
Fax: 612-333-0432
www.dovetailinc.org