Arboriculture & Urban Forestry 2026
https://doi.org/10.48044/jauf.2026.002

Urban Residential Landowner Interest in Emerging Urban Wood Product Markets: Results from a Multi-City Survey

By Corinne G. Bassett, Dexter H. Locke, Nancy F. Sonti, Jesse Caputo, Brett J. Butler, Iris Montague, and J. Morgan Grove

Abstract. Background: For the past 20 years, approximately twice as many trees were removed annually from urban areas in the USA as were harvested annually from the US National Forest System. Yet, most of this wood is treated as waste instead of as a valuable resource to generate economic growth and sustainable cities. Residential landowners are key actors in the establishment of local urban wood economies as both sources of material and users of urban wood products, yet they remain a difficult to reach group compared with others, such as tree care companies, mill operators, and public landowners. Methods: We analyze a representative survey of urban residential landowners in 6 United States cities. We assess (1) status of participation in urban wood systems; and (2) interest in and perceived importance of urban wood products. Results: Overall, 15% of residential landowners reported purchasing or acquiring urban wood products in the past. Landowners were more likely to purchase—and were more interested in—lower value products like wood chips and compost than higher value products like lumber or furniture. Private sector actors, like landscaping and tree care companies, and social sources, like friends and family, were more often recognized as sources of trusted information for tree care advice than local or state government and nonprofit organizations. Conclusions: We present baseline results of, to our knowledge, the largest survey of urban wood perceptions and practices to date, which indicate a substantial group of landowners already engaged in urban wood economies, and discuss potential avenues to activate future participation.

Keywords. Local Economy; Private Landowner; Sustainable Timber; Wood Products; Wood Recycling.

INTRODUCTION

Urban forests are typically defined as all the trees and associated vegetation in urban areas and are managed for wide ranging benefits, from human health to environmental regulation to cultural values (Konijnendijk et al. 2006; Vogt 2024). However, unlike trees harvested from rural forests for wood products use, trees in urban areas are not typically managed or removed for this purpose. As wood product markets determine the willingness to pay for tree cutting, another definition for urban forests could be those areas where owners need to pay to have trees removed instead of the potential to be paid for harvested trees. After removal, these urban trees also face a different fate from their rural counterparts, often designated as waste and destined for landfills or repurposed as low value wood products, such as wood chips or firewood. A seemingly small issue when faced with managing the material from a single removed tree, the cumulative volume of wood removed in urban and peri-urban areas is staggering. Initial estimates show that the woody biomass lost annually across urban areas in the United States (USA), assuming 2% tree mortality rate, is equal to approximately 46 million tons of fresh weight merchantable wood, equivalent to 7.2 billion board feet of lumber (2.2 billion m^3) (Nowak et al. 2019). For comparison, annual timber harvests from 2005 to 2024 from the entire US National Forest System have ranged from 2 billion board feet to 2.9 billion board feet (56.6 million m^3 to 84.3 million m^3)(USDA Forest Service 2024).

There is a growing movement to divert urban wood from the waste stream and utilize this significant resource in an array of wood products, from

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high end furniture to construction grade lumber to wood chips (Grove et al. 2021, 2022). Using removed wood for valuable products both avoids substantial waste disposal fees and can be a foundation of profitable businesses and markets (Kloster et al. 2020). Efforts to estimate the volume of wood available from urban areas have occurred since at least the late 1990s and early 2000s (Whittier et al. 1995; McKeever and Skog 2003), with evidence of professional discourse on urban wood use going back even further (Ratcliff 1976; Swisher 1976). Urban wood utilization is now increasingly recognized as part of the sustainable urban forest management life cycle and seen as a new avenue to stimulate local economic growth, create jobs, and foster entrepreneurism (Pitti et al. 2020).

Recent efforts to establish urban wood economies have been focused on formalizing local networks and establishing more robust urban wood supply chains. Advances towards these goals include the establishment of the national Urban Wood Network (Grove et al. 2021), the creation of some of the first urban wood product lines by national companies like Taylor Guitar (Millman 2020) and Room & Board furniture (Nudelman 2021), and the launch of innovative startups like Cambium Carbon (Hailstone 2024). Despite this progress, the establishment of robust urban wood markets still faces challenges such as coordinating diverse actors, workforce skill sets, and new sources of financing, emphasizing the need for strategic level information to inform decision making (Grove et al. 2022).

One challenge to growing urban wood economies is the scarcity of information about both urban wood supply and consumer demand for urban wood products that new actors can use to guide and support their initial investments and management decisions. While there are a growing number of case studies of municipalities creating urban wood utilization systems for the trees they manage (Quantified Ventures 2022; Tamblyn and Judd 2024), the role of private actors and their land is largely undocumented. Understanding the perceptions and management practices of urban residential landowners has substantial implications for local leaders seeking to propel potential urban wood economies. Residential landowners are a key source of material for urban wood products. Single family detached homes and their yards cover approximately 30% of the contiguous United States, which is approximately 4 times greater than all of the protected lands (about 7%)(Lerman et al. 2023). Additionally, residential landowners represent a key segment of potential end users of urban wood products, from high value products such as furniture or building materials to lower value landscape products like wood chips or firewood. In study of consumer behavior towards all wood products, recent studies have found that consumers value sustainability and cite it as one of the main reasons for purchasing wood products in general (Panico et al. 2018; Craig et al. 2024). In fact, after learning of the environmental benefits of using reclaimed wood, respondents in one study indicated that their perceptions of the product were more favorable after learning this information (Montague et al. 2023). However, there has been little research to date on preferences or attitudes towards urban wood specifically as a category of the spectrum of sustainable wood products.

Private residential landowners in urban areas represent a particularly difficult group to reach for many reasons, including the sheer number of them, spread across dense landscapes with diverse land use patterns and demographics, varied patterns of owner vs. renter occupied properties, and siloed property databases among government agencies across urban areas (An et al. 2024). To our knowledge, the only survey of this group with regard to urban wood practices was a survey of owner occupied single-family households in Harrisonburg, VA, USA (Schmitt-Harsh and Wiseman 2020), which found that while the majority of households did not recycle wood from their properties into wood products, nearly all supported use of their wood for wood products as opposed to disposal in a landfill. Other surveys of urban private landowners on their tree and land management practices in general have found that desires to manage outdoor landscapes more sustainably were balanced by factors such as aesthetics, social pressures, cost, and time (Larson et al. 2016, 2022; Pike et al. 2023). Tree management behaviors have also been found to vary by parcel size and the type of residence, for example single-family homes versus duplexes (Berland et al. 2023). Understanding the current wood utilization practices and perceptions of urban landowners not only fills a significant gap in knowledge about their role in urban systems but provides valuable data to inform decision making in establishing urban wood economies.

Recognizing the importance of understanding tree and green space management in urban areas—where

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over 80% of Americans reside—the Urban National Landowner Survey (UNLS) was developed by the USDA Forest Service to provide information on perceptions and land management practices of private residential landowners. This represents the urban analog of the National Woodland Owners Survey (NWOS), a key product of the USDA Forest Service's Forest Inventory & Analysis (FIA) program, which has been surveying private woodland owners since 1978 (Butler et al. 2016). In this article, we present baseline results of the status and perceptions of urban wood utilization among representative samples of urban residential landowners across 6 United States cities in 5 states: Baltimore, Maryland; Denver, Colardo; Austin and Houston, Texas; Portland, Oregon; and St. Louis, Missouri. To our knowledge, these data represent the most widespread of their kind to date. The objectives of this study are to:

- Describe the status and perceptions of urban wood use among urban residential landowners in the USA through a multicity analysis;
- Explore differences in these perceptions by property characteristics and land management behaviors;
- Discuss potential applications of these data for different actor types within urban wood product systems; and
- Demonstrate the potential use and application of the USDA Forest Service's UNLS dataset.

METHODS

Approach

This study is a descriptive analysis of a subset of questions included in the USDA Forest Service's Urban National Landowners Survey (UNLS). Overall, UNLS aims to understand "who owns the trees and green spaces across America's urban areas, why they own them, what they have done with them in the past, and what they plan to do with them in the future." Complete methods are documented in Butler et al. (2025).

Beginning in 2016, pretesting was conducted with focus groups in Austin, Texas, and Baltimore, Maryland, resulting in an initial questionnaire pilot tested in Austin, Texas, and 4 cities in Wisconsin (Green Bay, Madison, Milwaukee, and Wausau). The final 2018 UNLS questionnaire, select results of which we present in this article, consisted of questions related to ownership and land characteristics; property management activities; tree related concerns on their property; participation in programs and organizations; information sources; opinions on neighborhood and community characteristics; attitudes towards trees; urban wood use; and demographics. There were slight modifications to the questionnaire in the subsequent years, but the structure and bulk of the questions remained the same throughout the study.

UNLS methods were designed to reach a statistically representative sample of urban residential landowners within a city. Sampling methods are adapted from the National Woodland Owners Survey (NWOS) and can be summarized "as an area-based sample design with inclusion probabilities proportional to size of holdings within the geographic boundary" (Butler et al. 2025). Following NWOS methods, a "net" of contiguous hexagons was generated for each urban area, and one sample point was located within each hexagon. Questionnaires were sent to addresses of all sample points found to represent residential owners (determined via spatial overlays with municipal property data). The target sample size of private, residential landowners in each urban area was 100 respondents, based on the minimum sample size needed for reporting for a geography for the base NWOS. For UNLS, the sample areas for each city are the 2010 Census Place boundaries, to be consistent with boundaries used in sampling Urban FIA plots (Edgar et al. 2021).

The Baltimore sample was contacted completely in 2018 (Locke et al. 2025), while the other 5 cities included in this analysis were contacted in a panel from 2019 to 2021 (Table S1). Following NWOS protocol and Dillman's Tailored Designed Method (Dillman et al. 2014), ownerships at each sample point received up to 4 contacts over a 28 day period: a prenotice postcard, a first questionnaire packet, a reminder/thank you card, and a second questionnaire packet. Data entry consisted of robust quality check procedures. Nonresponse bias, when a potential respondent does not respond to a survey or does not respond to all questions, was assessed to confirm that surveys captured representative samples of private residential landowners of each urban area. Nonresponse was assessed by comparing early (first 25%) and late (last 25%) respondents. Of the 11 representative variables tested, none significantly differed (P-value > 0.05) between the early and late respondents (Butler et al. 2025). Cooperation rates

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calculated are the number of complete responses divided by the total complete, partial, and nonresponses (Table S1)(Butler et al. 2025).

Study Cities

The 6 cities included were: Baltimore, Maryland; Denver, Colorado; Austin, Texas; Houston, Texas; Portland, Oregon; and St. Louis, Missouri. These 6 cities had urban wood sections included in their UNLS questionnaires and were conducted in similar time periods with the same approach. The cities were selected to cover a wide variety of geographic contexts and ecoregions. Additionally, to align with FIA's urban program (launched in 2015), cities also needed to have an established FIA field inventory and state or local partners who expressed interest in adding the UNLS to their Urban FIA portfolio (Figure 1; Table 1). In general, when working with state and local partners, the largest city in each state was selected, but the state of Texas decided to focus on Austin first, and then Houston.

Urban Wood Section of Questionnaire

UNLS questionnaires in 6 cities included a specific section of questions related to urban wood use. The urban wood section of the UNLS questionnaires included 5 questions related to urban wood use (see Table S2). These are the focus of this analysis and are

Table 1. Populations of sampled areas of each of the 6 study cities.

Census place	Area (km^2)	Total population (aggregated 2017 to 2021, millions)	Population density (people / km^2)	Owner occupied (% of housing units)
Austin (n = 81)	790	0.91	0.00115	44.36
Baltimore (n = 145)	224	0.59	0.00265	47.94
Denver (n = 97)	400	0.71	0.00176	49.54
Houston (n = 244)	1,625	2.35	0.00144	43.91
Portland (n = 112)	376	0.65	0.00172	53.36
St. Louis (n = 54)	171	0.30	0.00177	44.73

Note: To estimate population within the sampled areas for each city, the 2017 to 2021 American Community Survey block group data were aggregated into the Census Place boundaries using an area-weighted method (i.e., if half of a block group was in, half of the population was attributed to the Place boundary). The vast majority of block groups were completely contained in each Census Place; the median percent area in was 100% and the mean was 82.4%.

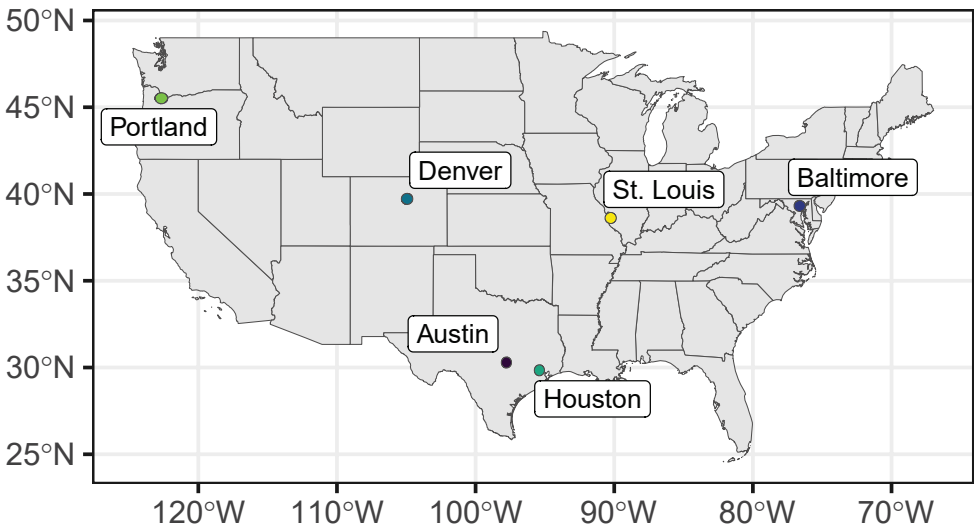

Figure 1. The 6 UNLS cities (from West to East): Portland, Oregon; Denver, Colorado; Austin, Texas; Houston, Texas; St. Louis, Missouri; and Baltimore, Maryland.

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examined in context of other characteristics collected in the UNLS. Two of these questions were included in the questionnaires for all six cities, one question was asked in four cities, and two questions were asked in three cities.

Analysis

We took a descriptive and comparative approach to analysis of results to serve our aim to provide initial, strategic level findings. We performed cross-tabulations, calculated descriptive statistics across all included cities (e.g., percent of responses), and created graphical visualizations (e.g., Likert-style bar charts, summary tables) using R 4.4.2 (R Foundation, Vienna, Austria). Percentages of respondents were calculated based on the number responding to each question. The number of respondents per question varies due to skipped questions (i.e., nonresponse), questions with skip-patterns (i.e., "if you responded yes to the previous question, then…"), and questions only included in a subset of the 6 cities. Therefore, the number of respondents per question varied and is noted along with percentages throughout the results. Chi-square tests of independence were performed using the Janitor package (Firke et al. 2024) to compare the relationships of frequencies within groups and significance level assessed at $\alpha = 0.05$.

For questions related to specific wood product types, we used a previously developed framework developed to retrospectively group the types of urban wood products into 3 value tiers (Urban Wood Network [date unknown]). Low value products included wood chips or mulch, compost, and whole logs; medium value products included lumber and firewood; and high value products included furniture, interior or exterior home products (e.g., doors, cabinets, trim), flooring, art or jewelry, and small items (e.g., kitchen goods).

RESULTS

Descriptive Statistics

The overall cooperation rate was 17.96% and ranged from a low of 13.35% in Houston, Texas, to a high of 24.51% in Portland, Oregon (Table S1). Across all cities, the sample was mostly composed of single-family, detached homes with 1 to 10 trees on the property (Table 2). Comparatively fewer respondents from Baltimore were in single-family detached homes (63%, compared to the other 5 cities which ranged from 86% to 98% (Table S3). Duplexes/townhouses/rowhomes made up 26% of Baltimore respondents, while the other 5 cities ranged from 2.5% to 9.3%. A plurality of respondents for each city reported having 1 to 5 trees on their property (ranging from 36% to 56%; see Table S3 for property characteristics broken down by city).

Status of Tree Management Activities

Urban residential landowners actively manage trees on their properties and generate woody biomass. Across all cities ($n = 732$), almost half of respondents (44%) reported removing one or more trees on their property in the last five years, while the rest reported that no trees were removed (52%) or that they did not know (4%)(Table S4).

All participants were asked about who, if anyone, performs tree work on their property. Tree work was generally performed by the survey respondent/landowner (48%, 329/689) or by a landscaping company or tree care professional (43%, 273/637). Respondents also reported that tree work was performed by their spouse (20%, 136/689) or child (5%, 19/383). Relatively few reported that tree work was performed by

Table 2. Property characteristics across all residential landowners surveyed in Baltimore, MD; Denver, CO; Austin, TX; Houston, TX; Portland, OR; and St. Louis, MO.

Characteristic	$n = 733$[1]
Number of trees per property	
0	57 (7.8%)
1 to 5	336 (46.0%)
6 to 10	158 (22.0%)
More than 10	175 (24.0%)
I don't know	6 (0.8%)
Unknown[2]	1.0
Residence type	
Single family home, detached	627 (86.0%)
Duplex/townhouse/rowhome	65 (8.9%)
Apartment building	18 (2.5%)
Other	22 (3.0%)
Unknown[2]	1.0

[1] *n* (%)
[2] Unknown values are excluded from percentages (e.g., due to nonresponse).

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a tenant (3%, 20/630) or by a homeowner's association or co-op (2%, 17/732). Combining respondent/landowner, spouse, child, and tenant suggests that approximately 76% of respondents perform tree care themselves, while 43% employ a professional. Seven percent reported that no one performed tree work on their property (52/732). Differences in denominators of these results reflect differences in response options between cities ("child" was not an option in this question for all cities)

Status of Participation in Urban Wood Use Systems

Respondents were given the following definition for urban wood: "'Urban wood' is wood that comes from a city or town's public or private trees that were removed due to death, disease, or other circumstances (NOT due to economic value)". Relatively few participants reported purchasing or acquiring urban wood products; 15% said yes, 76% said no, and 9% said I don't know (n = 732). By city, responses ranged from 9.7% to 28% saying yes, 66% to 81% saying no, and 2.7% to 12% saying I don't know. Of the respondents who selected yes, most reported purchasing or acquiring wood chips or mulch, followed by firewood (Figure 2).

Perceived Importance of Utilizing Urban Wood

Respondents had different levels of perceived importance of urban wood utilization depending on whether wood came from their property or from their city/town and different interest in purchasing urban wood products depending on the type of wood product in question. Overall, more respondents felt it was moderately to very important that trees removed from their city were used in wood products than the number indicating it was important to use trees removed from their property as wood products (Figure 3). There was generally more interest in lower value products, like compost and wood chips or mulch, than higher value products, such as furniture or lumber (Figure 4).

How Does Perceived Importance of Using Removed Trees for Urban Wood Products Differ by Property Characteristics and Tree Management Practices?

There was little difference found in perceptions around the importance of urban wood use by property characteristics and tree management practices. Respondents with trees on their properties had somewhat higher perceived importance of using wood both from their own property and from their city in general compared to respondents without trees, but this was not found to be statistically significant per the chi-squared test of independence (see below).

When asked to rate the importance of using wood from trees removed in their city/town as wood products (asked in all 6 cities), there were no significant differences found in responses from properties with differing numbers of trees (Table 3). This was the case both in comparing responses from properties with no trees and a grouped variable of all properties with more than one tree (X^2 [df = 4, n = 726] = 4.0, P = 0.41) and in comparing responses from properties with no trees, 1 to 5 trees, 6 to 10 trees, and more than 10 trees (X^2 [df = 12, n = 726] = 14.0, P = 0.32).

When asked to rate the importance of using wood from trees removed from their property as wood products (asked in Baltimore, Denver, and Houston), slightly fewer of these respondents indicated they thought it was important to use trees from their property as urban wood products compared to the importance of doing so with trees removed in their city/town generally (Table 3). However, there was also no significant association between the number of trees on a respondent's property and their perceived importance of using wood from trees removed from their property as urban wood products, whether comparing responses from properties grouped by no trees and more than 1 tree (X^2 [df = 4, n = 384] = 5.9, P = 0.21) or grouped by no trees, 1 to 5 trees, 6 to 10 trees, or more than 10 trees (X^2 [df = 12, n = 384] = 15, P = 0.25).

Recent experience removing trees did not seem to impact the perceptions of respondents. Between respondents who had or had not removed a tree on their property in the past 5 years, there was no significant difference in perceived importance of using removed trees from their city/town for urban wood products (X^2 [df = 4, n = 705] = 0.60, P = 0.96) or from their property (X^2 [df = 4, n = 379] = 2.9, P = 0.58). Of respondents who said one or more trees had been removed in the past five years (n = 182), 22% said that wood utilization of trees from their property was not important, 18% said of little importance, 29% said moderately important, 19% said important, and 13% said very important. Of respondents who said no trees had been removed from their property in the past 5 years (n = 197), 24% said that wood utilization

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from their property was not important, 18% said of little importance, 22% said moderately important, 23% said important, and 13% said very important.

There was no significant association found whether or not the landowner had purchased or acquired any urban wood products between those living in a single-family home or duplex/townhouse/rowhome (X^2 [df = 1, n = 633] = 4.0, P = 0.05). Of all the residential landowners owning a duplex/townhouse/rowhome (n = 58), 7% (n = 4) had purchased or acquired any urban wood products. Of all the residential landowners owning a single-family home (n = 575), 18% (n = 105) had purchased or acquired any urban wood products.

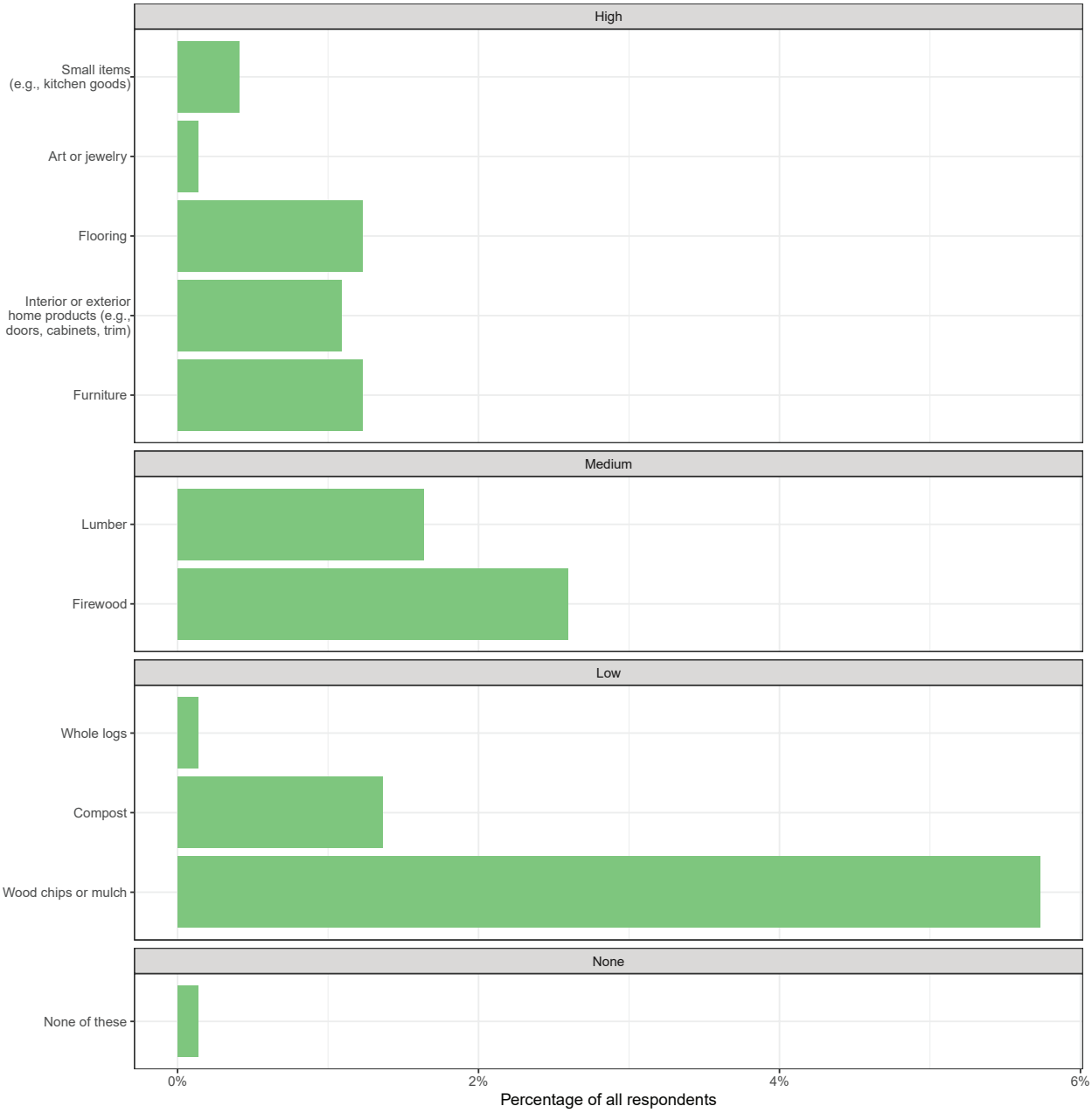

Figure 2. Responses to, "Which, if any, of the following urban wood products did you or your company purchase or acquire?" All respondents had answered "Yes" to the preceding question, "Have you or your company ever purchased or acquired urban wood products (e.g., wood chips, firewood, flooring, small items) from the city/town where the property is located?" (Figure S1). Products were grouped in the analysis process into high, medium, and low tiers of value (Urban Wood Network [date unknown]).

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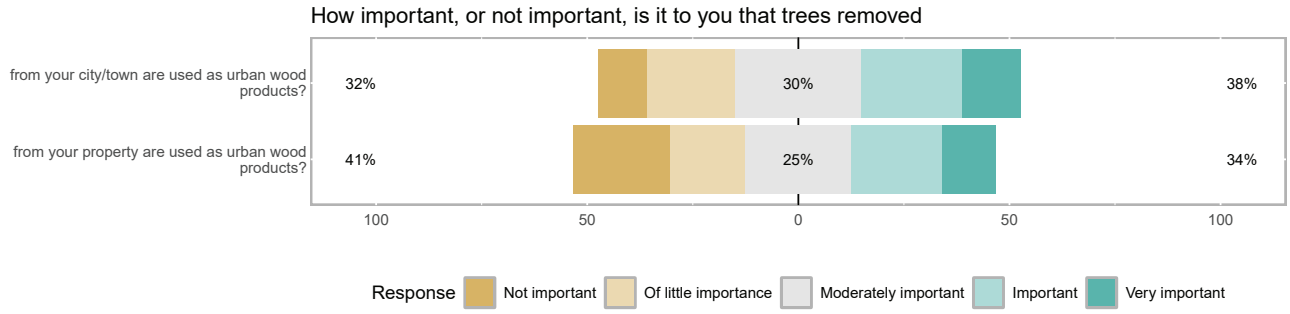

Figure 3. Responses from Denver, CO; Houston, Texas; and Baltimore, Maryland, to the question, "How important, or not important, is it to you that trees removed from your property are used as urban wood products?" (*n* = 384); and, "How important, or not important, is it to you that trees removed from your city/town are used as urban wood products?" (*n* = 525). Responses of "not applicable" were excluded from calculation of percentages for both questions.

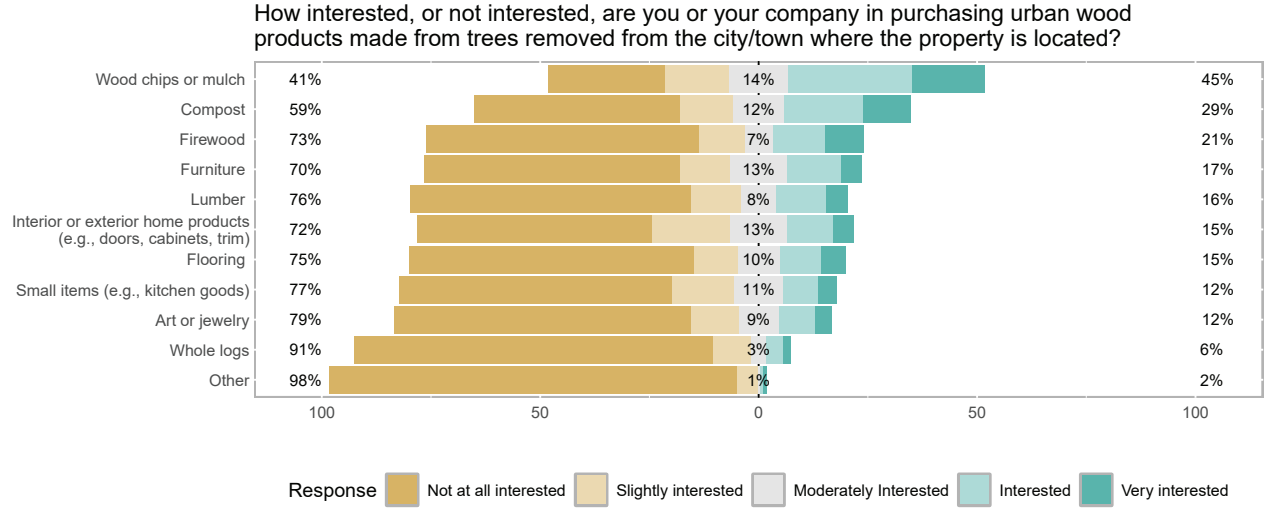

Figure 4. Responses from Portland, Oregon; Denver, CO; Houston, Texas; and Baltimore, Maryland, to the question, "How interested, or not interested, are you or your company in purchasing urban wood products made from trees removed from the city/town where the property is located? Check one box for each item." Due to skipped questions, percentages are reflective only of n respondents: art or jewelry (*n* = 413); compost (*n* = 437); firewood (*n* = 455); flooring (*n* = 451); furniture (*n* = 447); interior or exterior home products (e.g., doors, cabinets, trim)(*n* = 448); lumber (*n* = 446); other (*n* = 665); small items (e.g., kitchen goods)(*n* = 412); whole logs (*n* = 460); wood chips or mulch (*n* = 419).

Table 3. Importance of using wood from trees removed either *in their city/town* or *from their property* by the amount of trees on the respondent's property.

Trees removed from	Amount of trees on property	Importance of using removed trees for urban wood products				
		Not important (%)	Of little importance (%)	Moderately important (%)	Important (%)	Very important (%)
Their city/town[1]	No trees (*n* = 57)	19	25	28	18	11
	At least one tree (*n* = 669)	12	20	29	24	14
Their property[2]	No trees (*n* = 32)	38	22	19	16	6
	At least one tree (*n* = 352)	23	18	25	21	13

[1] Asked of participants in all 6 cities.
[2] Asked of participants in Baltimore, Denver, and Houston.

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How to Reach Urban Residential Landowners

Respondents also answered questions addressing sources of information about property care. Although these questions were not asked directly in relation to urban wood, responses may provide context about how to most effectively reach private residential landowners for increased participation in urban wood use systems.

When asked, "How, if at all, would you or your company prefer to get information or advice about the care of the trees/grass/shrubs on this property?", the 5 responses most common across all cities were: written materials, such as brochures or other publications (50%); talk to someone in person (49%); from the internet or social media (42%); from a lawn and garden center (31%); and attend a workshop (21%). The other options were: talk to someone on the phone (16%); read product labels (14%); go to a local library (8%); and other (4%). Ten percent selected, "I don't want/need information or advice." This question was asked of respondents from Portland, St. Louis, Houston, Denver, and Baltimore (i.e., not Austin)($n = 413$ for all options except, "go to a local library" [$n = 400$]).

When asked to relate their level of agreement or disagreement with the statement, "I/we know who to ask for help on how to properly plant and care for trees on the property," most respondents either agreed (51%) or strongly agreed (20%). The remaining respondents selected neither agree nor disagree (15%), disagree (10%), or strongly disagree (3.8%). Five cities were asked this question ($n = 624$): Baltimore, Portland, Austin, Houston, and St. Louis.

When asked, "Who do you trust for providing you with information about caring for or planting trees on your property?", substantially more respondents indicated that they trusted landscaping and tree care professionals (75%) compared to other sources. Respondents indicated similar levels of trust in sources such as employees at lawn and garden centers (29%) and extension agents or educators (21%) as they did family members or friends (25%) and neighbors (20%). Only 16% selected nonprofit organizations. The least frequently selected sources of trusted information were local government employees (9.1%) and state government employees (7.1%). Of respondents, 8.4% indicated that they trusted "No one" for information on caring for or planting trees on their property. Only 3 cities (Baltimore, Denver, and Houston) were asked this question ($n = 451$ for all options except "neighbors" [$n = 405$]).

DISCUSSION AND CONCLUSIONS

Overall, our results point to relatively low rates of participation in urban wood systems and low perceived importance of using trees from urban areas as wood products among urban residential landowners in these 6 United States cities. However, when viewed as percentages of all residential landowners in a particular city, these rates may represent a sizable population that could be engaged in urban wood use and a significant portion of the volume of wood removed from urban areas each year (Nowak et al. 2019). There are an estimated 219,922,123 urban residents in the United States (80.7% of the total population)(US Census Bureau 2021). If behavior amongst residential landowners in these 6 cities is similar to those in urban areas across the country, 15% would therefore correspond to approximately 33 million people who have purchased or acquired any urban wood products. This rough estimate reveals that urban wood products could yield substantial volumes of wood biomass for products and diversion of that biomass from the wood stream if landowners in all cities assign similar importance to urban wood utilization and act accordingly. Similarly, the relatively higher interest in lower value products like wood chips or mulch was not too surprising, given perhaps greater familiarity with those low value products being sourced with local wood compared to high value products like furniture or flooring.

Nine percent of landowners report not knowing if they have ever purchased or acquired urban wood products, suggesting at first glance that > 90% of urban landowners do know whether or not they have purchased or acquired urban wood products (Figure S1). This conclusion merits scrutiny. Given that the most commonly used urban wood product is chips/mulch and that chips are often used locally and sold in bulk, it is probable that a substantial number of the 76% of landowners who report never having used urban wood have, in fact, used urban wood without realizing it. It is likely that a "no" answer for this question would be better interpreted as meaning either (1) that landowners used no wood products at all, or (2) that landowners did not purchase or acquire wood products that were specifically and conspicuously labeled as urban wood. For these reasons, the actual rate of purchasing or acquiring of urban wood products, especially for chips/mulch, could be much higher than 15% of residential landowners.

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A similar concern is that respondents may have used products classed as urban wood products by our definition, but respondents were not used to considering such products with the label of "urban wood," even after reading the definition provided in the questionnaire. For instance, a study interviewing utility contracted tree crew members in Connecticut on their perceptions of wood recovery programs found evidence that homeowners in downtown or suburban areas were more likely to want all woody biomass from utility removals removed, while "people in the woods want the wood" and were more likely to want chips, firewood, or even hardwoods for higher value products (Kloster et al. 2020). In this case, the definition and labelling of products of utility tree removals as urban wood, and an individual's perception of living in an urban area or not, could impact their response to a survey question about using wood removed from their property as urban wood products. There could also be regional differences in the use of products, for example, firewood for heating. Though the use of urban wood products is still likely low compared to total residential landowners as we found, it could be possible that participants' responses were influenced by unfamiliarity with the term urban wood or the source of the products they use.

While research on urban wood product preferences is scarce, the wood products industry has investigated consumer preference for sustainably sourced wood, which could indicate potential future interest in urban wood products. Research indicates that consumers are interested in sustainable products and that sustainability concerns may lead to increased wood products use in the future (Espinoza 2020; Montague et al. 2023). However, consumers may be less willing to purchase sustainable products if the costs for these products are substantially higher or when there is financial scarcity (Sachdeva and Zhao 2021).

There are inherent barriers to using urban wood that may increase processing costs and decrease consumer demand, despite progress towards including urban wood as a type of sustainable wood products. Most urban trees are removed because of damage or for safety reasons (Pitti et al. 2020). Removal often yields irregular species and sizes of various qualities, complicating milling processes. These trees also may contain nails and other debris that may further complicate processing and deter use (Bratkovich et al. 2014). If there are limited urban wood processors, logistics may be further complicated due to extended transportation and lack of storage.

Different actors may have different goals and incentives in establishing urban wood products systems, which may result in different interactions and participation levels with residential landowners. To some, residential landowners are primarily a customer for a service, while to others, residential landowners are primarily an indirect source of wood material products. Surveys of residential landowners can help to gauge interest and direct decision making with this group. Tree care companies could use these results to understand the potential of offering services like "urban wood use facilitation" or to develop relationships or partnerships with the rest of the supply chain. Mill operators could benefit from knowing broadly the perceptions of their work in their city and the neighborhoods they are more likely to source material. Furniture and value added companies could use such surveys as market data on the potential success of various product lines. Finally, many in the public sector, like municipalities or affiliated NGOs, are trying to advance urban wood products for their objectives, such as reducing landfill waste, creating jobs, and developing businesses and markets. Awareness of behavior patterns and how landowners receive information on tree management can inform more effective outreach and communication to landowners for both producers and consumers of urban wood products.

Considering the relatively low participation in urban wood use systems identified in these results, a logical next step for organizations seeking to establish urban wood product markets would be to consider how best to reach urban residential landowners. Our results indicate that private sector members of the green industry, including landscaping companies, tree care companies, and garden centers, are both recognized and trusted as sources of advice and information for tree care. There was also evidence for the importance of word of mouth in disseminating information as a preferred method for receiving information and as relatively trusted sources, similar to NWOS results for forest landowners outside of urban areas (Butler et al. 2021). Exploring underlying reasons for such differing levels of trust in sources for tree care advice could be a fruitful research direction. More effective communication strategies could be to meet people where they are by working to disseminate

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information through trusted messengers (Wilkins et al. 2018).

Our study presents a baseline upon which further research can build. Future studies could explore underlying reasons for perceived importance or behaviors to understand the barriers and opportunities to participate in urban wood economies. Investigating other stakeholders in the urban environment, or other types of urban landowners, could also help to paint a fuller picture of urban wood systems. Additionally, while we found relatively small differences among these 6 cities, it could be possible for other cities, such as in regions with more significant presence of the timber industry, to have different results. Finally, if conducted again in the future, especially in cities where there had been concerted efforts to establish urban wood use systems, surveys such as UNLS could help to detect any changes in public perception and behavior.

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ACKNOWLEDGEMENTS

Many thanks to Emily Silver as well as all past and current members of UMass Amherst Family Forest Research Center for their contributions to early conceptualization and development of the Urban National Landowners Survey. The findings and conclusions of this publication are those of the authors and should not be construed to represent any official USDA or US Government determination or policy.

Corinne G. Bassett (corresponding author)
USDA Forest Service
Northern Research Station, Baltimore Field Station
Baltimore, MD, USA
corinne.bassett@usda.gov
ORCID: 0000-0002-5254-0688

Dexter H. Locke
USDA Forest Service
Northern Research Station, Baltimore Field Station
Baltimore, MD, USA
dexter.locke@usda.gov
ORCID: 0000-0003-2704-9720

Nancy F Sonti
USDA Forest Service
Northern Research Station, Baltimore Field Station
Baltimore, MD, USA
nancy.f.sonti@usda.gov
ORCID: 0000-0001-8581-8124

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Jesse Caputo
USDA Forest Service
Northern Research Station
Amherst, MA, USA
jesse.caputo@usda.gov
ORCID: 0000-0001-6891-1052

Brett J. Butler
USDA Forest Service
Northern Research Station
Amherst, MA, USA
brett.butler2@usda.gov
ORCID: 0000-0002-2465-7993

Iris Montague
USDA Forest Service
Forest Products Laboratory
Starkville, MS, USA
Iris.montague@usda.gov
ORCID: 0009-0003-8131-7738

J. Morgan Grove
Yale University
Yale School of the Environment
New Haven, CT, USA
morgan.grove@yale.edu
ORCID: 0000-0002-7803-074X

Conflicts of Interest: The authors reported no conflicts of interest.

Appendix on next page

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Appendix.

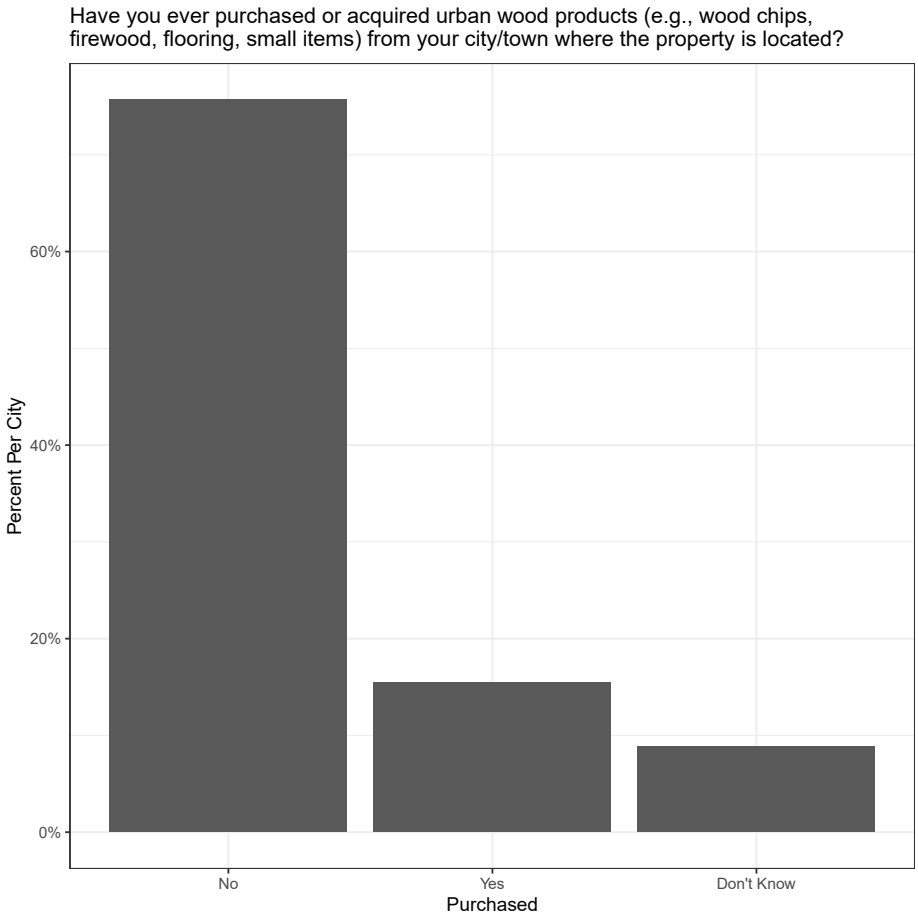

Figure S1. Most respondents had never purchased or acquired urban wood from their city (76%), representing a substantial new market which could be engaged (15% responded Yes, 9% responded Don't Know). Responses are from all 6 cities.

Table S1. Sample size by city and year and cooperation rates.

Characteristic	Overall *n* = 7,331[1]	Portland *n* = 1,121	Denver *n* = 971	Austin *n* = 811	Houston *n* = 2,441	St. Louis *n* = 541	Baltimore *n* = 1,451
Year							
2018	145 (20.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	145 (100.0%)
2019	325 (44.0%)	39 (35.0%)	22 (23.0%)	35 (43.0%)	209 (86.0%)	20 (37.0%)	0 (0.0%)
2020	117 (16.0%)	23 (21.0%)	37 (38.0%)	26 (32.0%)	14 (5.7%)	17 (31.0%)	0 (0.0%)
2021	114 (16.0%)	42 (38.0%)	30 (31.0%)	14 (17.0%)	17 (7.0%)	11 (20.0%)	0 (0.0%)
2022	32 (4.4%)	8 (7.1%)	8 (8.2%)	6 (7.4%)	4 (1.6%)	6 (11.0%)	0 (0.0%)
Cooperation rate	17.96%	24.51%	18.69%	18.67%	13.36%	13.43%	19.10%

[1] *n* (%)

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Table S2. Urban wood relevant questions asked by city.

Question	Portland	Denver	Austin	Houston	St. Louis	Baltimore
How important, or not important, is it to you that trees removed from this property are used as urban wood products?		x		x		x
How important, or not important, is it to you that trees removed in your city/town are used as urban wood products?	x	x	x	x	x	x
Have you ever purchased or acquired urban wood products (e.g., wood chips, firewood, flooring, small items) from your city/town?	x	x	x	x	x	x
Which, if any, of the following urban wood products did you purchase or acquire?						
Wood chips or mulch		x		x		x
Compost		x		x		x
Firewood		x		x		x
Whole logs				x		
Lumber		x		x		x
Furniture		x		x		x
Flooring		x		x		x
Interior or exterior home products (e.g., doors, cabinets, trim)		x		x		x
Art or jewelry		x		x		x
Small items (e.g., kitchen goods)		x		x		x
None of these				x		
Other (please specify)				x		
How interested, or not interested, are you in purchasing urban wood products made from trees removed from your city/town?						
Wood chips or mulch	x	x		x		x
Compost	x	x		x		x
Firewood	x	x		x		x
Whole logs	x	x		x		x
Lumber	x	x		x		x
Furniture	x	x		x		x
Flooring	x	x		x		x
Interior or exterior home products (e.g., doors, cabinets, trim)	x	x		x		x
Art or jewelry	x	x		x		x
Small items (e.g., kitchen goods)	x	x		x		x
Other	x	x		x		x

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Appendix. Continued.

Table S3. Property characteristics by city.

Characteristic	Overall *n* = 7,331[1]	Portland *n* = 1,121	Denver *n* = 971	Austin *n* = 811	Houston *n* = 2,441	St. Louis *n* = 541	Baltimore *n* = 1,451
Number of trees per property							
0	57 (7.8%)	3 (2.7%)	8 (8.2%)	0 (0.0%)	6 (2.5%)	14 (26.0%)	26 (18.0%)
1 to 5	336 (46%)	40 (36%)	54 (56%)	33 (41%)	107 (44%)	30 (56%)	72 (50%)
6 to 10	158 (22.0%)	28 (25.0%)	22 (23.0%)	22 (27.0%)	61 (25.0%)	5 (9.3%)	20 (14.0%)
More than 10	175 (24.0%)	39 (35.0%)	13 (13.0%)	25 (31.0%)	67 (28.0%)	4 (7.4%)	27 (19.0%)
I don't know	6 (0.8%)	2 (1.8%)	0 (0.0%)	1 (1.2%)	2 (0.8%)	1 (1.9%)	0 (0.0%)
Unknown[2]	1	0	0	0	1	0	0
Residence type							
Single family home, detached	627 (86%)	104 (93%)	86 (89%)	79 (98%)	218 (90%)	48 (89%)	92 (63%)
Duplex/townhouse/rowhome	65 (8.9%)	3 (2.7%)	9 (9.3%)	2 (2.5%)	9 (3.7%)	4 (7.4%)	38 (26.0%)
Apartment building	18 (2.5%)	2 (1.8%)	1 (1.0%)	0 (0.0%)	7 (2.9%)	1 (1.9%)	7 (4.8%)
Other	22 (3.0%)	3 (2.7%)	1 (1.0%)	0 (0.0%)	9 (3.7%)	1 (1.9%)	8 (5.5%)
Unknown[2]	1	0	0	0	1	0	0

[1] *n* (%)
[2] Unknown values are excluded from percentages (e.g., due to nonresponse).

Table S4. Responses by city to question, "Have one or more trees been removed from this property in the past 5 years?"

	Portland	Denver	Austin	Houston	St. Louis	Baltimore	Total
No	61 (16.1%)	53 (13.9%)	41 (10.8%)	107 (28.2%)	32 (8.4%)	86 (22.6%)	380 (100.0%)
Yes	45 (13.8%)	42 (12.9%)	36 (11.1%)	126 (38.8%)	17 (5.2%)	59 (18.2%)	325 (100.0%)
Don't know	6 (22.2%)	2 (7.4%)	4 (14.8%)	10 (37.0%)	5 (18.5%)	0 (0.0%)	27 (100.0%)
Total	112 (15.3%)	97 (13.3%)	81 (11.1%)	243 (33.2%)	54 (7.4%)	145 (19.8%)	732 (100.0%)

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