

ST. LOUIS DECONSTRUCTION MARKET ASSESSMENT

April 2019

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ABOUT DELTA INSTITUTE

Established in 1998, Delta Institute is a Chicago-based nonprofit organization that collaborates with communities to solve complex environmental challenges across the Midwest. Since our founding, we have managed deconstruction programs and projects in Gary, Indiana, Cook County, Illinois, Chicago, Illinois, and Detroit, Michigan for a variety of partners such as land banks, cities, and counties.

Learn more at www.delta-institute.org.

ABOUT ST. LOUIS DEVELOPMENT CORPORATION

St. Louis Development Corporation (SLDC) is the City's economic development arm. SLDC's mission is to stimulate the market for private investment in City real estate and business development and improve the quality of life for everyone who lives in, works in and visits St. Louis.

Learn more at www.stlouis-mo.gov/sldc.

ABOUT GREEN CITY COALITION

Green City Coalition is a partnership between the City of St. Louis, the Missouri Department of Conservation, St. Louis Development Corporation, and the Metropolitan St. Louis Sewer District, working collaboratively with a network of member organizations and residents to convert vacancy to vibrancy in the City of St. Louis. GCC partners recognized the potential for a robust deconstruction program to afford several benefits to residents and the region, particularly the transformation of a decades-long vacancy challenge into an opportunity to stimulate the materials reuse market and create new job opportunities. Through partnerships with Missouri Department of Natural Resources, the Environmental Improvement and Energy Resources Authority, Environmental Protection Agency, Delta Institute, St. Louis Community College Workforce Solutions, and more, Coalition partners and members have developed a robust approach to increasing deconstruction in St. Louis, with this Market Assessment as a crucial first step.

Learn more at www.greencitycoalition.org.



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Introduction & Executive Summary

St. Louis, Missouri, like many Midwestern legacy cities, has experienced a sharp decline in population since the mid-20th century, resulting in vacant and abandoned properties across the city. The St. Louis Land Reutilization Authority (LRA), the oldest land bank in the country, owns thousands of vacant properties, and public funds are budgeted to remove vacant structures in unsafe condition. The 2017-2018 city budget included \$1.5 million dedicated to public demolitions, and the 2018-2019 budget has increased that amount to \$3.6 million.¹ Additionally, the Metropolitan St. Louis Sewer District (MSD) has committed \$13.5 million over a five-year period for the removal of vacant and blighted structures.²

The St. Louis Development Corporation (SLDC) and other city departments are interested in exploring opportunities to leverage demolition and vacant structure removal programs and create positive economic and environmental outcomes for local residents and the region. One of the potential strategies to increase positive impacts is through the deconstruction of vacant buildings. Deconstruction refers to the systematic disassembly of structures so valuable building materials can be returned to the local marketplace, as opposed to landfilled. Though many building materials can be locally recycled (e.g. masonry, vinyl siding, roof scrap), which is preferable to disposal, this report focuses on material reuse.

Key Findings

The City of St. Louis and surrounding region has a tremendous opportunity to scale up deconstruction programs and strengthen building material reuse markets, supported by Mayor Lyda Krewson's *Plan to Reduce Vacant Lots and Buildings*.³ This program can provide opportunities for local economic and environmental benefits.

Finding: Nationally, deconstruction and material salvage industries are growing with support from public and private organizations and agencies.

Through policy implementation, creation of web-based, publicly available tools, and strategic partnerships with other initiatives (e.g. workforce development and historic preservation), public agencies are supporting emerging local building material reuse markets across the country. Concurrently, the national market of commodity-level reclaimed lumber has grown over 220% since 2010, helping to bring reclaimed materials into the mainstream.

Finding: A strong network of stakeholders for both supply and demand of reclaimed building materials exists in St. Louis, and the network has the potential to grow.

There are currently dozens of organizations and businesses that are generating, buying, selling, and using reclaimed building materials in the St. Louis region, representing a robust marketplace. Additionally, there are hundreds of identified businesses in the region that have the potential to salvage, sell, or use reclaimed building materials.

Finding: Salvageable building materials in St. Louis' vacant structures have economic potential and are in high demand.

Though not all vacant structures are appropriate candidates for deconstruction, using a condition scoring index can help identify structures that can be expected to yield valuable materials. Using this index for the current dataset of vacant structures in St. Louis, an estimated 24.8 million bricks

and 10.4 million board feet of lumber could be salvaged. Combined with additional salvaged materials in the best condition structures, a potential salvage value range of \$18.25 million to \$39.38 million is available to enter the local market.

Finding: Deconstruction of vacant, publicly-owned properties in St. Louis has the potential to increase the economic impacts of planned vacant structure removal programs.

While deconstruction costs more than a traditional demolition, it would also increase the labor hours required on a project and wages paid as a result of each structure removed. Additionally, the sale or donation of reclaimed building materials can increase the net value of existing structure removal programs.

Finding: Deconstruction and building material salvage has significantly improved environmental outcomes, compared to traditional demolition.

Deconstruction reduces fugitive dust generation and significantly reduces waste disposal, which can positively impact greenhouse gas emissions. Based on the recovery assumptions for brick and lumber, 126,500 tons of material could be diverted from landfills. Using EPA's Waste Reduction Model (WARM), this diversion has the potential to result in a net greenhouse gas emission reduction of 42,066 metric tons of CO_{2e}, the equivalent of 9,000 passenger vehicles off the roads.

Recommendations

Support from the SLDC, other local government departments, and organizations can help bolster the deconstruction and building material reuse industry. Based on the findings in this report, Delta Institute recommends the following actions:

- SLDC and other city departments should convene a **local advisory committee** to consider developing legislation to encourage or require building material reuse in St. Louis.
- SLDC in collaboration with other city departments should consider funding and supporting **deconstruction training at multiple experience levels** for demolition contractors and other interested workers.
- SLDC should work with the LRA and Building Division to develop and use condition scoring criteria and building inspector recommendations to help **prioritize building deconstruction**.
- SLDC and the LRA should work with the Building Division to **bid demolitions and deconstructions in larger packages** to allow for significant quantities of materials to be aggregated for donation or resale.
- SLDC should encourage **real-estate developers and the private sector** to salvage reclaimed building materials and incorporate deconstruction into development projects.
- SLDC should consider a partnership with state and regional entities to help join or create an **online system for brokering reclaimed building materials**.

For full recommendation text and rationale, see Section 6: Recommendations

Section 1: National Trends

Deconstruction is the process of dismantling structures in a way that enables materials to be salvaged. Deconstruction and the building material reuse industry has grown in recent years. Indicators for growth in the sector include an increase in local legislation preventing building materials from entering landfills, collaboration with other initiatives like workforce development and historic preservation, development of new programs and tools to increase the size and effectiveness of the marketplace, and incentives for the private sector to engage with deconstruction and building material reuse.

The Environmental Protection Agency (EPA) released a new strategic plan in 2015 that outlined the national priorities for the agency from 2017 to 2022. “The Built Environment” is one of the EPA’s Sustainable Materials Management Strategic Priorities, which includes increased recycling and reuse of construction & demolition (C&D) debris, and improved data tracking for how much C&D material is disposed, recycled, and reused.⁴ Concurrent with a federal focus on C&D material reuse, organizations involved with deconstruction and building material reuse nationwide are seeing positive business outlooks. Delta Institute and the Building Material Reuse Association (BMRA) surveyed BMRA members and similar organizations in 2018, and 63% responded that their business outlook as compared to the last three years was “much better” or “a little better” and 30% found it to be about the same.⁵

The following section includes indicators of a growing building material reuse industry across the country, and strategies the St. Louis area could implement to strengthen its own market.

Key Players in National Reclaimed Lumber Market

Over the past two decades processing reclaimed and salvaged lumber into new products, including flooring, wall and ceiling paneling, decorative and structural timbers, wood finishes, and furniture, has developed as an industry. The lumber, which many of these companies use as feed stock for their production, is generally old growth rough sawn lumber (lumber milled prior to the 1930’s) including white pine, Douglas fir, and yellow pine. Reclaimed and old growth lumber have several qualities that have led to their increased use, including their low carbon footprints as well as their superior strength and durability compared to lumber produced in modern mills. While reclaimed lumber provides many benefits, its processing cost make it more expensive than other lumber supplies.

“I have been involved in the business for over 20 years and it’s really interesting to see how it has changed, we used to be able to get lumber for free and now we are buying it.”

-Michele Caryl,
Pioneer Millworks

To understand the financial trends in these emerging industries, Delta Institute analyzed sales data from 12 key players in the American reclaimed lumber market. These companies were identified in a report produced by *Grandview Research, Reclaimed Lumber Market Size Report, Product Analysis, End-Use Analysis, Regional Outlook, Competitive Strategies and Forecasts, 2018 To 2025*. Sale volume data was collected for each of the 12 businesses using ReferenceUSA, a national business and markets database (See Appendix A for company details). Overall, the 12 companies have all experienced growth over the past ten years. In 2010, the cumulative sales revenue of these 12 businesses was estimated at \$39.5 million and has grown by over 220%, with a cumulative sales volume over \$127.2 million in 2018.

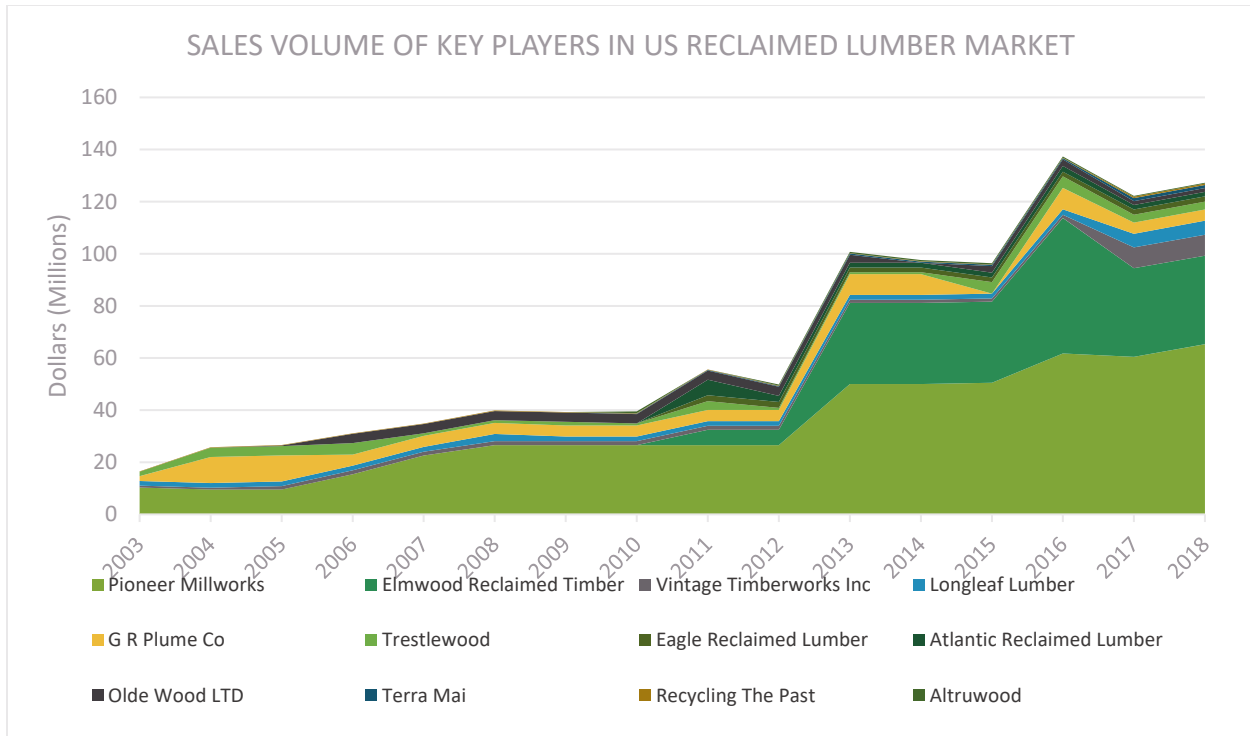


Figure 1: Annual Sales Volume of Key Players in US Reclaimed Lumber Market, 2003 to 2018.

The largest of the 12 identified companies is Pioneer Millworks, which has headquarters located in both New England and the Pacific Northwest. An interview was conducted with Michele Caryl of Pioneer Millworks to provide insight on the growing industry and to understand how the company sources materials. Below are high level findings from the interview:

- Pioneer Millworks purchased over one million board feet of reclaimed lumber in 2018. In prior years, they purchased between one million and three million board feet of reclaimed lumber.
- The smallest dimension of lumber they will accept is 2" x 6" and the smallest quantity of lumber they will purchase is an entire semi-trailer (2030-4050 cubic feet depending on semitrailer dimensions).
- Because of the amount of lumber they are buying at a time and size requirements of the lumber, much of Pioneer's materials are from commercial and industrial structures.
- Demolition contractors are the most significant supplier of lumber to Pioneer Millworks.
- Historically, Pioneer Millworks has sourced most of their materials from the East and West Coast because their facilities are located in New York and Oregon. While the East Coast generally has an older building stock, Pioneer Millworks sources materials from all over the country. Roughly 10 to 12 years ago, they purchased lumber from a structure that was demolished in St. Louis.

Deconstruction and Workforce Development

Deconstruction is increasingly seen as an opportunity for “triple-bottom line positive impact,”⁶ where the economic and environmental benefits are paired with social benefits, such as workforce development. Deconstruction provides a valuable opportunity for job training and skill development for individuals with barriers to employment, like those who have struggled with addiction issues or have been previously incarcerated. Additionally, deconstruction training can often be paired with other training and certification, such as OSHA safety training, which can help participants gain access to a variety of jobs in the construction industry.

These programs can be managed by government agencies, nonprofit organizations, social enterprises, and for-profit businesses. The following are three examples of program structures that can include workforce development in the deconstruction and building material reuse industry. These programs can add a social benefit to the local community, make deconstruction more cost-competitive with demolition, and increase the visibility of the industry.

Partnership Programs Managed by Workforce Development Organizations

Refab, a St. Louis-based nonprofit that creates training and employment opportunities through the sustainable practices of deconstruction, refabrication, and resale, has partnered with several local workforce development agencies to provide temporary employment and job training for vulnerable populations including homeless veterans. The workforce development organization provides case management while Refab provides on the job training and feedback. Refab has hired graduates of their workforce development program when permanent positions have opened, but typically participants find permanent employment elsewhere during or after their time at Refab.⁷

Programs Managed In-House by Deconstruction/Salvage Organizations

In Baltimore, Maryland, the non-profit Humanim has developed “sister organizations,” Details Deconstruction and Brick & Board, to manage both sides of the deconstruction and salvage process. Details Deconstruction dismantles structures in the Baltimore area, Brick & Board manages the warehouse for processing and selling the reclaimed materials, and both hire workers with barriers to employment, including criminal records.⁸

Programs Managed by Public Agencies

In 2013, the Cook County, Illinois Sheriff’s office began the Restoring Neighborhoods Workforce (RENEW) program, which trains current inmates in deconstruction practices and provides OSHA certification for participants. The program works in neighborhoods experiencing issues of vacancy and blight to safely remove the blighted properties and provide valuable training to participants to prepare for similar work once they return to their communities.^{9,10} Since 2013, the program has resulted in the removal of over 200 structures.

Building Material Reuse and Deconstruction Policies

Local governments at the municipal and county levels are seeking to better manage C&D debris and reduce the amount of valuable building materials entering landfills. One indication of growth for the deconstruction and building material reuse industry is the passing of several ordinances across the country that require or encourage diversion of C&D material from landfill. These ordinances often require C&D recycling and increasingly, material reuse is also included in the legislation. Ordinance mechanisms vary, and each strategy has strengths and challenges. Local governments should carefully consider which type of legislation is most appropriate for their municipality or county.

Several early programs and ordinances, including the 2001 Construction Demolition Diversion Deposit Program in San Jose, California only required a certain percentage of C&D debris to be diverted from landfill in order to receive a refund on a deposit, without specifying type of diversion or targeting material streams.¹¹

Since 2001, other counties and municipalities have implemented several variations of C&D debris diversion legislation to best fit each locality. In Illinois, the Cook County Demolition Debris Diversion Ordinance from 2012 includes a diversion percentage target, but also specifies that 5% of materials must be reused, as opposed to being recycled.¹² This ordinance resulted in increased diversion of demolition materials each year from 2012 to 2015, with the 2015 diversion rate reaching 95.4%.¹³ However, due to the weight-based nature of the ordinance, diverting heavier materials, such as concrete, is prioritized over diverting lumber and other less dense material. The Construction and Recycling Ordinance in Madison, Wisconsin from 2010 pairs the overall diversion percentage with requirements for reuse or recycling of specific material streams.¹⁴ This ensures that wood, metals, shingles, and other materials are being diverted, rather than only the heaviest materials.

Portland, Oregon passed a Deconstruction Ordinance in 2016 that requires all homes built in 1916 or earlier or designated as historic to be deconstructed, rather than demolished.¹⁵ This ordinance focuses on the removal process (not materials generated) and was passed in response to a housing demand increase as opposed to a surplus of vacant structures.¹⁶ The Deconstruction Advisory Group in Portland selected 1916 for ordinance enforcement because they determined that the houses meeting that threshold would generate the amount of building materials that the reclaimed lumber and other material markets could absorb.¹⁷ Additionally, the Portland City Council followed the deconstruction ordinance with new regulations for lead and asbestos abatement in demolitions, which helps to reduce the cost difference between demolition and deconstruction.¹⁸ An average of 20 homes were deconstructed annually before

Ordinance Examples

San Jose, CA (2001)

Contractors pay a deposit, refundable upon receipt of documentation that 75% of C&D debris is recovered and diverted

Madison, WI (2010)

Buildings projects with steel and concrete supports must recycle 70% of materials. New wood supported structures and remodeling projects greater than \$20,000 must reuse or recycle all wood, non-toxic metals, scrap drywall, cardboard, and shingles

Cook County, IL (2012)

Minimum 70% of C&D waste from all building projects must be diverted from landfill where 5% of waste from residential projects must be reused

Portland, OR (2016)

Homes built before 1917 must be deconstructed

the 2016, and in the first year of the ordinance, 80 of the 318 structures permitted for demolition were deconstructed resulting in an estimated 2,500 tons of material diverted from landfills.¹⁹

In 2018, Milwaukee, Wisconsin passed a similar ordinance that required all homes and duplexes built in 1929 or earlier to be deconstructed, along with any designated historic homes.²⁰ However, in early 2018, there were only five certified deconstruction contractors in Milwaukee and far more structures were affected by the ordinance than could be deconstructed in a timely manner.²¹ The City Council voted in January 2019 to freeze the ordinance for one year to manage the blighted property. The ordinance freeze also requires Milwaukee's Department of Neighborhood Services to fund \$1.2 million in targeted deconstructions and deconstruction training for private sector contractors.²² Organizations involved in deconstruction and building material reuse in Milwaukee, including Razed & Found, see benefit in the ordinance freeze to offer a chance to train contractors, gain experience with different levels of deconstruction and the associated data tracking requirements, and raise awareness of the local reuse economy.²³

GreenLynx, a deconstruction and building material reuse organization in northern California recommends several additional policies to bolster local reuse economies including expedited permitting for projects that include deconstruction, streamlined reporting to local agencies for material reuse, adjustments to the local building code to encourage deconstruction or material reuse, or eliminating taxes on used lumber or other building materials.²⁴ Cities can also leverage economic incentive programs like TIF funding or commercial loan programs to fund deconstruction and redevelopment.²⁵

As more municipalities, counties, and states implement legislation to prevent sending valuable building materials to landfills, more markets for the reclaimed materials will emerge and strengthen across the country.

Connecting Consumers to Materials

Once salvaged, connecting reclaimed materials to buyers and end users can be an additional challenge. To address this challenge, organizations - including government entities, nonprofit organizations, and for profit businesses - are working to develop innovative ways to connect potential consumers to a supply of reclaimed building materials.

Pathway21, a B Corporation started by the U.S. Business Council for Sustainable Development, has developed "Materials Marketplace" software where businesses can post available or desired materials, and be connected to other businesses or individuals with complementary needs.²⁶ The cross-industry connections brokered through the existing Materials Marketplaces reduce the amount of C&D material, including brick and lumber, sent to landfill and reduce the need for virgin material. In the United States, the city of Austin, Texas,²⁷ as well as Ohio,²⁸ Tennessee,²⁹ and Michigan³⁰, have developed city- or statewide Marketplaces to establish local circular economies. These platforms are supported and managed by government agencies including Austin Resource Recovery, Tennessee Department of Environment and Conservation, Ohio Environmental Protection Agency, Michigan Department of Environmental Quality, and Michigan Economic Development Corporation.

For lumber specifically, the American Wood Council, Canadian Wood Council, and the Building Material Reuse Association (BMRA) partnered to create a directory for wood recycling and reuse in North America

- Reusewood.org. The directory includes organizations in the reuse sector that accept and sell materials, such as barnwood, board lumber, heavy timber, engineered lumber, and more.³¹

Pathway21 software, Reusewood.org, and other tools are indicative of an increase in investment and innovation in the reclaimed building material industry, and an increase in the geographic size of existing marketplaces.

Deconstruction and Historic Preservation

Restoration and repurposing is the ideal treatment of vacant historic buildings, however, in many cases this may be not possible or practical. Costs of renovation may exceed the cost of new construction, structures may not be compatible with the local community's needs, or the building could be in such a deteriorated state that it is no longer structurally sound. Cities throughout the United States have faced these challenging decisions when dealing with the renovation and demolition of historic and cherished structures. When restoration is not desired or feasible, deconstruction and building material reuse can serve as means to preserve built history while managing blight and responding to development needs. Below are two different examples of how deconstruction methods have been used for redevelopment and historic preservation:

Missoula Mercantile Building, Missoula MT

The Missoula Mercantile building, a 140 year old structure in the heart of downtown Missoula, was vacant for over six years after its last tenant, Macy's, moved out in 2010. In 2016, a developer proposed demolishing the building to make way for a hotel development because "all reasonable uses for the building were no longer economically feasible given the costs to rehab the building and the price tenants were willing to pay for renting an old building."³² Despite being denied a demolition permit by the Historic Preservation Commission, the City Council overrode the commission's decision. After a local preservation group sued to overturn the council vote and much public kickback, it was decided that the Mercantile Building would be deconstructed and not demolished. The cost of deconstructing the 113,000 sq. ft. building was \$95,800 (about \$150,000 including foundation removal and excavation). The project's developer received roughly \$3.5 million in TIF funding³³, which was used to fund the deconstruction, foundation removal and excavation, and environmental services.³⁴ The nonprofit organization, Home ReSource, and company, Heritage Timber, partnered to dismantle the building and salvage all possible materials. Most of the material was donated to Home ReSource, including over 200,000 board feet of lumber.³⁵ Many elements of the historic structure were repurposed and can now be found in residences, commercial buildings, and offices through Missoula.

Madison/ Wabash CTA Station, Chicago IL

Built in 1896, the Madison/Wabash Chicago Transit Authority (CTA) station was the last remaining original CTA "L" train station housed in Chicago.³⁶ While this station was an icon and architectural gem, it was in serious need of modernization to bring it up to par with the other elevated train stations located in the city's downtown Loop. In 2015, demolition of the station began, which included a partial deconstruction to "rescue a section of the station house's Palladian design facade, which features Baroque-style window

surrounds as well as handrails, pressed tin ceiling and wall tiles, a pre-turnstile ticket booth, wooden platform planks, and other decor from rapid transit's bygone era."³⁷ While the main elements of the façade were kept by Preservation Chicago for display to the public, an auction was held at a local nonprofit, the Rebuilding Exchange, where members of the public could bid on items that used to be part of the station. The Items for auction included station decking, signage, seating, decorative tin ceiling tiles, and other unique and historic features.³⁸ Over 600 individuals attended the auction, and the sales of the salvaged materials generated tens of thousands of dollars in revenues for the non-profit.

Section 2: Stakeholders

The building material reuse industry involves a multitude of stakeholders, each of which are integral in the process of bringing materials that may otherwise be considered waste to the marketplace. Each stakeholder group plays a unique role in the process and all must be included to support a robust deconstruction program.

Stakeholder Group	Description	Role	Benefit Derived from Increase in Material Reuse
Demolition and Deconstruction Contractors	Individuals and companies that generate C&D debris as a byproduct of their work	Generate materials	Increased revenue from reclaimed materials
Building Material Reuse Marketplaces	Retail store and warehouses that sell reclaimed building materials to the public	Make materials publicly available	Increase in materials for resale
Design Build	Entities that incorporate reclaimed materials into building and interior design	Transform materials into high value items Mainstream and introduce aesthetic to broader audiences	Local and reliable sources of materials
Material Wholesale (Regional/National Scale)	Individuals and companies who purchase large quantities of commodity-level salvaged and reused building materials, like brick and lumber, to be retailed	Aggregate materials for large scale processing	More raw materials for processing
Value Added Processors	Entities that use reclaimed building materials to create new products	Transform materials into high value items	Local and reliable sources of materials

Table 1: Stakeholder Types

As part of this research, Delta Institute identified organizations and businesses that fit into each stakeholder category. Delta conducted interviews with several individuals within these stakeholder groups to better understand the local supply and demand for reclaimed building materials in St. Louis (See Appendix B for stakeholder list). Interview findings are aggregated and summarized in *Section 4: Building Materials Demand*.

Additionally, Delta Institute used Standard Industry Classification Codes (SIC Codes) to identify all businesses located in the St. Louis Metro Area that classify themselves in an industry that could generate reclaimed building materials, or sell/use reclaimed building materials. The SIC codes in the search include:

Generators of Building Materials:

- Demolition Contractors (179502)

Generators & Users of Reclaimed Building Materials:

- Home Builders (152112)
- Contractors (179977)
- Building Contractors (154213)

Users or Sellers of Building Materials:

- Woodworkers (175106)
- Salvage, Architectural (154101)
- Furniture, Designers & Custom Builders (571217)
- Design & Build (871201)
- Building Material, Used (593207)
- Salvage & Surplus Merchandise (561102)
- Brick, Used (521123)

Delta Institute used ReferenceUSA to compile all of the businesses within these classifications. Each business has the potential to register themselves under multiple SIC codes (up to six different classifications). The Primary SIC code a business identifies is generally the most applicable description, but businesses can select additional SIC codes to further describe goods and services provided. For example, the Collinsville Habitat for Humanity ReStore's Primary SIC code is "593207, Building Materials-Used", its secondary SIC classification is "593222, Thrift Shops", and tertiary classification is "596104, E-Commerce."³⁹

Within the seven county St. Louis region, there are 71 business classified as demolition contractors who could potentially salvage building materials for reuse. There are 1,283 businesses that could potentially function as both a supply of reclaimed building materials and user of reclaimed building materials (including contractors, building contractors, and home builders). There are currently 193 business in the region that are either selling reclaimed building materials or could potentially use reclaimed building materials as a feedstock. Woodworkers make up the largest category of potential end sources for reclaimed building materials, as there are 92 businesses in the region who classify themselves as such.⁴⁰

POTENTIAL USERS/SELLERS OF RECLAIMED MATERIALS (DEMAND)

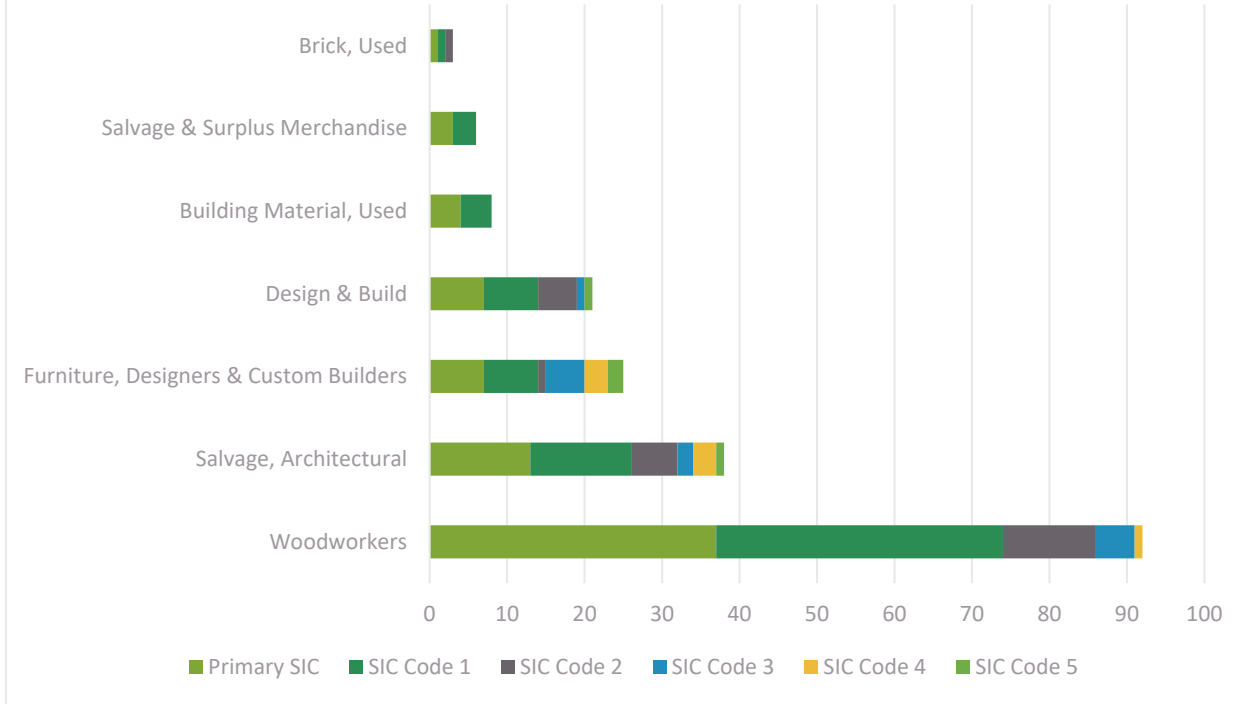


Figure 2: Potential Reclaimed Building Material Stakeholders in St. Louis Region – Demand

POTENTIAL SUPPLIERS AND GENERATORS OF MATERIALS (SUPPLY)

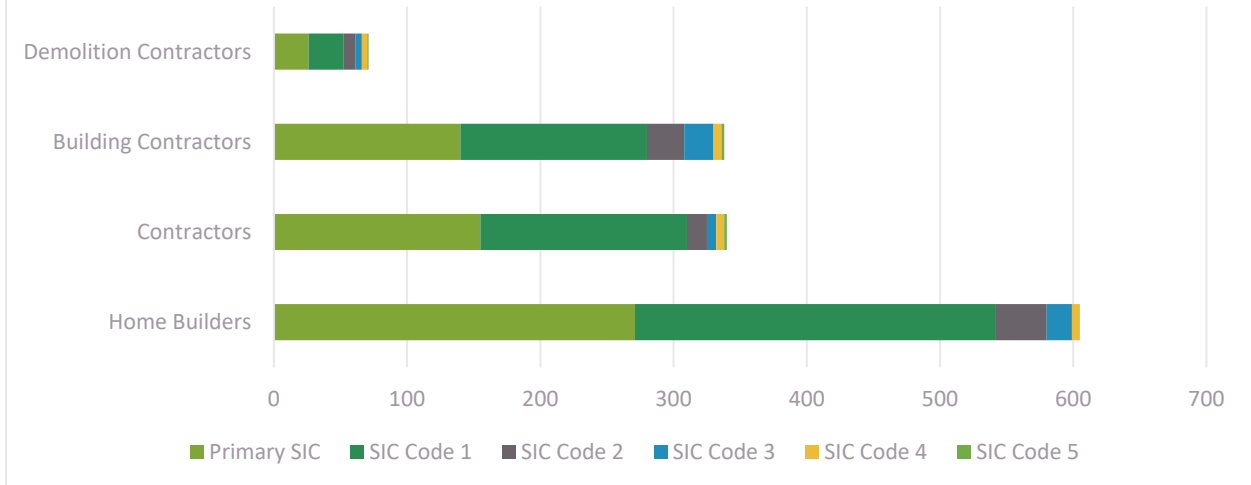


Figure 3: Potential Reclaimed Building Material Stakeholders in St. Louis Region - Supply

Section 3: Building Materials Supply

The City of St. Louis currently contains over 7,500 vacant buildings, many of which pose a liability in their current state. However, the materials contained in these vacant buildings, if salvaged for reuse, could provide a resource and asset to the community. The materials found within St. Louis' vacant buildings can be broken into three different categories – 1) lumber, 2) brick and masonry, and 3) finishes and other. The potential for salvage in each of these three categories is dependent on the condition of the structure and materials.

Materials

Lumber: Dimensional lumber used in the structure of a building for framing, roof/ floor joists, subflooring, roof decking, and siding. The majority of wood frame structures in St. Louis are built using fir and pine (softwoods).

Brick & Masonry: Blocks made from fired or sun-dried clayed. Brick can be used as both a building's structure, as well as a façade. Many of the bricks in St. Louis' older housing stock are particularly valuable because the clay used to create bricks (sourced from Eastern Missouri) is exceptionally high quality.

Finishes & Other: Building elements (interior and exterior) that do not function as essential for structure, but rather as aesthetic or other practical functions. Examples include: interior finishes- molding, trim, built-ins, cabinets, banisters, newel posts, mantles, wood accents, ceiling tiles, and furniture, exterior architectural elements- columns, corbels, exterior trim, gables, brackets, doors- interior and exterior, windows, plumbing- plumbing fixtures, sinks, bathtubs, toilets, and lighting- overhead light fixtures, wall mounted light fixtures, sconces, chandeliers, ceiling fans.

Findings from Stakeholder Interviews

To estimate the quantity of building materials available in the City's vacant housing stock, Delta Institute relied on data and input gathered through local stakeholder interviews, including interviews with demolition and deconstruction contractors, and data from past deconstruction projects conducted nationwide. Key findings include:

- Demolition contractors stated that most demolished buildings were not in good enough condition for contractors to safely enter the structure and salvage the materials within.
- While condemned structures are often not a good source for finishes and lumber, there is still a significant opportunity to salvage brick. Demolition contractors indicated that the salvage rates of brick are much lower for a condemned structure, but indicated they are still typically able to salvage around 50% of the brick. The remaining 50% of brick is generally damaged by the demolition process.
- When demolishing a structurally sound building, contractors can use hand wrecking techniques that result in much higher salvage rates.
- Contractors suggested that the potential for lumber salvage is primarily dictated by the quality and availability of lumber and ease of access. Similar to brick, a structure that is in excellent condition has better salvage opportunities, compared to condemned structures. However, there

is still potential for small quantities of lumber to be salvaged from a machine wrecking demolition (e.g., floor joints on ground level).

- Generally, older structures that are slated for demolition contain more valuable materials that are worth salvaging. Most structures that were built before 1930 contain old growth and rough sawn lumber (which can be sold for a premium) and brick from structures constructed before 1926 is high quality. Older structures are also more likely to contain unique architectural elements and finishes.

Evaluating St. Louis Vacant Housing Stock

Based on recommendations from demolition and deconstruction contractors, only select structures were included in material supply estimations for St. Louis’s vacant structure stock. Condition and age are the two key factors that would make a structure a better candidate for deconstruction. Out of all vacant structures in St. Louis, over 91% were constructed prior to 1930, and over 30% were constructed prior to 1900, representing a tremendous opportunity for salvaging high quality materials.

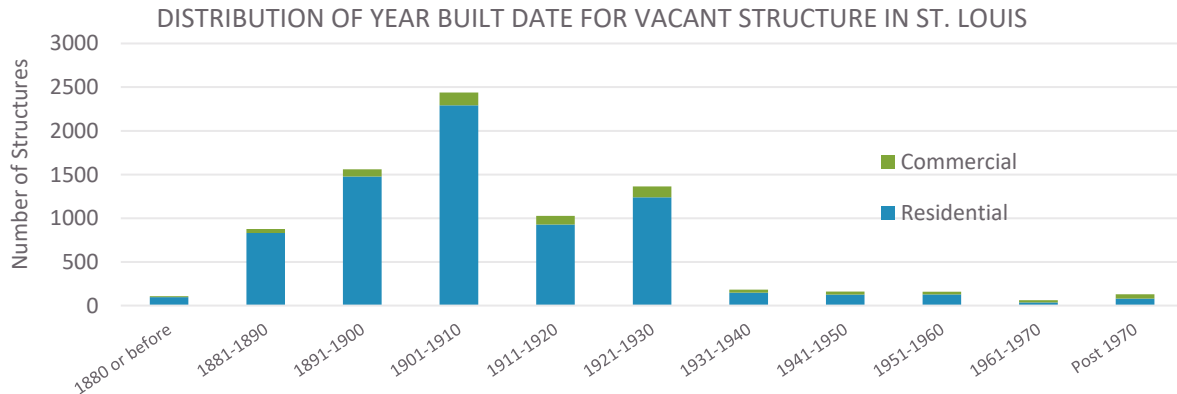


Figure 4: Distribution of Structure Year Built Dates

To assess structure condition, Delta Institute used data available through the City of St. Louis Vacancy Dataset. With this information, a structure condition score was created to determine what structures are more likely to be in better condition. Variables considered in this analysis include:

- Land Reutilization Authority (LRA) Tenure
 - Description: 2018 minus the year the structure was acquired by the LRA
 - Rationale: Structure that have been owned by the land bank for a long period of time are likely to be in worst condition
- Years Vacant
 - Description: Count of the years that the Building Division marked the parcel as vacant (NOT consecutive)
 - Rationale: Buildings that have been vacant for a longer period of time are more likely to be in worse condition

- Maintenance Costs
 - Description: Dollar amount of maintenance services provided by Forestry since January 1, 2008 (not including fees and interest)
 - Rationale: Vacant structures that require excessive maintenance (refuse removal, falling trees, etc.) are more likely to be in worse condition

Each of these variables were assigned a value between zero and ten, - ten indicating the structure is in the best condition and a value of zero indicating the structure is in the worst condition. For example, a structure that has been vacant for the longest time, 29 years, received a score of zero, and a structure has been vacant for the shortest time, zero years, received a score of ten. All three scores were then added together and normalized to create a structure condition score. See Appendix C for more details on the structure condition scoring Framework. With these scores, the structure was broken into three different groups that would indicate to what level they should be deconstructed, and what materials could be salvaged. The three groups of structures are:

- **Group 1: Best Condition** = Structures that were in the top 10% based on structure condition score (10.0-8.8). These structures are likely to be in the best condition and should be prioritized for full deconstruction with the salvage of brick, lumber, and finishes (100% salvage rate).
- **Group 2: OK Condition** = Structures that were in the top 11-50% based on structure condition scores (8.7-4.7). These structures are likely to not be in the best condition, but could still present opportunity for material salvage. These structures were assumed to have a potential brick salvage rate of 50% (only for brick structures built prior to 1926) and a 25% lumber salvage rate.
- **Group 3: Worst Condition** - Structures that were in the bottom 50% based on structure condition scores (4.7-0.0). These structures are likely to be in the worst condition relative to the other structures assessed. However, there is still a small opportunity to salvage brick from these structures, with an estimated salvage of 25% for brick but no other materials salvaged.

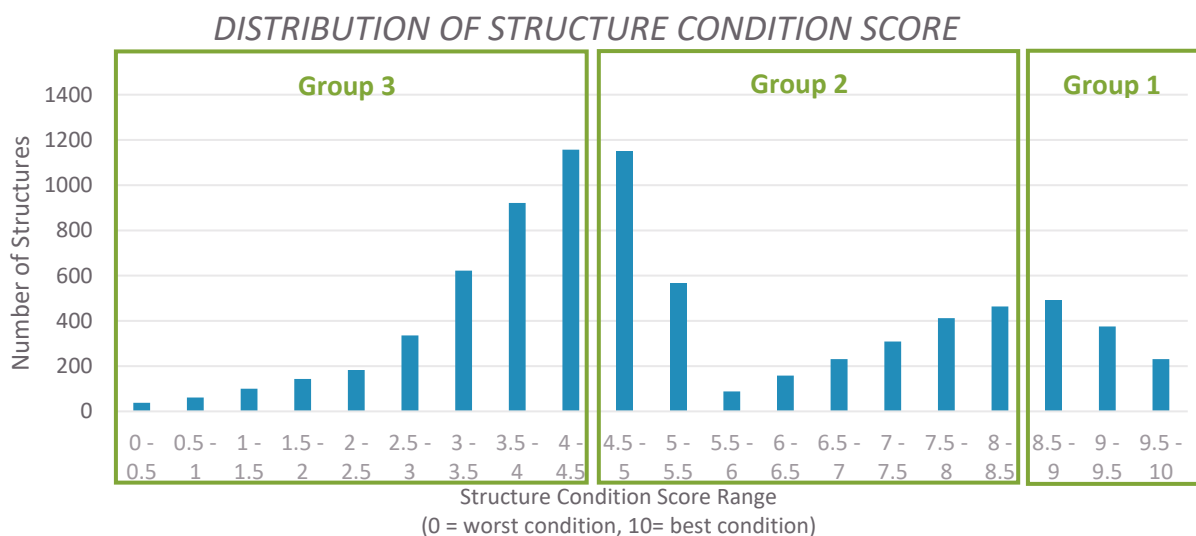


Figure 5: Distribution of Structure Condition Score of Vacant Structures in St. Louis

Estimating Materials Quantities and Value

To estimate the potential value of materials that could be generated per structure based on the groupings outlined above, Delta Institute relied on data from a previous deconstruction project. This dataset was created by collecting data through a literature review of a past deconstruction project that included structure details, as well as data from Delta's past deconstruction pilot programs. Once compiled, this dataset represents 57 structures from projects in Oregon, Florida, Michigan, Missouri, and Pennsylvania. Information collected per structure includes structure age, the total value of salvageable materials, quantities of lumber salvaged, and amounts of brick salvaged. Once compiled, this information was used to generate material salvage estimates and values per square foot. These values were then applied to each structure in the three condition groups. Listed below are estimated salvage value and quantity per square foot that were used to assess each group.

- Full Deconstruction, All Materials (Lumber, Brick, and finished): **\$ 5.50 per sq. ft.**
- Brick: **4.80 bricks per sq. ft.**
- Lumber: **3.70 Board Feet of lumber per sq. ft.**

Each of the ratios listed above was multiplied by each structure's square footage to provide per structure estimates and was discounted depending on its structure condition grouping. Complete square footage data was not available for commercial structures, so the ground floor square footages were multiplied by the least number of floors it could have based on its classification (Example: A 10,000 sq. ft. ground floor structure between 2-10 stories is estimated to have a total square footage of 20,000). Due to this approximation, the salvage potential of a commercial building is an underestimate. Only buildings listed to be made of brick or lumber were included in the estimations. Below are estimates of the quantity of potential brick and lumber that could be salvaged from vacant structures in the City of St. Louis.

SALVAGE VALUE BY SQUARE FEET

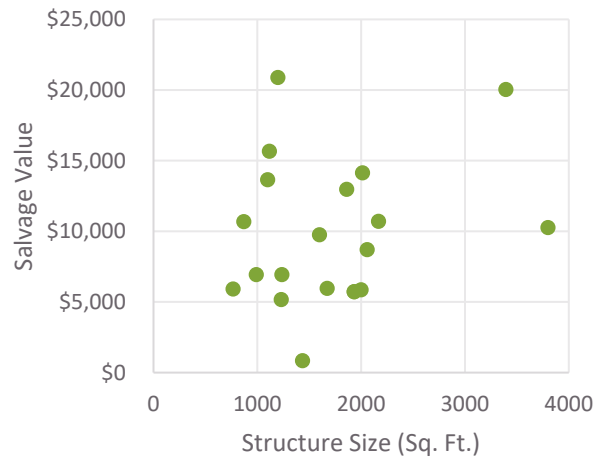


Figure 6: Relationship between Structure Square Footage and Value of Materials Salvaged from Deconstruction Project Data Set

Example Deconstruction Project



Project Overview:

- Deconstruction completed by Refab in 2017
- Project completed over 30 weeks
- Deconstruction crew size- 4.5 FTE

Building Description:

- 2 ½ story mixed use building in St. Louis
- Constructed in 1904
- 13,000 Sq. Ft.

Materials Salvaged:

- 28,500 board feet of old growth lumber
- 160 pallets of brick (80,000 bricks)
- Select interior finishes

- Total Potential Brick Salvage- **24.8 million bricks** (or 49,600 pallets of brick)
 - Commercial Structures- 2.7 million bricks (or 5,400 pallets of brick)
 - Residential Structures- 22.1 million bricks (or 44,200 pallets of brick)
- Total Potential Lumber Salvage- **10.4 million board feet of old growth lumber**
 - Commercial Structures- 1.7 million board feet of old growth lumber
 - Residential Structures- 8.6 million board feet of old growth lumber

Groups	Low	High	Number of structures
Group 1: Best Condition, Full Deconstruction Top 10% of Structure Condition	\$ 7,986,000		715
Group 2: OK Condition, Salvage 50% of Brick and 25% of Lumber Top 11%-50% of Structures	\$ 8,188,000	\$ 27,924,000	2968
Group 3: Worst Condition, Salvage 25% of Brick Bottom 50% of Structure	\$ 2,081,000	\$ 3,468,000	2637
TOTAL Value of all Groups 1-3	\$ 18,255,000	\$ 39,378,000	6320

Table 2: Summary of Potential Salvage Values of Reclaimed Building Materials Based on Structure Condition Groupings.

Table 2 summarizes the value of materials that could be salvaged from each group of structures based on structure condition scores. The total value of all materials salvaged from all three groups is estimated to be \$18.25 million to \$ 39.38 million. The values of salvaged materials was estimated for each grouping based on structure condition and corresponding salvages rates. The low and high values for salvaged brick were determined to be \$0.30 to \$0.50 based on information provided by stakeholders interviewed. This range of prices represents the wholesale and retail prices of reclaimed St. Louis brick. The low and high values for old growth lumber was determined to be between \$0.90 and \$4.30. This information was collected through a national survey of reclaimed lumber retailers. Value of lumber per board feet varies widely because of the desirability of larger dimensional lumber. For example, a board foot of old growth 2" x 6" lumber retails for between \$0.75 and \$3.00 while a board foot of old growth 2" x 12" lumber retails for between \$1.50 and \$6.00 per board feet (see Appendix D for lumber pricing guide).

Section 4: Building Materials Demand

Delta Institute interviewed several stakeholders in the building material reuse marketplace in St. Louis, and reviewed business and community data to determine the potential expansion of a reclaimed building materials market.

Materials

The materials within St. Louis' vacant buildings can be broken into three different categories – 1) lumber, 2) brick and masonry, and 3) finishes and other. Demand in each of these categories is dependent on the condition material-specific factors.

Lumber

The majority of wood frame structures in St. Louis are built using Douglas fir and yellow pine, both of which are softwoods. Interviews with reclaimed lumber retailers indicated that texture, age, and dimensions generally have a larger impact on demand than tree species. The most popular and valuable styles of reclaimed lumber in the St. Louis area are rough sawn lumber, where unique, rustic texture is visible, and old growth lumber. See Appendix D for lumber price ranges based on national retailers.

As described in *Section 1: National Trends*, there are several large national companies that divert large quantities of reclaimed lumber from landfills for processing and resale. These companies typically accept certain lumber dimensions and are able to source and sell material nationwide due to the commodity-scale of their work. However, St. Louis is home to several smaller organizations that work on a local scale sourcing and processing smaller quantities of more unique lumber into higher value items such as furniture or design items.⁴¹

Several organizations that use reclaimed wood for custom furniture or design indicated that barn wood from the rural areas of the St. Louis region is more desirable than lumber from urban structures. Barn lumber tends to be older, come in longer dimensions, made from hard woods (and thus can be more durable), and has a compelling story that is attractive to customers. Tom Niemeier of SPACE Design in St. Louis believes that historic wood from barns and

Old Growth Lumber

“Old growth” lumber refers to dimensional lumber milled from trees that reached full maturity, which is primarily found in structures built prior to 1930. This lumber is of much higher quality than the lumber produced in modern mills, and the distressed and patinated look can also make it desirable for consumers. Three signs to identify old growth lumber:

- **True Dimensions:** While we frequently refer to dimensional lumber in whole numbers (e.g. 2x4), lumber produced in modern mills is pressure treated, so dimensions are closer to 1.5x 3.5. Old growth lumber was milled before pressure treatment processes were commonly used, so they will actually be 2x 4.
- **Visible Saw Marks:** Lumber produced in modern mills generally has a smooth finish due to the pressure treating process and milling technologies. Another feature of old growth lumber is the visible saw marks that will run along the surface of the boards. This is called “rough sawn” lumber.
- **Tight Grain:** Most of the lumber used today is milled from relatively young trees, which results in a loose woodgrain on the ends. Lumber milled before the 1930s originated from mature trees, which have a much tighter wood grain on the ends of the board. In the image below, the lumber on the left is old growth.



urban structures is a lasting trend for aesthetic and sustainability reasons.⁴²

Brick & Masonry

St. Louis is well-known for the quality and prevalence of its brick, and it has been the building material of choice for over a century due to the abundance of high-quality clay naturally present in the region. Additionally, following a devastating fire in 1849, the city instituted an ordinance requiring the use of non-flammable construction material. In St. Louis today, old, vacant brick structures tend to be in better condition than similar wood structures as brick is a highly durable building material.⁴³

Although St. Louis brick is considerably more valuable than other types of reclaimed brick, there are some limitations to using salvaged brick. Brick buildings constructed in the second half of the 20th century or later, when Portland cement mortars gained popularity, may not be appropriate for salvage and reuse. Portland cement can absorb into the brick, making it difficult or impossible to remove all the original mortar, which can hinder the bond of any mortar applied for reuse.⁴⁴ Additionally, during demolition or deconstruction, more durable bricks intended for the external wall faces may be mixed with less durable bricks intended for internal wall faces.⁴⁵ For this reason, St. Louis bricks are often sold in southern states with less severe winter weather than Missouri and Illinois, where even the less durable bricks can withstand the elements.⁴⁶ Demand for St. Louis brick is also high in areas without the rich clay deposits of Missouri for the deep red aesthetic, particularly for non-structural purposes, such as pathways or patios.^{47,48}

The value of St. Louis brick and high vacancy rates created a situation where brick walls in abandoned structures were being knocked down so the bricks could be stolen and sold.⁴⁹ Dangerous practices including pulling down walls with trucks and burning down structures. The collapse of numerous buildings and economic losses for the city encouraged activists like Alderman Sam Moore to support stricter regulation in the buying and selling of bricks.⁵⁰

Finishes & Other

“Finishes & Other” refers to building elements (interior and exterior) that do not function as structure, but have aesthetic or other practical functions. Examples include interior finishes (e.g. molding, trim, cabinets, banisters, mantles, ceiling tiles, and furniture) and exterior architectural elements, such as doors, windows, plumbing, and lighting.

Delta Institute’s interviews with reclaimed building material retailers, Refab and Habitat for Humanity Restore, indicated that most of the demand for finishes is for low cost alternatives to new items (e.g. cabinetry, light fixtures) or unique/vintage architectural items. Interior design trends can also have an impact on what sort of finishes are being both donated and purchased each year.⁵¹

Some materials in this category can be difficult to sell, and may take up valuable warehouse space for salvage retailers. Trim and moulding are typically designed for a specific house and kept consistent throughout the entire structure, which can make selling reclaimed trim for a small project particularly difficult. There is also consistently low demand for hollow-core and non-panel doors in the reuse industry. Safety concerns can also affect the ability to sell certain materials that may cause exposure to lead or asbestos. Customers are often warned to assume that all paint on reclaimed items could be lead paint and instructed how to safely strip and dispose of the paint. Plumbing fixtures that drinking water could

flow through may also be refused by retailers to avoid the cost of testing the pipes for compliance with the Lead Safe Drinking Water Act.⁵²

Retailers

Habitat for Humanity St. Louis has two ReStore locations where lumber, doors, cabinetry, appliances, plumbing, and other materials and goods donated or salvaged from their deconstruction program are sold. Delta Institute spoke to Josh Vaughn from Habitat for Humanity St. Louis who stated that the St. Louis ReStore has “continued to grow in every aspect,” due in part to improved and inexpensive advertising available on Facebook and other websites and a general increased interest in “upcycling” and other sustainability topics.⁵³ Additionally, Habitat for Humanity St. Louis publishes annual financial data, including ReStore retail receipts. Since 2011, steady growth in both material donations and revenue have allowed ReStore St. Louis to open a second location and plan for a third.^{54,55} Habitat for Humanity St. Charles County ReStore has also indicated annual revenue growth on their 990 reports.⁵⁶

Unfortunately, our interviews also revealed that some smaller building material retail organizations, most without any online presence, have or will be leaving the industry. The inventory of these closed organizations is planned to be donated in bulk to an organization that continues to operate in the area.⁵⁷

HABITAT FOR HUMANITY ST. LOUIS
RESTORE SALES REVENUE

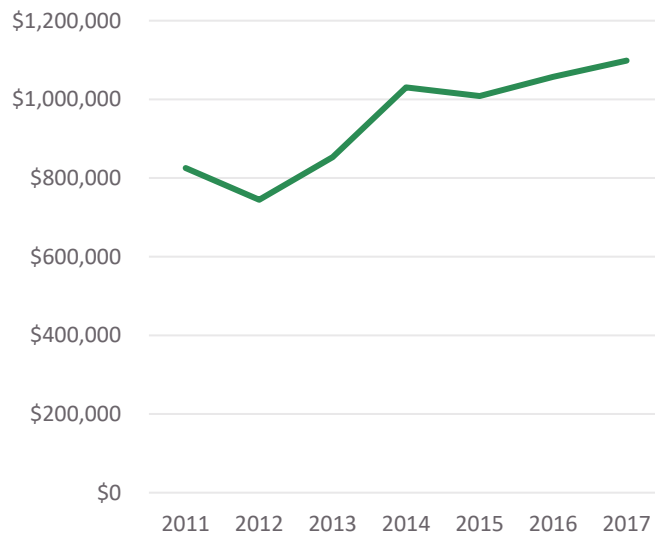


Figure 7: Habitat for Humanity St. Louis Restore Sales Revenue

AVG MONTHLY DONATIONS TO HABITAT
FOR HUMANITY ST. LOUIS RESTORE

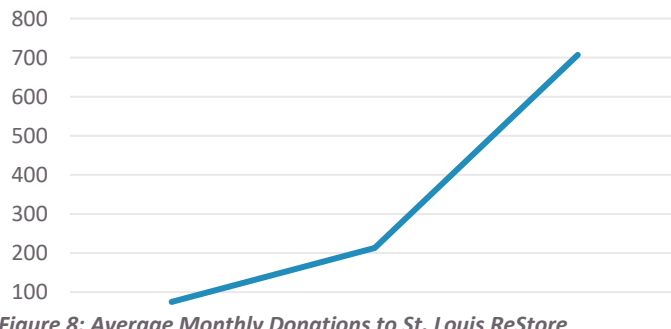


Figure 8: Average Monthly Donations to St. Louis ReStore

NOTE: Donations do not illustrate quantity or quality of items donated. One donation may refer to a single item or large load.

Customers

Though building materials originating in the St. Louis area are often sold outside the region, this report focuses on St. Louis region as identified in the OneSTL Regional Plan from 2013. This geography is comprised of St. Louis County, MO, Madison County, IL, Monroe County, IL, St. Clair County, IL, Franklin County, MO, Jefferson County, MO, St. Charles County, MO, and the City of St. Louis, MO.⁵⁸ As of the 2010 Census, this region was home to over 2.5 million people.⁵⁹

Residents of the St. Louis region have an average of \$61,605 of disposable income, and spend an average of \$2,023.31 annually on household furnishings and equipment (Table 3).

	Average Disposable Income	Household Furnishings & Equipment Consumer Spending (total)	Household Furnishings & Equipment Consumer Spending (avg)
<i>Source</i>	<i>Disposable Income Report, based on 2010 Census data</i>	<i>Market Profile Report, based on 2010 Census data</i>	<i>Profile Report, based on 2010 Census data</i>
St. Louis, MO (city)	\$46,777	\$206,417,346	\$1,467.92
St. Louis County, MO	\$71,728	\$984,698,376	\$2,410.50
Madison County, IL	\$56,345	\$203,167,685	\$1,871.82
Monroe County, IL	\$70,719	\$32,309,440	\$2,403.80
St. Clair County, IL	\$55,605	\$192,175,614	\$1,849.73
Franklin County, MO	\$56,834	\$74,372,011	\$1,816.26
Jefferson County, MO	\$60,093	\$162,266,677	\$1,904.67
St. Charles County, MO	\$74,742	\$373,565,413	\$2,461.80
Total	-	\$2,228,972,562	-
Average	\$61,605	-	\$2,023.31

Table 3 : Disposable Income and Household Spending in St. Louis Region, US Census data provided by ESRI Business Analyst

Interviews with reused building material retailers indicated that customer groups include contractors, furniture builders, designers, rehabbers, crafters (particularly around the holiday craft fair season), homeowners, small entrepreneurs, and property managers. Eric Schwarz with Refab in St. Louis reported that the majority of his customers are homeowners shopping for items for their own property, and over a quarter of customers in a month are returning customers.⁶⁰

Section 5: Impact Assessment of Deconstruction

Deconstruction offers several environmental and economic benefits for communities with high vacancy rates. Compared to traditional demolition, deconstruction generates less toxic dust, reduces waste sent to landfills, and reduces consumption of virgin materials by introducing a reclaimed alternative to the market. In addition to diverting waste materials from landfills, deconstruction also contributes to pollution reduction and the reduction of greenhouse gases. When materials are recycled instead of put into a landfill, it reduces pollution created via manufacturing. Reusing wood preserves forests and their air filtering capacity.

In addition to the benefits to a community's environment, deconstruction also results in several positive economic outcomes, including increases in labor required to remove a structure and revenues generated from reclaimed materials. While there are several benefits to deconstruction, there are also costs. Because deconstruction requires more time and labor hours of work, it can also be more costly than traditional demolition. In some situations, these costs can be reduced or even eliminated through revenue generated from the resale of building materials. The following section forecasts the cost implications for a large scale deconstruction program for the City of St. Louis, as well as some of the associated economic and environmental benefits.

Costs of Deconstruction

In 2013, Delta Institute worked in partnership with Economic Development Growth Engine (EDGE) to implement a deconstruction pilot program in Wayne County, Michigan. The pilot program involved the full deconstruction of 17 residential structures in Wayne County in which all costs were reported as well as revenues generated from the resale of building materials. Simultaneously, data was collected on 10 demolished structures. The same information was collected from both the deconstruction and demolition groups, allowing for a comparison of costs between the two. The average cost of deconstruction per structure was \$15,172 (or \$8.62 per sq. ft.) compared to \$7,632 (or \$5.13 per sq. ft.). Cost of asbestos abatement were not included in these examples because not all deconstructed or demolished homes included in the pilot underwent abatement. The average cost for abatement of both deconstructed and demolished home was \$1,930 (or \$1.11 per sq. ft.). The total cost of the structures deconstructed was 67% greater than those demolished (per sq. ft.).

	Structures	Total Sq. Ft.	Total Cost	Cost per Sq. Ft.	Revenue per Sq. Ft. (Materials Sales)
Deconstruction w/ Backfill	17	29,910	\$ 257,939	\$ 8.62	\$ 6.01
Demolition w/ Backfill	10	14,873	\$ 76,328	\$ 5.13	-
TOTAL	27	44,783	\$ 334,267	\$ 7.46	-
Asbestos Abatement	21	36377	\$ 40,536	\$ 1.11	-

Figure 9: Cost Comparison of Deconstruction and Demolitions, Wayne County Deconstruction Pilot, 2013.

While the additional cost to deconstruct these 17 structures was significant, the value of materials salvaged from these structures represented a significant source of revenue. In lumber alone, between

3,900 and 9,000 board feet was salvaged from each structure, resulting in \$5,400 to \$18,540 in additional revenue from each. The average revenue generated through the resale of salvaged materials was \$6.01 per sq. ft., which reduced the net cost of deconstruction to \$2.61.

Demolition Type	Structures	Average Total Cost (Complete & In Progress)	Average Cost Per Sq. Ft. (Complete & In Progress)
City Building Division	274	\$7,810.12	\$4.94
Urban Greening Program	174	\$12,184.16	\$11.64
Weighted Average		\$9,508.97	\$7.54

Table 4 – Demolition costs. NOTE- Average Cost of Demolition in St. Louis for 2018. Source: <https://www.stlvacancy.com/>
NOTE- Cost per sq. foot Estimations were based on 299 of the demolitions due to availability of Structure Sq. Ft. Data.

To forecast potential cost of a deconstruction project in St. Louis, Delta Institute first analyzed demolition cost data for the city. In 2018, 448 publicly funded demolition occurred. The demolition were divided into two different categories for assessment because each funding source has different specifications that affect the cost of the demolition. The average total cost of demolitions funded through the building division were roughly \$7,810 (or \$4.94 per sq. ft.) and \$12,185 (or \$11.64 per sq. ft.) for demolitions funded through the Urban Greening Program, a partnership between SLDC and the Metropolitan St. Louis Sewer District.⁶¹

Using the data collected from the Wayne County deconstruction pilot program, Delta Institute forecasted the cost of deconstructing the structures demolished in 2018. For each structure in the demolition dataset, demolition costs were broken into three categories as to not overestimate the increased cost of deconstruction. For example, in Wayne County, 11% of the total cost was for asbestos abatement. For this analysis, we assumed all demolitions that occurred in 2018 included abatement. The deconstruction cost multiplier was not applied to this cost because it is not dependent on whether the structure is removed through demolition or deconstruction.

Additionally, demolitions that were part of the Urban Greening Program cost on average 55% more than Building Division Demolitions. These additional costs were associated with specifications regarding foundation removal and fill, which is not affected by how the structure is removed. For this reason, the deconstruction cost multiplier was only applied to 45% of the demolition costs of the Urban Greening Program.

	Building Division	Urban Greening Program
Structure Size (sq. ft.)	1500 sq. ft.	1500 sq. ft.
Original Demolition Costs	\$8,000	\$12,400.00
Estimated Demolition Cost (Minus Abatement)	\$7120	\$11,520.00
Est. Additional Cost for Deconstruction	\$ 4,842	\$ 4,842
Est. Total Cost for full Deconstruction & Abatement	\$ 13,462	\$ 17,862

Table 5: Example Deconstruction Cost Calculations

Scenario 1: All 2018 Demolitions as Deconstructions

The total cost for all 448 publicly funded demolitions that occurred in 2018 was over \$4.2 million. If all 448 structures that were demolished in 2018 were deconstructed, the total cost is estimated to be over

\$6.1 million, a 45% increase. The estimated average deconstruction cost for building division structures is \$12,536 (\$7.93 per sq. ft.) and \$15,737 for Urban Greening Program Demolitions (\$15.51 per sq. ft.).

Demolition/ Deconstruction (Type)	Structures	Demolitions		Deconstruction	
		TOTAL Cost	Est. TOTAL Cost	Average Cost per Structure	Average Cost per Sq. Ft.
City Building Division	274	\$ 2,139,974	\$ 3,435,086	\$ 12,536.81	\$ 7.93
Urban Greening Program	174	\$ 2,120,044	\$ 2,738,354	\$ 15,737.67	\$ 15.51
TOTAL	448	\$4,260,018	\$6,173,440	-	

Table 6: Cost of 2018 St. Louis Demolitions Compared to Predicated Deconstruction Costs (Scenario 1). NOTE- Cost per sq. foot Estimations were based on 299 of the demolitions due to availability of Structure Sq. Ft. Data

As identified in Section 3: Building Material Supply, not all structures are ideal candidate for deconstruction. To demonstrate the additional costs for more feasible scenarios, Delta assessed the additional cost of deconstruction if 10% of 2018 demolitions were deconstructions (Scenario 2) and if 50% of 2018 demolitions were deconstructions (Scenario 3).

Scenario 2: 10% of 2018 Demolitions as Deconstructions

If 10% of structures that were demolished in 2018 had been deconstructed (45 structures), the total cost for the deconstruction of those structures would be an estimated \$617,344. The total cost for 2018 structure removals (including both deconstruction and demolition) would increase by an estimated \$191,342 or 4.5% of overall program cost.

Demolition/ Deconstruction (Type)	Number of Demolitions (90% of 2018)	Number of Deconstructions (10% of 2018)	Cost of Demolitions	Cost of Deconstructions	Total Cost for 2018
City Building Division	246	28	\$1,925,976	\$343,509	\$2,269,485
Urban Greening Program	157	17	\$1,908,040	\$273,835	\$2,181,875
TOTAL	403	45	\$3,834,016	\$617,344	\$4,451,360

Table 7: Predicted Cost of 2018 St. Louis Demolitions and Deconstruction for Scenario 2.

Scenario 3: 50% of 2018 Demolitions as Deconstructions

If 50% of structures that were demolished in 2018 had been deconstructed (224 structures) the total cost for the deconstruction of those structures would be an estimated \$3.1 million. The total cost for 2018 structure removals (including both deconstruction and demolition) would increase by an estimated \$956,711 or 22.5% of overall program cost.

Demolition/ Deconstruction (Type)	Number of Demolitions (50% of 2018)	Number of Deconstructions (50% of 2018)	Cost of Demolitions	Cost of Deconstructions	Total Cost for 2018
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City Building Division	137	137	\$1,069,987	\$1,717,543	\$2,787,530
Urban Greening Program	87	87	\$1,060,022	\$1,369,177	\$2,429,199
TOTAL	224	224	\$2,130,009	\$3,086,720	\$5,216,729

Table 8: Predicted Cost of 2018 St. Louis Demolitions and Deconstruction for Scenario 3

Economic Benefits of Deconstruction

While deconstruction does present some additional cost, there are several benefits in term of employment, wages paid, and labor hours worked that can have a ripple effect through a community. Whenever new income is injected into an economy, it creates a total economic impact that is larger than the initial influx. Increased employment leads to higher percentage of the population paying taxes, which helps to support the economy.

In 2016, Portland, Oregon implemented a deconstruction ordinance that required that all residential structures built prior to 1916 must be deconstructed instead of demolished. During the initial implementation of the policy, a study was conducted to measure the changes in economic impacts and labor as a result of deconstruction. The results of the study demonstrated that deconstruction requires significantly more time and labor, resulting in more employment opportunities and wages paid. Research found that the average single family home demolition required crews of two to three people working for two days with 32 to 48 total hours of labor required for each structure.⁶² Deconstruction on the other hand required crews of 6-8 people working for 10 to 15 days to dismantle a structure with 480 to 960 total hours of labor required for each structure.⁶³

Using the labor hours and crew sizes, Delta Institute estimated the amount of labor hours worked to complete the 448 demolitions that occurring in 2018 and the amount of labor hours that would have been worked if those projects had been deconstruction projects instead. Using the total hours worked to complete these project, total wages paid were also calculated. Assumptions included in this analysis are as follows:

- All of the 448 demolitions were single family homes, resulting in very conservative estimates. Larger or multi-unit structures would generally require more labor.
- Each demolition project that occurred had three crew members: one demolition supervisor, and two demolition workers. Each deconstruction project was assumed to have one deconstruction supervisor and seven deconstruction workers.
- Wages for supervisor positions were estimated to be \$21.36 per hour⁶⁴ and demolition worker wages were estimated to be \$14.75 per hour.⁶⁵ These estimates are based on national averages provided by PayScale.

In 2018, there were 23 contractors that completed the 448 publicly funded demolitions (Baseline Scenario). Based on the assumptions outlined above, those demolitions required between 14,336 and 21,504 labor hours, resulting in \$243,042 to \$364,564 in direct wages.

To demonstrate the additional benefits of deconstruction, Delta assessed the additional wages paid and labor hours of deconstruction for three different scenarios:

- 1) If all 448 structures that were demolished in 2018 were deconstructed (Scenario 1),
- 2) If 10% of 2018 demolitions were deconstructions (Scenario 2),
- 3) If 50% of 2018 demolitions were deconstructions (Scenario 3).

These three scenarios align with the scenarios outlined in the section above. All scenarios were based on total estimated labor ranges provided by the Portland, Oregon study. Labor is reported in hours as opposed to full-time jobs, as many may be part-time or contract employees.

Indicator	All Demolition (Baseline)	All Deconstruction (Scenario 1)	10% Deconstruction (Scenario 2)	50% Deconstruction (Scenario 3)
Estimated Labor Hours (Low)	14,336	215,040	21,504	107,520
Estimated Labor Hours (High)	21,504	430,080	43,008	215,040
Estimated Wages Paid (Low)	\$ 243,042	\$3,349,516	\$334,951	\$1,674,758
Estimated Wages Paid (High)	\$ 364,564	\$6,699,033	\$669,903	\$3,349,516

Table 9: Estimated Labor Hours and Wages Paid for Deconstruction and Demolition

Scenario 1: All 2018 Demolitions as Deconstructions

If the 448 structures had been deconstructed instead of demolished, they would have required between 215,040 and 430,080 labor hours, resulting in \$3.35 million to \$6.7 million in wages paid.

Scenario 2: 10% of 2018 Demolitions as Deconstructions

If those 45 of the 448 structures had been deconstructed instead of demolished, they would have required between 21,504 and 43,008 additional labor hours, resulting in \$334,951 to \$669,903 in additional wages paid.

Scenario 3: 50% of 2018 Demolitions as Deconstructions

If those 224 of the 448 structures had been deconstructed instead of demolished, they would have required between 107,520 and 215,040 additional labor hours, resulting in \$1.67 million to \$3.35 million in additional wages paid.

Environmental Benefits of Deconstruction:

In addition to the potential economic benefits, deconstruction can have significant positive environmental outcomes compared to traditional demolition. Because deconstruction is a more gentle process, it produces significantly less dust, reducing the lead and particulate exposure risk for the surrounding community. Above all, deconstruction results in significant reductions in waste generation as well as greenhouse gas emissions compared to traditional demolition.

“When the structures fall, heavy metals carried by dust can travel several blocks, drifting into open windows and settling into neighbors’ yards.”

– *St. Louis Dispatch*, “*St. Louis demolition bring renewed risk for lead poisoning*,” 2019.

To estimate the amount of waste reduced, Delta Institute focused on commodity materials (lumber and brick) because they are both more easily measured and more consistently present in vacant structures. The estimated quantities of materials that could be salvaged for reuse (identified in *Section 3: Material Supply*) were converted from board feet and bricks to tons. For this conversion, we assumed each brick weighs 9 pounds, and each board foot of lumber salvaged weighs 2.4 pounds. This weight estimate assumes that all lumber is salvaged is old growth Douglas fir. The salvage of 24.8 million bricks from the vacant structure would result in 111,700 tons of material diverted from landfills, and the salvage of 10.4 million board feet of old growth lumber would result in 14,800 tons of materials diverted from landfills.

To estimate the greenhouse gas emission reduction (in Metric Tons of Carbon Dioxide Equivalent, MTCO₂E) that would result from the salvage and reuse of St. Louis’ brick and lumber, Delta Institute utilized the Waste Reduction Model (WARM)⁶⁶ developed by the EPA. Greenhouse gas equivalent was calculated for the quantities of lumber and brick that could be salvaged, but due to model limitations; we were not able to estimate reductions from other salvaged materials (including finishes). The salvage and reuse of 24.8 million bricks and 10.4 million board feet of lumber would result in a net greenhouse gas emissions reduction of 43,066 Metric tons of CO₂E. This is equivalent to removing annual emissions from over 9,000 passenger vehicles or conserving over 4.8 million gallons of gasoline.⁶⁷

Material	Estimated Quantity Recovered for Reuse	Waste Reduction Potential	Green House Gas Reduction Potential (MTCO ₂ E)
Bricks	24.8 million bricks	111,700 tons	14,996
Lumber	10.4 million board feet	14,800 tons	28,070
TOTAL		126,500 tons	43,066

Table 10: Estimated Waste Reduction and GHG Emission Reduction from Material Reuse. EPA.

Section 6: Recommendations

The City of St. Louis and surrounding region has a tremendous opportunity to scale up deconstruction programs and strengthen building material reuse markets, supported by Mayor Lyda Krewson's *Plan to Reduce Vacant Lots and Buildings*.⁶⁸ St. Louis' vacant housing stock provides a higher density of valuable building materials compared to other major Midwestern cities, and materials like St. Louis brick are in high demand. There are several businesses and non-profits currently operating in the St. Louis area to bring many of these materials to market, and support from SLDC and other local government departments and organizations can help bolster the existing marketplaces and attract new buyers and sellers into the industry.

Recommendation: SLDC and city departments should convene a local advisory committee to consider developing legislation to encourage or require building material reuse in St. Louis.

Several municipalities and counties across the country have implemented policies to increase diversion of C&D materials from landfills. Ordinance mechanisms vary, and each strategy has strengths and challenges. An advisory committee made up of a representative group of local stakeholders should carefully consider if an ordinance is beneficial for St. Louis at this time, and which type of legislation is most appropriate for the area. Factors including feasibility, incentives, enforcement, material type, and structure age/historic significance are important considerations when creating policy recommendations.

Recommendation: SLDC in collaboration with city departments should consider funding and supporting deconstruction training at multiple experience levels for demolition contractors and other interested workers.

Managing vacant properties effectively while strengthening a reclaimed building materials market requires a workforce capable of deconstructing the desired structures. Without local training, properties designated for deconstruction may remain vacant and fall into a blighted condition. Deconstruction training also provides an opportunity for various models of workforce development for those with barriers to employment. Support for deconstruction training could include providing structures for training that are good candidates for deconstruction, coordinating permitting and utility disconnection, and coordinating post-training demolition of the remaining structure.

Recommendation: SLDC, LRA and the Building Division should develop and use condition score criteria and building inspector recommendations to help prioritize building deconstruction.

Not all structures are good candidates for deconstruction. There is some concern from contractors that they will be expected to salvage large quantities of building materials from structures that are not in good condition. SLDC should work with the LRA and Building Division to develop and use condition score criteria to help prioritize building deconstruction. Additionally, a system should be created for building inspectors to report what they think may be a good candidate. While a data-informed approach will help narrow down potential deconstruction candidates, physical walkthroughs and inspections will help ensure the deconstruction program is efficient and impactful.

Recommendation: SLDC and the LRA should work with the Building Division to bid demolitions and deconstructions in larger packages to allow for significant quantities of materials to be aggregated for donation or resale.

Many purchasers of reclaimed lumber will only purchase materials in large volumes. The volumes required to fulfill these limits are much more significant than an individual house could provide. Because of this, large purchasers of reclaimed building materials acquire most of their lumber from commercial and industrial demolitions and deconstructions. Larger bid packages will allow for more significant quantities of materials to be aggregated, which will provide demolition and deconstruction contractors with more outlets to sell reclaimed building materials. Additionally, SLDC could create or facilitate a cooperative among demolition contractors that would allow them to aggregate enough materials for competitive resale.

Recommendation: SLDC should encourage real-estate developers and the private sector to salvage reclaimed building materials and incorporate deconstruction into development projects.

There is a significant amount of vacant structures that are not publicly owned and have the potential to be developed by the private sector, including commercial and industrial properties. SLDC should encourage real-estate developers and the private sector to salvage reclaimed building materials and incorporate deconstruction into development projects. Real-estate developers have significant control over how materials are handled in their project. SLDC and other city departments could also consider providing incentives such as allowing TIF funding to cover the additional cost of deconstruction for proposed developments in TIF districts or expediting permitting processes for projects that incorporate building material reuse and deconstruction.

Recommendation: SLDC should consider a partnership with state and regional entities to help join or create an online system for brokering reclaimed building materials.

To more effectively market reclaimed building materials efficiently connect consumers or donations to retailers, several states, municipalities, and organizations have established online marketplace tools. Removing barriers for contractors or other customers to purchase reclaimed material and developing a user-friendly alternative to landfilling C&D debris will strengthen the local marketplace.

APPENDICES

Appendix A: Key Actors in the National Reclaimed Lumber Market

Company Name	Address	City	State	ZIP Code	IUSA Number	Sales Volume
Longleaf Lumber	115 Fawcett St	Cambridge	MA	02138	976832139	\$5-10 Mil
Longleaf Lumber	31Commercial Dr	Berwick	ME	03901	268811692	\$500,000-1 Mil
Vintage Timberworks Inc	47100 Rainbow Canyon Rd	Temecula	CA	92592	961954690	\$5-10 Mil
Atlantic Reclaimed Lumber	1093 Highway 91	Elizabethton	TN	37643	403745535	\$1-2.5 Mil
Terra Mai	8400 Agate Rd	White City	OR	97503	71-5467924	\$1-2.5 Mil
Elmwood Reclaimed Timber	13200 NW Arrowhead Trfy	Kansas City	MO	64165	404146947	\$10-20 Mil
Elmwood Reclaimed Timber Inc.	22701 S Peculiar Rd.	Peculiar	MO	64078	423503831	\$10-20 Mil
Olde Wood LTD	7557 Willowdale Ave SE	Magnolia	OH	44643	258602416	\$1-2.5 Mil
Trestlewood	933 Frontage Rd	Blackfoot	ID	83221	433469510	\$1-2.5 Mil
Trestlewood	15405 S East Promontory Rd	Corinne	UT	84307	420991546	< \$500,000
Trestlewood	292 N 2000 W # A	Lindon	UT	84042	977398551	\$2.5-5 Mil
G R Plume Co	1373 W Smith Rd # A1	Ferndale	WA	98248	409784238	\$2.5-5 Mil
Eagle Reclaimed Lumber	215 S Cannon Ave	Murfreesboro	TN	37129	404000760	\$1-2.5 Mil
Eagle Reclaimed Lumber	9275 Patterson Rd	Rockvale	TN	37153	736162859	\$1-2.5 Mil
Recycling The Past	381 N Main St	Barnegat	NJ	08005	965030240	\$500,000-1 Mil
Altruwood	1634 SW Alder St	Portland	OR	97205	400228095	< \$500,000
Pioneer Millwork	835 E San Carlos Ave	San Carlos	CA	94070	455219444	\$5-10 Mil
Pioneer Millworks	1068 Center St	San Carlos	CA	94070	42-443-3450	\$2.5-5 Mil
Pioneer Millworks	1180 Commercial Dr.	Farmington	NY	14425	523474435	\$10-20 Mil
Pioneer Millworks	2675 NE Orchard Ave	McMinnville	OR	97128	714320598	\$10-20 Mil
Pioneer Millworks	3850 Mack Rd	Amarillo	TX	79118	424955376	\$5-10 Mil
Pioneer Millworks	8375 Kempwood Dr.	Houston	TX	77055	389474966	\$10-20 Mil

Source: Reference USA

Appendix B: Building Material Reuse Stakeholders in St. Louis

Name	City/ Town	Address & Phone	Website	Stakeholder Category	Interview
Habitat for Humanity - St. Louis	St. Louis, MO	3763 Forest Park Ave, St. Louis MO, 314-678-4576	https://www.habitatstl.org/	Reclaimed Building Material Marketplace	yes
Refab	St. Louis, MO	3130 Gravois Ave, St. Louis MO, 314-357-1392	http://www.refabstl.org/	Reclaimed Building Material Marketplace	yes
American Timber Salvage	St. Louis, MO	2100 N 2nd St., St. Louis MO, 314-550-0754	http://americantimbersalvage.net/	Reclaimed Building Material Marketplace	
Folsom Reclaimed	St. Louis, MO	4006 Folsom Ave, St. Louis MO, 314-583-0938	https://www.facebook.com/folsomreclaimed/	Reclaimed Building Material Marketplace	
Century Used Brick	St. Louis, MO	2324 S 3rd St., St. Louis MO, 314-962-4400	No website listed	Reclaimed Building Material Marketplace	
North St. Louis Lumber	St. Louis, MO	652 E Holly Ave, St. Louis MO, 314-318-2162	No website listed	Reclaimed Building Material Marketplace	
Perhat Lumber	St. Louis, MO	6023 S. Broadway, St. Louis MO, 314-481-9302		Reclaimed Building Material Marketplace	
Habitat for Humanity - St. Charles County	St. Peters, MO	186 Mid Rivers Center, St. Peters MO, 636-978-5712	http://habitatstcharles.org/	Reclaimed Building Material Marketplace	
Habitat for Humanity - Des Peres	Des Peres, MO	2117 Sams Drive, Des Peres MO, 314-678-4576		Reclaimed Building Material Marketplace	
Habitat for Humanity	Union, MO	PO Box 178 Union, MO Franklin County 636-583-1020	http://www.franklincountymohabitat.org/contact.html	Reclaimed Building Material Marketplace	
Habitat for Humanity - Collinville	Collinsville, IL	101 E Clay St., Collinsville IL, 618-223-1711	http://collinsvillehfh.wixsite.com/collinsvillehfh/restore	Reclaimed Building Material Marketplace	
Habitat for Humanity ReStore	Crystal City, MO	345 Bailey Rd, Crystal City MO	https://www.habitat.org/us-mo/crystal-city/jefferson-county-mo-hfh-inc	Reclaimed Building Material Marketplace	
Junque	St. Louis, MO	3519 S Broadway, St. Louis, MO 63118	No website listed	Reclaimed Building Material Marketplace	
Fellenz Antiques	St. Louis, MO	439 N Euclid Ave, St. Louis, MO 63108		Reclaimed Building Material Marketplace	
Reclaim Renew	St. Louis, MO	2145 Barrett Station Rd St. Louis, MO 63131	https://reclaimrenew.com/	Value Added Processor	
Rustic Grain	St. Louis, MO	9420 Watson Industrial Park, St. Louis, MO 63126	http://rusticgrain.com/	Value Added Processor	yes
Mwanzi	St. Louis, MO	3412 Lemp Ave. St. Louis, MO 63118	http://www.mwanzi.com/	Value Added Processor	
Perennial	St. Louis, MO	3762 S Broadway, St.	https://perennialstl.org/	Value Added Processor	yes
Space	St. Louis, MO	4168 Manchester Ave.	http://spacestl.com/	Design Build Studios	yes
Killeen	St. Louis, MO	3015 Salena St #203, St. Louis, MO 63118	http://killeenstudio.com/	Design Build Studios	

LU Design	St. Louis, MO	St. Louis, MO 63116	https://www.lucasupdates.com/	Design Build Studios	
Urban Improvement Construction	St. Louis, MO	1607 Tower Grove Avenue	http://uicstl.com/	Design Build Studios	
KAI	St. Louis, MO	2060 Craigshire Road	http://www.kai-db.com/showcase/portfolio	Design Build Studios	
Boardwalk Hardwood Floors	Crestwood, MO 63126	9000 Watson Rd, St. Louis, MO 63126	http://www.boardwalkhardwood.com/reclaimed-beams-timbers/	Lumber or Brick Wholesale/ National	
Deconstruction Development Partners	St. Louis, MO	4579 Laclede Ave. #400 St. Louis MO, 63108	https://www.ddp-corporation.com/	Consultant	yes
Citizen Carpentry	St. Louis MO		http://www.citizen-carpentry.com/	Value Added Processor	yes
Brentwood Material Co.	Brentwood MO	2950 S Brentwood Blvd.	https://www.brentwoodmaterial.com/about-us-2/	Reclaimed Building Material Marketplace	

Appendix C: Structure Condition Scoring Framework

Description	Value Range		Value Range	Index Score
	Min	Max		
LRA Tenure	Min	1987	30	0
	Max	2017		10
Years Vacant	Max	29	29	0
	Min	0		10
Maintenance Costs	Max	547,908	547,908	0
	Min	0		10
Condition Score	Max	9.972	20.028	0
	Min	30		10

Appendix D: Old Growth Lumber Value

Lumber Dimension (W" x H")	Price per Linear Foot		Ln. ft. per BF	Price per Board Foot	
	Low	High		Low	High
1x4	\$0.25	\$1.50	3.00	\$0.75	\$4.50
1x6	\$0.40	\$2.00	2.00	\$0.80	\$4.00
1x8	\$0.45	\$3.00	1.50	\$0.68	\$4.50
1x10	\$0.60	\$4.00	1.20	\$0.72	\$4.80
1x12	\$0.75	\$6.00	1.00	\$0.75	\$6.00
2x4	\$0.50	\$1.67	1.50	\$0.75	\$2.50
2x6	\$0.75	\$3.00	1.00	\$0.75	\$3.00
2x8	\$1.00	\$4.00	0.75	\$0.75	\$3.00
2x10	\$1.25	\$6.67	0.60	\$0.75	\$4.00
2x12	\$1.50	\$12.00	0.50	\$0.75	\$6.00
4x4	\$2.00	\$5.00	0.74	\$1.48	\$3.70
4x6	\$3.00	\$10.00	0.50	\$1.50	\$5.00
6x6	\$4.50	\$15.00	0.33	\$1.50	\$5.00
AVERAGE	-	-	-	\$0.92	\$4.31

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