



**A STATEMENT OF RESEARCH NEEDS
TO ADVANCE THE RECOVERY AND REUSE OF BUILDING MATERIALS
16 September 2022**

INTRODUCTION:

Build Reuse is a registered 501(c)3 educational nonprofit established in 1994 that serves as the premier national organization promoting the recovery, reuse, and recycling of building materials in the United States and Canada. We are also committed to developing social investment and workforce development programs in the deconstruction industry. Our vision is to transform our communities by creating a building industry in which used and excess materials become an asset and waste is no longer acceptable.

Build Reuse is soliciting proposals for research. The objective of this research is to support advocacy organizations, industry and educational organizations, Public jurisdictions, and building professionals' efforts to incorporate recovered building materials within the planning, design, construction, and building removal industries, including historic buildings. Building Reuse anticipates academic institutions, industry and professional organizations and societies, non-profit organizations, public entities and organizations with similar interests in a sustainable built environment will be interested in performing or supporting research.

See <https://www.buildreuse.org/> for information on Build Reuse.

BACKGROUND:

600 million tons of construction and demolition materials were generated in the United States in 2018 - more than twice the amount of generated municipal solid waste - of which 60% ends up in landfills (<https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/construction-and-demolition-debris-material>). Landfills negatively affect biodiversity, groundwater pollution, and the health of surrounding communities. Prioritizing reuse through deconstruction minimizes the amount of material that is landfilled.

Manufacturing new building materials to replace those wasted through demolition creates the vast majority of environmental stressors occurring throughout the materials' life cycles. Reuse limits further extraction of virgin materials, which is energy- and water-intensive, and puts pressure on wildlife habitats and ecosystems. Material reuse is an important tool in combating climate change impacts of the construction industry.

Over the next forty years, our total building stock is estimated to double, while nearly a third of our present building stock will come down.

Imagine for a moment: one third of the buildings in your neighborhood, town, or city are demolished and the materials landfilled. At the same time, forests and other resources continue to be mined for new materials. How we utilize the existing resources in our communities is an essential consideration in building a more sustainable future?

Meanwhile, many local communities lack economic opportunities, face under-employment of marginalized populations, and are dealing with disinvestment in local building stock. Build Reuse is about giving communities the tools to reinvest those materials in ways that create jobs in deconstruction and reuse centers, create economic opportunity for small local businesses, and save resources.

We believe that, dollar for dollar, an investment in reuse is one of the wisest investments a community can make.

Reuse is local. It builds economies, it builds lives, it builds community. We have seen it again and again throughout the country, but not nearly enough. Reuse needs to become the standard practice it once was to make the difference we need.

Once again, imagine for a moment that a third of buildings in your community are removed.

- *What if*, instead of demolishing these structures and sending materials to a landfill, that the material went to local reuse centers and was reinvested right back into your community?
- *What if*, as a result, this method of material reinvestment generated new local jobs?
- *What if* a portion of the materials were salvaged for reuse in existing structures of the same age, addressing deferred maintenance issues and repairing existing affordable housing in the process?
- *What if* small businesses popped up throughout the reinvestment process, turning these materials into furniture, art, and other necessities?
- *What if* a transformative technology and innovation sector flourished, focused on creating new building products utilizing existing materials - instead of continuing to mine our forests and earth for virgin materials - helping to break the take-make-waste cycle in the building industry?

This happens on a small scale in many communities today. *OUR GOAL IS TO MAKE IT HAPPEN EVERYWHERE.*

RESEARCH:

This Statement of Research Needs defines eight broad themes that describe Build Reuse's research interests. These are:

- Gap Analysis
- Building Material Reuse Potential
- Tracking Construction and Demolition Waste
- Environment and Sustainability
- Economics
- Social and Societal Issues
- Policy
- Historic Buildings

It then sets out a series of more specific Research Topics organized within those eight broad themes. Each Research Topic sets out the importance of the topic, identifies the variety of ways in which research in this topic could have practical impact in supporting the work of Build Reuse, and gives a list of questions to guide those looking to perform research that will help us achieve our mission.

This Statement of Research Needs is a living document. Over time, topics of a similar import will emerge as the building material recovery and reuse environment evolves. Updates will be issued as needed.

Research Theme: Gap Analyses.

A considerable amount of information and practical knowledge about building materials recovery and reuse has been accumulated over the years. However, there is a lot we still don't know that can accelerate this practice within the construction industries. Expanding our knowledge base is critical to achieving wider implementation. By identifying gaps in our institutional knowledge research can be targeted to topics that will potentially have the greatest impact on the built environment.

Research will have an impact if it reveals knowledge, resources and products we currently do not possess but are necessary to advance the practice of building material recovery and reuse. Once armed with this knowledge and tools we can target research and development to be most effective in accelerating recovery and reuse practices.

Topics for Gap Analyses include:

- Supply and demand data for recovered building materials.
- Performance data for recovered building materials.
- Recovered building material supply sources and availability for reuse.
- Applications of recovered building materials in building design, new construction, renovations and interior design, furnishings and non-building-related products.
- Applications of recovered building materials in historic buildings.
- Cost, productivity, resource allocation and scheduling data.
- Academic coverage of building material recovery and reuse in building-related curricula.

Research questions that will help our mission include:

- What information do we need, but do not currently have, that will support recovery and reuse practices?
- What information will compel policy makers to reduce C&D waste and embrace building material recovery, recycling and reuse?
- How can we infuse students and young professionals with the values of resource conservation and circular economy within academic institutions' curricula?

Research Theme: Building Materials' Reuse Potential.

There is an enormous potential to reuse building materials. Anecdotally we know upwards of 75% of demolition materials from a single building can – and have -- been recycled and reused. However, we don't know the total national inventory of building materials available for reuse on a regional or national basis. Anecdotally we know that new buildings' content can – and have – consisted of upwards of 90% recycled and recovered building materials. However, we don't know the market potential of widespread reuse of materials. In other words, we don't know, objectively, the hidden treasure available to us or how to capitalize on its value.

Topics for quantifying building materials' reuse potential include:

- Potential quantities and characterization of reusable building materials that can be recovered through building removal and renovation activities.
- Potential building material reuse opportunities.
- Potential inventory and applications of recovered material in historic building applications.
- Tracking Deconstruction and Reuse Services and Outlets.
- Uniform metrics and methods for gathering, managing and maintaining data on recovering and reusing building materials.

Research will have an impact if it informs building planners, designers, constructors, managers, and removal practitioners of the opportunities for materials recovery and reuse. It will have an impact if it reduces uncertainties, and therefore risk, associated with materials availability, qualities, and supply. It will have an impact if practitioners become comfortable in adopting these practices and incorporating them into their mainstream practices.

Research questions that will help our mission include:

- How much potentially recoverable building material is available in buildings being removed in a given time period and location (or regionally, or nationally)?
- How can potentially recoverable building materials be identified, measured and recorded?
- How much recovered building material can be incorporated in new construction, renovation and remodeling in a given time period and location?
- What are the properties of recoverable building materials?
- Where can recovered building materials be taken once removed from a building?
- Where can recovered building materials be obtained for inclusion in new construction, renovation or remodeling projects?

Research Theme: Tracking Construction and Demolition Waste.

Solid waste is routinely measured and reported by local solid waste management authorities and summarized for upward reporting. It is typically categorized as municipal solid waste, construction and demolition waste, and hazardous waste. Furthermore, recording and reporting methods vary from authority to authority, and the accuracy of this data is often questionable. As such reporting is typically an administrative task, it is often of marginal use to waste management professionals, construction and demolition practitioners and policy makers. A recording and reporting paradigm shift is necessary to make C&D waste data truly useful to building material recovery and reuse practices.

Research will have an impact if it reveals to waste management policy and decision makers the benefits of waste reduction and material recovery and reuse. It will have an impact if it resonates with construction service providers and the public to the extent policy and decision makers will find it good politics to support these efforts.

Topics for tracking C&D waste include:

- C&D waste tracking and reporting practices at local, state, and federal Levels.
- Data gathering mechanisms.
- Data integrity, reliability and usefulness to solid waste reduction efforts.

- Development of C&D waste, recovery and reuse data that is meaningful to policy makers at public jurisdictions.
- Applications of C&D waste data to building planning, design, construction, management and removal processes.
- Improvements in C&D waste data gathering and reporting processes necessary to accelerate building material recovery and reuse practices.

Research questions that will help our mission include:

- How accurate are C&D waste tracking processes at present?
- How should C&D waste data improve solid waste reduction?
- What are the costs and logistical burdens incurred with landfill disposal of C&D materials?
- What are future trends in C&D landfill closure and the locations, permitting, construction and operation of new C&D landfills?
- How does C&D waste data drive policy affecting building planning, design, construction, management and removal processes?
- How should C&D waste data be used to support building material recovery and reuse policies and practices?

Research Theme: Environment and Sustainability.

The construction industry is by far the largest consumer of natural resources ((*Matos, G., (2017) Use of raw materials in the United States from 1900 through 2014: U.S. Geological Survey (USGS) Fact Sheet*)). Wasting these resources through demolition and landfill disposal creates environmental stressors such as groundwater contamination and greenhouse gas emissions. An abundance of statutes and regulations have been promulgated to manage and reduce landfill disposal. Furthermore, extracting resources, manufacturing, and transporting new building materials create upwards of 90% of materials' environmental stressors over their life-cycles. Available data and tools such as the USEPA Waste Reduction Model, the Athena Environmental Impact Estimator, Consortium for Research on Renewable Industrial Materials and the US National Energy Research Laboratory's US Life Cycle Inventory Database have been applied to reveal the adverse impacts of landfilling C&D materials and manufacturing new building materials to replace them is considerable.

Research will have an impact if it reveals to waste management policy and decision makers the full spectrum of adverse environmental impacts associated with landfill disposal of C&D materials and the benefits of waste reduction and material recovery and reuse. It will have an impact if it resonates with public to the extent policy and decision makers will find it good politics to support these efforts.

Topics for Environment and Sustainability include:

- Embodied carbon benefits possible with building materials recovery and reuse.
- Energy consumption and life cycle benefits possible with building materials recovery and reuse.
- Life Cycle Inventory and Life Cycle Analysis data resources, methodologies and methods.
- Climate resilience.
- Community resilience; applications of recovered building materials to post-disaster recovery efforts.
- Life-cycle and indirect monetary costs associated with C&D landfill disposal; cost reduction potential associated with building material recovery and reuse.
- Potential contribution of quantitative LCA and Life Cycle Cost Analysis to policy and policy decision makers.

Research questions that will help our mission include:

- What are the real environmental impacts of landfilling C&D materials?
- What environmental stressors can be reduced or eliminated through building material recovery and reuse?
- What are the real monetary costs associated with C&D landfill disposal, both initial and long term?
- How can we monetize non-first-costs associated with the adverse effects of C&D landfill disposal; who ultimately pays these costs?
- How can building material recovery and reuse support climate resilience?
- How can building material recovery and reuse support community resilience in post-disaster recovery efforts?

Research Theme: Economics.

In the construction industry, lowest first cost almost always drives decisions. Traditional wrecking is almost always less expensive in first cost than deconstruction. Building with new materials is most frequently more convenient than seeking sources of recovered materials. Other benefits may be possible but will not be achieved if there is a greater out-of-pocket cost to the service provider, and therefore the entity paying for the services. This lowest-first-cost paradigm must be shifted to a best value paradigm to make building material recover and reuse more economically attractive than traditional wrecking and landfill disposal.

Research will have an impact if it convinces building planning and design professionals, construction contractors, facility managers, and demolition contractors that recovery and reuse is economically viable. It will have an impact if dependable cost data reduces uncertainty, and

therefore risk, associated with recovering and reusing building materials. It will have an impact if practitioners become comfortable incorporating recovery and reuse into their mainstream practices. I will have an impact if regulators and policy makers are comfortable policies or ordinances favorable to material recovery and reuse will be acceptable to the construction industry and public at large.

Topics for Economics include:

- Costs data for deconstruction and reuse services.
- Cost data for incorporating recovered materials into new projects.
- Deconstruction methods, techniques and procedures to achieve cost parity with traditional wrecking and landfill disposal practices.
- Non-first-cost economic impacts associated with traditional wrecking and landfill disposal; potential economic benefits of materials recovery and reuse.
- Growing the deconstruction and reuse industries.
- Balancing supply and demand.
- Commercial and non-profit deconstruction and reuse experiences and opportunities.
- Business models for financially sustainable deconstruction and reuse service providers, commercial and non-profit.
- Appraising the value of recovered building materials.
- Economic benefits to the community.
- Economic impact of favorable material recovery and reuse policy to the construction industry.

Research questions that will help our mission include:

- What does deconstruction cost compared to traditional wrecking and landfill disposal?
- What are recovered building materials worth?
- How much do recovered materials cost compared to new materials?
- Where can we find deconstruction and reuse cost data?
- How can the cost of deconstruction services be reduced to be more competitive with traditional wrecking and landfill disposal?
- How can commercial and / or non-profit deconstruction and reuse businesses succeed in the marketplace?
- What potential for cost avoidance is possible with deconstruction and reuse?
- How do non-first-costs contribute to deconstruction practitioners and policy makers' decision making processes?

Research Theme: Social and Societal Issues.

We know the practice of reuse inherently recognizes and prioritizes existing community values. Reinvesting the wealth embodied in existing materials back into the communities from which they originated has cultural and social potential.

Compared to mechanical demolition, deconstruction is labor intensive, requiring a team of individuals with specialized knowledge. Mechanical demolition of a 1,400 square-foot house requires a crew of 2-3 workers, as opposed to 6-8 if that same structure were deconstructed. Deconstruction also feeds a larger reuse economy, indirectly supporting jobs in material warehousing, retail and sales, and material manufacturing.

Many Build Reuse member organizations are dedicated to using deconstruction as a tool for workforce development, especially for women, people of color, and people impacted by the justice system or with other barriers to employment.

Research will have an impact if it reveals to community leaders and governments the employment and social support opportunities possible with a robust material recovery and reuse industry. It will have an impact if benefits are evident to the public to the extent policy and decision makers will feel comfortable with supporting these efforts.

Topics for Social and Societal issues include:

- Job growth across deconstruction and reuse industries.
- Economic multipliers associated with building material recovery and reuse businesses.
- Skills training and workforce development experiences and opportunities.
- Synergy between building materials recovery and reuse businesses and other existing social programs.
- Economic benefits to the community.
- Non-monetary benefits to the community.
- Societal benefits that will resonate with policy makers.

Research questions that will help our mission include:

- How can the building material recovery and reuse industry provide skills training, workforce development and employment opportunities?
- How can the building material recovery and reuse industries piggy-back with other existing social programs?
- What benefits will a community accrue with an expanded workforce and job growth?
- What economic multipliers will result from a robust building materials recovery and reuse industry and employment opportunities?

Research Theme: Policy.

Construction practitioners are reluctant to adopt any practice that presents a risk, of which they are not familiar, or present a potentially a higher cost or greater effort than their standard practices. While benefits of atypical practices may be evident, adoption is unlikely to occur unless required or at least encouraged by the prevailing authority. Public policy, therefore, is often necessary to direct the construction industry toward practices that are in the general public interest. The challenge is to encourage public entities to develop or adopt policies that are favorable to waste reduction and building materials recovery and reuse without drawing opposition from the building industry or the public at large. If the industry and public perceive additional cost or effort, a proposed policy becomes a political liability regardless of its merit.

Research will have an impact if it becomes politically and economically acceptable to governmental entities to promulgate policies and guidance to accelerate building material recovery and reuse practices and achieve the anticipated positive results. It will have an impact if such policies are acceptable to planning and design professionals, construction contractors, facility managers, demolition contractors and the public at large. It will have an impact if positive results are evident upon adoption of the policies.

Topics for Policy include:

- Political and economic factors that resonate with policy makers.
- Basis on which policy makers make decisions; relationships with the industry and public at large.
- Advocacy from outside the governmental entity.
- Impact of existing building codes, ordinances, and government-issued guidance on building materials recovery and reuse.
- Tools and resources to support policy.
- Incentives to stimulate building material recovery and reuse.
- Legislation Tracking.

Research questions that will help our mission include:

- What “hot button” issues will resonate with policy and decision makers both in favor of and opposition to developing policy requiring building material recover and reuse to some extent?
- What waste reduction and building material recovery and reuse-related policies have been adopted within the United States and Canada?

- What policies have proven successful, achieving the expected benefits, and which have not; which provisions have proven constructive and which have proven ineffective or counterproductive; what lessons learned can be had from existing policies?
- What is the most effective method of promoting building material recover and reuse; voluntary compliance, explicit mandate, incentives, others?
- What revisions, if any, are necessary to building codes, local ordinances, permitting processes and other existing governance to optimize the benefits of materials recovery and reuse?

Research Theme: Historic Buildings.

The historic building preservation community and the building materials recovery and reuse community have generally operated independently of each other. On the surface this seems odd. Vintage building materials become available when a historically or architecturally significant building must be removed due to deterioration, excessive damage or safety concerns. Preservation, renovation, restoration and repurposing historically significant buildings require materials that are authentic to their design and provenance. Such materials are typically unavailable as new products and must be custom fabricated. In many cases, duplicate materials are not permitted. Acquiring period- and style-appropriate materials can be problematic. Materials from historically and architecturally significant buildings that must be removed can help fill this gap.

Research will have an impact if recovering historically or architecturally significant materials and components and reusing them in historic building preservation, renovation, restoration and repurposing projects become common practices. It will have an impact when an infrastructure exists to match supply and demand so that materials reuse for historic projects becomes standard practice.

Topics for historic buildings include:

- Quantities and characterization of historically and architecturally significant materials that potentially can be recovered from buildings scheduled for demolition.
- Vintage building material recovery methods and techniques.
- Reuse applications in a historic building context.
- Infrastructure for matching vintage materials supply and historic buildings demand.
- Costs of recovering and incorporating vintage materials into historic buildings.
- Business models for recovery and reuse service providers.

Research questions that will help our mission include:

- What types of vintage materials and components are available from buildings scheduled for demolition?
- How can these materials be quantified, characterized and inventoried?
- What unique methods and techniques are required to recover and reuse vintage building materials?
- How can the supply of vintage materials be matched with the demand?
- What is required to familiarize building material recovery service providers with historic building renovation, restoration, preservation and repurposing professionals?
- What revisions to existing historic preservation guidance are necessary to enable the use of recovered building materials?

CONTACT BUILD REUSE.

If you or someone you know are interested in performing research in response to this Statement of Research Needs, or have any questions about Build Reuse, please contact us at <https://www.buildreuse.org/contact>. In the Message window, please enter “Statement of Research Needs” and indicate your organization, topic or topics in which you are interested, and a brief statement of what you would like to accomplish through this research. We will reply to your message within two business days and schedule further discussion about your research plans.

