‘There is no such thing as away’:

RESIDENTIAL DECONSTRUCTION AS A METHOD FOR WASTE DIVERSION IN CANADA’S BUILT ENVIRONMENT

A SUMMARY REPORT PREPARED AND PRESENTED BY

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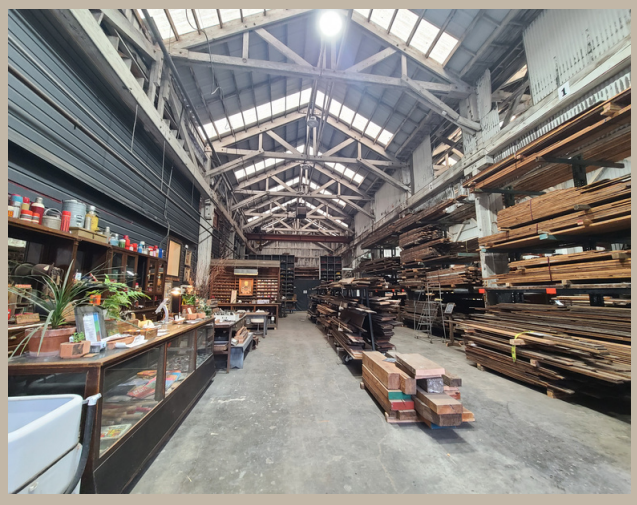
Introduction

Waste diversion and reduction continues to be a prominent discussion among Canadian municipalities as we collectively recognize the impact that waste production has on the environment and our future, especially in the context of climate change. Much of the focus in this regard has been on individual waste generation and reduction and the “zero-waste” movement, with less focus on construction, renovation, and demolition (CRD) waste. Research shows that CRD waste contributes between 27% and 40% of total municipal solid waste in Canada and it is estimated that the CRD sector is responsible for 40% of raw material consumption in North America. With an estimated potential of 95% of CRD materials being available for salvage, reuse, repurposing, and recycling, there is a lot of opportunity for growth in responsible CRD waste management. My research shows that deconstruction, rather than demolition of buildings, is an important next step in waste diversion for Canadian municipalities and the waste generated from CRD presents an opportunity to recover a significant amount of resources. This research explores the barriers for deconstruction programs and policies for large, Canadian municipalities, how to overcome those barriers, and establishes a framework for moving forward in a municipal setting, working with the City of Edmonton for a real-world application. The results show that deconstruction has a small foothold in Canada and the US, but there are some leading-edge and developing examples. My framework builds on these and offers a path for actioning residential building deconstruction that can have a significant impact on reducing CRD waste going to landfills.



CRD Waste in Canada

In recent decades, municipalities across North America have begun the push for material solid waste reduction by encouraging individuals and households to reduce their production of waste (single-use items, source-separated waste collection, “zero-waste” movement, etc.). Although personal actions and change for reducing waste are important and do contribute to general environmental health and sustainability, moving to a circular economy can further reduce solid waste, stress on natural resources, reduce carbon emissions and contribute to a healthy future (Delphi, 2021; Nunes et al., 2019; Potting et al., 2017). Canada ranks among the top waste producers per capita in the world and it is estimated that on average 27% of municipal solid waste (MSW), or 4 million tonnes annually comes from the CRD sector, and 61% of that comes from the residential sector (Giroux, 2014; Government of Canada, 2020, 2021; Service & Kelleher, 2020; VanderPol, 2014; Yeheyis et al., 2013). In North America, studies have also shown that the construction sector is responsible for nearly 40% of raw material consumption (CCME, 2019). In Canada, 42% (1.67 million tonnes) and 47% (1.87 million tonnes) of all CRD waste in Canada is from renovations and demolitions, respectively, demonstrating the opportunity to recover significant value through the recovery of these natural resources, which changes the view from materials being waste to a resource bank (CCME, 2019).

Deconstruction

Deconstruction as a method of waste diversion has been gaining traction in North America, as well as Europe, over the past decade, and benefits municipal environmental and carbon footprints (Nunes et al., 2019). It is largely part of the circular economy movement, as it encourages resource recovery through the physical dismantling of buildings. The movement towards creating a circular economy and recognition of construction, renovation, and demolition (CRD) waste as a resource bank presents a unique opportunity to not only reduce CRD waste but also reduce stress on natural resources through reduced consumption and reduce climate change impacts (CCME, 2019; Nunes et al., 2019). Deconstruction is a process that allows waste diversion through reusing and recycling various natural resources that come from buildings, and as such it is different from separating and recycling demolition materials. Deconstruction materials primarily include wood (lumber, plywood, interior doors), steel products, and cement (Delphi, 2021; Nunes et al., 2019; Yeheyis et al., 2013). Deconstruction focuses on product reuse, repair, sharing, and donation. Although deconstruction has been well justified due to environmental benefits (CCME, 2019; Nunes et al., 2019), it is evident that barriers remain within municipalities for the implementation of codes, policies, and programs as per a lack of policy and program adoption. Some jurisdictions in North America have enacted by-laws that require deconstruction of specified residential buildings.

Research Purpose & Objectives

Since it is evident that deconstruction can aid in municipal, provincial, and federal waste reduction, while also helping to make strides towards climate change goals, the purpose of this research is to determine promising ways that Canadian municipalities can action waste diversion through deconstruction of the built environment and related resource recovery.

Objectives:

- To identify leading-edge examples of local governments that have taken action to implement programs for residential building deconstruction.
- To determine barriers to the implementation of municipal residential building deconstruction programs.
- To reveal the policies and programs that are essential for a municipality to consider when taking action to implement residential building deconstruction.
- To establish best policy approaches and practices for overcoming barriers to implement programs for residential building deconstruction.

Data Collection & Methods

The primary methods for data collection that I used included a document review, semi-structured interviews, a summary response sheet for interviewees, personal observation, and a focus group discussion.

Personal Observation

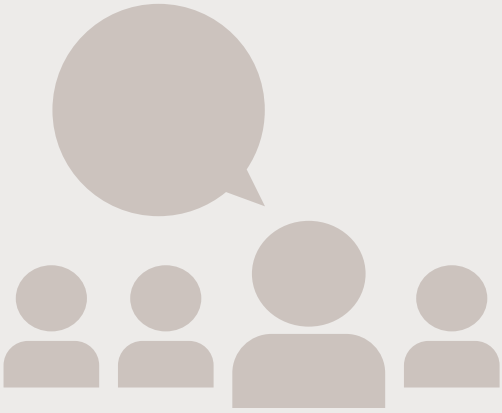
Thanks to the Mitacs Accelerate Internship grant that I received, I was able to do site visits in Seattle, Portland, Victoria, and Vancouver to observe deconstruction sites, go to deconstruction companies' warehouses to better understand the process, learn about barriers that they face, and see how they overcome these barriers firsthand. This presented a unique opportunity to observe and discuss potential challenges in the deconstruction process. I was also able to discuss the barriers experienced by those directly involved in the operations and business. Images from these visits are incorporated into the thesis as is the data from my discussions. These photos are shown throughout this document.

Interviews

24 Semi-structured interviews were conducted with the purpose of understanding how leaders in deconstruction have taken action to implement programs, including barriers to program development and how those barriers have been overcome. As well, this included determining what barriers those who are not yet in the deconstruction sector foresee facing. Subject experts were drawn following sectors:

- municipalities waste division,
- municipal governance,
- construction companies,
- deconstruction companies,
- consulting,
- engineering,
- regional governments,
- and some smaller waste-related companies.

As a follow-up to the interviewees, I analyzed the data and put together a summary sheet, which was sent to all participants to get their feedback on some of the key themes. This acted as a triangulation method to ensure the data I had received was reflected back well and to ensure there were no gaps that had to be filled.



Focus Group

My focus group included six staff of the City of Edmonton who were involved in waste management and CRD waste, climate change planning, and senior decision-makers, to discuss the implications of my findings for a municipality. This included discussing what future implementation of building deconstruction programs, policies, and initiatives may look like, what they view as realistic, and what may be problematic. As well, the focus group provided a unique opportunity to have many actors involved in deconstruction and the broader CRD industry, to discuss together the best steps forward, bringing in their own unique experiences and role within deconstruction.

Findings

My findings can be grouped into the following categories:

- Current initiatives
- Benefits
- Barriers
  - to deconstruction practice
  - to developing and implementing deconstruction policy
- Policies, programs, and initiatives
  - primary
  - complementary
- Framework for actioning deconstruction

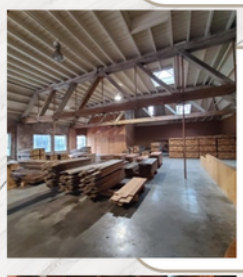
A summary of each can be found on the following pages.

Current Deconstruction Initiatives

International

Palo Alto, CA

- All residential and commercial full structure removals are required to be deconstructed
- A salvage survey and proof of salvage is required



San Antonio, TX

- Residential structures and accessory units built in 1945 or earlier and is an eight-plex or smaller, or 1960 and earlier for historic properties or conservation districts, must be deconstructed
- Required to use a certified deconstruction contractor

Portland, OR

- Pre-1940 single dwelling homes are required to be deconstructed
- Required to use a certified deconstruction contractor
- Pre-deconstruction form is required to be submitted

Pittsburgh, PA

- 2021 directive to deconstruct city-owned condemned buildings
- City piloted deconstruction on city-owned properties, exploring policy options

Canadian

Victoria

- Pre-1960 single- or double-family homes, being replaced by single-or double-family homes require3.7 kg per sq. ft. of above-ground floor space (phase 1)
- Required refundable salvage fee of $19,500

District of North Vancouver

- Pre-1950 homes, require 3.5 kg or 2.6 board ft per sq. ft. of finished floor space
- Refundable $15,000 waste diversion deposit required

Vancouver

- Heritage homes and all homes built pre-1910 require 90% recycle and reuse with 3 metric tonnes of wood salvaged
- Character homes built pre-1950 require, by weight, 90% recycle and reuse
- Homes built pre-1950 and non-character require, by weight, 75% recycle and reuse

Benefits of and Barriers to Deconstruction

Environmental

- Reduces waste entering landfills and methane emissions from landfills
- Retains embodied carbon in the materials and reduces emboded carbon emissions associated with new materials
- Conserves natural resources required to make new materials
- Reduces emissions in the construction sector

Social

- Improves public health and safety by reducing exposure to toxic pollutants (asbestos, lead paint, toxic dust) and leaching from traditional demolition
- Provides jobs and opportunities in trades and workforce entry
- Preserves a sense of place and community in neighbourhoods
- Provides meaningful jobs

Economic

- Provides up to five times more green jobs than tradition demolition
- Strengthens supply of salvaged materials, which are often higher-quality, and reduces cost of new materials
- Tax incentives for deconstruction materials
- Lowers costs of maintining landfills
- Contributes to the local materials economy

Historical & Cultural

- Honours the history of materials and those who built the structures
- Preserves historic architectural styles
- Develops trade skills that may be lost generationally
- Improves future building design, material design, and construction practices
- Fosters circular economy culture and resourcefulness, not a 'take-make-waste' culture

Barriers to **deconstruction practice**

- **Storage/Space:** The materials need to be processed in order to re-enter the market and the space for the in-between stages for the materials is difficult to come by and can be very expensive.
- **Cost:** Deconstruction does cost more than traditional demolition. With Canadian provincial and federal tax credits it is only more costly upfront, but with the tax credits offered in Canada annually, it is cheaper when considering the tax rebates.
- **Capacity:** Building a workforce and the proper education to support that. Specifically for how to deconstruct properly, the benefits, the challenges, and how to handle the material are all important challenges.
- **Age of home:** The age of homes play a role in how easy a structure is to deconstruct and the quantity of materials that can be salvaged due to newer technology, such as adhesives, in newer homes.

Barriers to developing and implementing **deconstruction policy**

- **Markets:** There needs to be a market for the materials. Without the market there is nowhere for the materials to go and will defeat the point of having any program or policy in place. These materials need to be recognized for the value they hold in the market.
- **Enforcement/accountability:** Without proper and effective enforcement of salvage requirements, it will be difficult to implement a successful program or policy.
- **Building codes**: Building codes need to be reassessed by all levels of government to better allow for salvaged materials (primarily lumber) to enter the new building stock and eliminate barriers for builders wanting to use salvaged materials.

Primary Deconstruction Policies

The following table provides a summary of a salvage requirement and deconstruction requirement including additional requirements for each that are often included. Some municipalities may use one or the other, or a blend of both. For example, Palo Alto requires both deconstruction and salvage, Portland only requires deconstruction, and Victoria only requires salvage. All of these include various additional requirements to support their choice of salvage and/or deconstruction requirement. The important considerations are whether or not the blend of requirements will be sufficient.

Salvage Requirement	Deconstruction Requirement
•Set in policy for homes of a certain age and zone to achieve a defined salvage requirement (not recycle) by weight per sq. ft. (many are lumber specific). May include some of the following requirements: •Refundable salvage fee •Proof of salvage	•Set in policy for homes of a certain age and zone to be deconstructed. May include some of the following requirements: •Refundable salvage fee •Require the use of certified deconstruction contractors if there is not a salvage requirement by weight. •Proof of salvage

Complementary Deconstruction Programs, Policies, and Initiatives

Complementary policies are just as important as the primary policy to actioning building deconstruction as they help with ensuring a return on investment, avoid unintended consequences that are often the result of industry finding loopholes in the system, and for municipalities to see the full benefits (Northwest Economic Research Center, 2016). The following table provides a summary.

Time and Financial Incentives	•Permitting •Subsidies & Grants
Time and Financial Disincentives	•Removal of Toxic Materials •True Cost Landfilling
Education	•Public Education Programs •Workforce Training
Other	•DfD/A •Building Codes •Salvage Assessments/Material Management Plans

A framework for actioning residential building deconstruction for larger Canadian municipalities

As a result of this work, I developed a framework for actioning residential deconstruction. Municipalities must pay close attention to the local context to implement the frame. The purpose is to guide a municipality through considering the essential aspects of a deconstruction bylaw or program in their local context.

Initiate Deconstruction Conversations

1. Assess the state of CRD waste management at all levels of government.
    a. Does deconstruction align with federal or provincial targets? Are there any other jurisdictions to call on for support? Are there any requirements for CRD materials?
2. Assess municipal strategies.
    a. Is there a current strategy that deconstruction aligns with or does a new strategy need to be developed?
3. Assess municipal targets and determine political lens that will be used to situate and action building deconstruction.
4. Establish which municipal department will lead and what other departments are needed for collaboration.
    a. This may require multiple teams and will require communication between multiple teams.
5. Assess municipal feasibility.
    a. Do you have the capacity and willingness to commit to long-term maintenance of a new strategy and/or by-law?
    b. Get support from council members with background information collected to continue investigating and allocating resources to the work.

Build the Foundation

1. Identify goals and targets for municipal deconstruction.
    a. Residential, commercial, or both?
    b. Brainstorm best policies and programs to help achieve goals and targets.
2. Gather supporting data:
    a. Conduct or outsource a full market assessment to determine where the current salvage, reuse, and recycling market is and what needs further development.
    b. Develop community engagement plan.
3. Establish networks and partnerships with local industry.
    a. Include discussion with builders, demolition and deconstruction contractors, local reuse businesses, waste haulers, architects, engineers etc.

Evaluate all Options

1. Assemble a working group with networks, including industry leaders and stakeholders in the municipality.
    a. This working group should work to develop the policies and programs as a group.
2. Define potential programs and policies.
3. Evaluate policies and programs identified and determine the best approach forward for your municipality.
    a. This will likely include a combination of policies and programs listed below.
    b. It is recommended to ensure this addresses the reuse market, workforce, and a salvage requirement at a minimum. These three elements are considered best practices for successful deconstruction programs.

Framework continued

Develop the Policies and Programs

1. Prepare plan with working group and define the parameters of the policies and programs for deconstruction and CRD waste diversion.
    a. Develop an appropriate enforcement plan.
    b. Ensure there are programs/policies that support the primary policy by filling in any market gaps, workforce requirements, research gaps, etc.
    c. Use a phased approach.
2. Conduct public consultation on the plan.
3. Prepare final plan and present to council for adoption with working group.

Implement the Policies and Programs

1. Implement supporting policies first. This may include:
    a. Educational programs (certifying contractors, workshops, training programs, etc.), market incentives, true landfill costs, toxic materials initiatives, etc. These will help ensure the success of the primary policy.
2. Implement primary policy using a phased approach.
    a. For example:
        - Year 1: single- and double-family homes built prior to 1950 being replaced by single- or double-family homes, with grants.
        - Year 2: single- and double-family homes built prior to 1950 being replaced by any structure.
        - Year 3: all homes built prior to 1960.
        - Year 4: all homes built prior to 1970.
        - Year 5: consider adding commercial buildings.
    b. The phased approach will heavily depend on your municipalities building stock and reuse market.

Improve on the Policies and Programs

1. Continually call upon regional, provincial, and federal government for support with CRD waste reduction: regional waste policy, building codes, DfD/A, grant programs, etc.
2. Conduct annual reports.
    a. Analyze statistics (e.g., housing stock applicable to the policies, type and quantity of materials salvaged, enforcement effectiveness) to determine gaps that may not have been identified.
3. Use annual reports to assess deconstruction policy and program effectiveness yearly. Some areas to consider include:
    a. Is the municipality ready for the next phase? If not, why? If yes, implement it.
    b. Is proper enforcement happening? If not, why? How can this be fixed?
    c. Identify areas where there is room for growth. Are there other deconstruction-related policies or programs that should be considered?
    d. This may require you to reconvene the working group and amend the by-law.

Conclusion

We live in an extremely complex and ever-changing world where we find ourselves in both a waste and climate crisis. When considering the waste crisis that we are in, deconstruction can play a role in diverting waste and contributing to a more circular economy. With only 16% percent of CRD waste in Canada being recycled and the remainder primarily going to landfill, there is a lot of work to do (Chen et al., 2022; Environment and Climate Change Canada, 2014). In conclusion, with the data collected through my research and as many participants voiced, it is possible to move from traditional demolition to systematic disassembly in order to salvage valuable resources. Deconstruction can help reduce embodied carbon emissions, prevent materials from being landfilled, reduce the quantity of natural resources that are required to be extracted to accommodate the growing population worldwide, and much more, through the reuse of salvaged materials. However, it is important to recognize that many policies must play together to result in the change that we need to see. Other policies such as home relocation and building preservation need to be considered and incorporated into policy as well. Deconstruction is one of many actions that must be considered as we move forward and move to a circular economy.

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