

‘There is no such place as away’: Residential deconstruction as a method for waste diversion in Canada’s built environment

By

Alexandra Velsink

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Clayton H. Riddell Faculty of Environment, Earth, and Geography

The University of Manitoba

Winnipeg, Manitoba R3T 2M6

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Abstract

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.

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Table of Contents

List of Figures	vii
List of Tables	viii
Abbreviations	ix
Chapter One: Introduction	10
1.1 Background	10
1.2 Research Purpose and Objectives	13
1.3 Research Design and Methods	14
1.4 Organization of Thesis	15
Chapter Two: Waste Management Today	16
2.1 <i>What is waste?</i>	16
2.1.1 Solid Waste and Sustainable Development	17
2.1.2 Moving to a Circular Economy.....	18
2.2 <i>Waste Management and Governance</i>	21
2.2.1 Governance as a tool for Sustainable Development and Waste Management.....	21
2.2.2 Policy Implementation and Complexities in the Waste Sector.....	23
2.2.3 Waste Policy Implementation in Alberta.....	27
2.3 <i>Deconstruction and Demolition Today</i>	28
2.3.1 The CRD Industry Today and the Importance of Resource Recovery	28
2.3.2 The Life Cycle of a Building	30
2.4 <i>Leading-Edge Deconstruction Initiatives</i>	32
2.4.1 International Deconstruction Initiatives.....	34
2.4.2 Canadian Deconstruction Initiatives	41
2.5 <i>Chapter Summary</i>	48
Chapter Three: Research Design and Methods	49
3.1 <i>Worldview</i>	49
3.2 <i>Qualitative Approach</i>	49

3.2.1 Case Example: Edmonton	51
3.3 <i>Data Collection Methods</i>	52
3.3.1 Document Review	52
3.3.2 Semi-structured Interviews	53
3.3.3 Personal Observation	55
3.3.4 Focus Group.....	55
3.3.5 COVID-19.....	56
3.4 <i>Data Analysis</i>	57
3.5 <i>Data Validation</i>	57
3.6 <i>Ethics</i>	58
Chapter Four: Benefits and Barriers to Deconstruction.....	59
4.1 <i>The Benefits of Deconstruction</i>	59
4.1.1 Environment.....	60
4.1.2 Social.....	65
4.1.3 Economic	68
4.1.4 Historical & Cultural Preservation.....	70
4.2 <i>The Barriers to Deconstruction</i>	71
4.2.1 Barriers to Deconstruction Practice	71
4.2.2 Barriers to Developing and Implementing Deconstruction Policy	82
4.3 <i>Chapter Summary</i>	87
Chapter Five: Policies, Programs, and Initiatives for Moving Forward	88
5.1 <i>Broad Policy Considerations for Deconstruction</i>	89
5.1.1 Primary Demolition Driver	92
5.1.2 Political Climate.....	93
5.1.3 Local Government Structure	95
5.1.4 The Role of Other Levels of Government	96
5.2 <i>Deconstruction Programs, Policies, and Initiatives for Actioning Deconstruction</i>	99
5.2.1 Deconstruction Primary Policies Overview	100

5.2.2 Complementary Policies and Programs	108
5.5 Chapter Summary	124
Chapter Six: Moving forward with Deconstruction in Canada	126
6.1 Recommendations from participants that underpinned framework development	126
6.1.1 Policy Recommendations.....	126
6.1.2 How to make it happen	129
6.2 A Framework for Actioning Deconstruction.....	132
6.3 A Case Example of Applying the Framework: The City of Edmonton	137
6.3.1 Focus Group Participant Reactions to the Framework	143
6.4 Chapter Summary	147
Chapter Seven: Conclusions and Reflections	149
7.1 Conclusions.....	149
7.1.1 Leading Edge Examples of Actioning Building Deconstruction.....	149
7.1.2 Barriers for Policy and Program Implementation for Actioning Building Deconstruction	151
7.1.3 Best Policy and Programs for Overcoming Barriers and Actioning Building Deconstruction	153
7.2 Concluding Comments	155
References	156
Appendix I: Interview Schedule for Semi-Structured Interviews.....	171
Appendix II: Focus Group Schedule.....	173
Appendix III: Focus Group Backgrounder Sheet.....	176
Appendix IV: Definitions	180

List of Figures

- Page 21 Figure 2: The linear economy, from natural resources to waste disposal (RPS, 2021)
- Page 22 Figure 3: A diagram of a simplified circular economy concept.
- Page 27 Figure 1: The governance structure for waste and recycling in Alberta (Government of Alberta, 2021).
- Page 31 Figure 5: The Building Material Management System network demonstrating the complexities of building waste materials (Minnesota Pollution Control Agency, 2022).
- Page 84 Figure 6: Percent and tonnage of CRD Waste Materials per material (Environment and Climate Change Canada, 2014).
- Page 89 Figure 7: The three layers of policy development for actioning deconstruction.
- Page 134 Figure 8: A high-level overview of the framework for actioning residential building deconstruction for larger Canadian municipalities
- Page 135-136 Figure 9: A framework for actioning residential building deconstruction for larger Canadian municipalities.
- Page 141 Figure 10: One city block in Edmonton with the house that was issued a demolition permit circled in red. This block is located in an older neighborhood, where a lot of demolitions are being issued to allow room for infills.

List of Tables

- Page 33 Table 1: A summary of current deconstruction initiatives in North America
- Page 34 Table 2: A summary of current, leading-edge deconstruction initiatives in the United States with highest regulations at the top and lowest at the bottom. Photos taken by myself while visiting sites with a Mitacs grant and are not all from the same city described. Photo 1: Sledge Warehouse, Seattle; Photo 2: Store front for GoodWood Deconstruction in Portland; Photo 3&4: Single-family home deconstruction in Portland.
- Page 42 Table 3 A summary of current, leading-edge deconstruction initiatives in Canada with highest regulations at the top and lowest at the bottom. Photos taken by myself while visiting sites with a Mitacs grant. Photo 1: Brentwood Bay Church, Vancouver Island; Photo 2: Lumber from a single-family home in Vancouver; Photo 3: 4 days from project completion for a single-family home in Vancouver.
- Page 60 Table 4: The environmental, social, economic, historical and cultural benefits of residential deconstruction.
- Page 72 Table 5: A summary of barriers to residential building deconstruction and policy for actioning residential deconstruction of the built environment.
- Page 101 Table 6: A summary of the two primary deconstruction policies for actioning residential deconstruction of the built environment with three primary components of the policies that are typically included in the requirement.
- Page 109 Table 7: A summary of complementary policies and programs for actioning residential deconstruction of the built environment.
- Page 133 Table 8: Main steps in actioning residential deconstruction for larger Canadian Municipalities.

Abbreviations

BIM: building information modelling

CRD: construction, renovation, and demolition

CSA: Canadian Standards Association

C&D: construction and demolition

DfD/A: design for disassembly and adaptability

DLC: demolition, land-clearing, and construction

HHW: household hazardous waste

MRF: materials recovery facility

MSW: municipal solid waste

NIMBY: not in my backyard

SSO: source separated organics

WtE: waste to energy

3R's: reduce, reuse, recycle

Chapter One: Introduction

1.1 Background

Waste is an integral part of society that is complex, continuously evolving, and inevitable yet holds a displeasure unlike many other things. It holds personal connections to an individual or group of individuals and shines light into the very nature of being. It is so displeasing that the average human, although so closely connected to it, has no comprehension of its journey, and simply put, wants it gone – ‘out of sight, out of mind’. Waste also holds variable definitions and understandings, making it complex to understand. This understanding is influenced by politics, government, industry, consumption, the value of scarcity as well as relating closely to health, gender, and so much more (Hird, 2021). In the context of the work here, I focus attention on material solid waste, which can be loosely defined as a material object that is no longer wanted by an individual and/or serves no purpose for them yet can hold a deep connection to the person (Hird, 2021).

In recent decades, municipalities across North America have begun the push for solid waste reduction by encouraging individuals and households to reduce their production of waste. Canada ranks among the top waste producers per capita in the world (Government of Canada, 2020a; OECD, 2021), with a particularly bad record beginning in 2015, when shipping containers arrived in the Philippines leaking ‘garbage juice’ (Hird, 2021). The containers were said to have recyclable content, but rather had municipal solid waste (MSW), containing items from adult diapers to household garbage (Hird, 2021). This was a jumping off point for Canada gaining a tarnished reputation for solid waste management and the realization of the need for serious conversations and actions around waste reduction.

The waste reduction movement and “zero-waste” conversations have become the dominant conversation in the solid waste management industry (Delphi, 2021; Veleva et al., 2017). 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).

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, as it is “the systematic dismantling of a structure and building components, specifically for reuse, recycling, and responsible waste management” (LightHouse, 2021). 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, reduced climate change impacts and land consumption for disposal of waste (CCME, 2019; Nunes et al., 2019).

In Canada, the CRD sector, also known as construction and demolition (C&D), contributes a significant amount to the solid waste stream and has largely avoided reuse and recycling efforts in North America, other than select municipalities (Ontario Waste Management Association, 2015; VanderPol, 2014). For example, a report released by Ontario Waste Management Association in 2015 showed that Ontario’s ICI and CRD sectors had a diversion rate of 11% while residential waste had a diversion rate of 47.7% (Ontario Waste Management Association, 2015; Resource Productivity and Recovery Authority, 2017). Within the CRD

sector, the average composition of the residual MSW generated by the sector is 40% wood, 34% other building materials, and 3% metals, although this varies across province and municipality (Government of Canada, 2020a; VanderPol, 2014; Yeheyis et al., 2013). Building materials can consist of, but is not limited to, wood and non-wood materials such as shingles, plaster/drywall, flooring, and bricks (Government of Canada, 2020a).

In North America, studies have shown that the construction sector is responsible for nearly 40% of raw material consumption (CCME, 2019). As mentioned above, the CRD sector also contributes a significant portion to Canada's total MSW, 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). Studies have also shown that nearly 95% of CRD waste has the potential to be recycled or reused, further justifying deconstruction (CCME, 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 implementation of codes, policies, and programs as per a lack of policy and program adoption.

Some jurisdictions in North America have enacted bylaws that require deconstruction of specified residential buildings. The jurisdictions that have taken action on deconstruction include Vancouver, Victoria, District of North Vancouver, Portland, San Antonio, Palo Alto, and

Pittsburgh (City of Vancouver, 2021; Portland, 2021b; Seattle, 2019). This does not include jurisdictions that have loosely set in place targets to separate and recycle demolition waste. The bylaws that have been adopted in these jurisdictions include different deconstruction requirements for different age homes, most often focusing on 1950 and earlier (City of Vancouver, 2021; Portland, 2021a; Seattle, 2019). The City of Vancouver was the first Canadian municipality to implement such bylaws, requiring pre-1950 homes to have 75% of the total mass reused or recycled, and 90% for homes that are also marked as character homes. This also now includes a requirement to deconstruct for character homes. The City of Victoria and District of North Vancouver have since implemented bylaws that require wood salvage for single-family homes (The Corporation of the District of North Vancouver, 2023; Victoria, 2021). These bylaws will be explored further in chapter 2. These homes are typically made of old-growth lumber, which is most often sold as finishing wood due to its high demand and high market value, demonstrating the environmental importance of recovering the buildings materials (Corneil, 2020). There is also effort put into reusing the lumber structurally and refinishing it to make new flooring and similar products.

Although there are other areas for CRD waste diversion that warrant attention, such as home relocation, the environment benefits that deconstruction provides, as listed above, the evolving interest in and complexity of the emerging policy and program responses to CRD waste, as well as my own personal interests, I focused my research specifically on deconstruction.

1.2 Research Purpose and 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 was to determine promising ways that Canadian municipalities can action waste

diversion through residential deconstruction of the built environment and related resource recovery.

Objectives:

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

1.3 Research Design and Methods

I first conducted a broad literature review on municipal deconstruction activities globally. The scope began large, recognizing that this is a new conversation. This continued throughout the thesis as more municipalities have begun discussing deconstruction and implementing bylaws/ordinances. Due to deconstruction bylaws entering conversations more recently, a global scale was used to ensure all possible examples of these are included and considered.

Data was then collected through a document review that included municipal, non-profit, and government reports, bylaws, programs, and policies.

I then carried out semi-structured interviews with subject experts, which include, but is not limited to, local governments that have acted on deconstruction, construction companies, deconstruction companies, active members in the market for deconstructed wood, and other related industries. This helped in determining how action has been taken in various industries, as well as determining barriers and how they can or have been overcome.

With the data from the document analysis and semi-structured interviews, I developed a conceptual frame for the implementation of a municipal, residential deconstruction policy. I then looked at how this frame could be implemented in the context of the City of Edmonton in a workshop/focus group with subject experts and players in Edmonton to get feedback on frame itself and determine any major gaps. The detailed methods are provided in Chapter 3.

1.4 Organization of Thesis

The thesis is organized into seven chapters. Following the introductory chapter, chapter two synthesizes background information through a literature and document review. This chapter also contains information gathered via a document review on current policies, programs, and initiatives within the deconstruction sector across the world, with more detailed emphasis given to data collected on the Canadian and American context. Chapter three details the research design and methods. Chapter four addresses barriers in place for deconstruction at a municipal level. Chapter five takes a deep dive into what policies, programs, and initiatives are essential for acting on the implementation of building deconstruction at a municipal level, with a smaller section regarding potential requirements or aids that can be implemented at a provincial or federal level. A framework for actioning deconstruction at the municipal level is presented in chapter 6, alongside a look into the case study with the City of Edmonton. The final chapter provides the conclusions of and reflections on the research.

Chapter Two: Waste Management Today

2.1 What is waste?

The first, and notably important consideration is, what is waste? Waste is complex; it is influenced by politics, consumption, and the value of scarcity, by government and governance, industry, and more (Hird, 2021). Ultimately, anything can become waste and what may be viewed as waste can be different for everyone (Hird, 2021). As is often said, ‘what waste is to one person, may not be to another’, in both the material and symbolic sense. In our consumer-driven and disposable society, waste is often considered an item that no longer holds a monetary value, or a resource that is no longer viewed in its current state as profitable, valuable, or functional (Hird, 2021). We could even argue that to be waste, there must be a tangible connection, in order to forget when we dispose of items there has to be something to be forgotten (Hird, 2021). The process of forgetting in our developed society is what makes waste so problematic (Hird, 2021). Governments have made it easy to forget: all one must do is go through the daily actions of collecting the waste and placing it on the curb for collection, and all for a small fee.

This is where opportunity presents itself for municipal solid waste (MSW) of which construction, renovation, and demolition (CRD) waste is a component. There is opportunity for governments to make people think critically about their waste, whether that be through costs, increased separation, fines for improper waste disposal, educational campaigns, and more. But to forget something we must know it first – like our own waste we put on the curb. This is where society sees an even further separation from the concept of waste in the CRD sector. For the average citizen, they are not aware, they do not know, and they cannot comprehend the complexity and scale of CRD waste. For personal renovations or demolitions, homeowners will hire a contractor, get a quote, pay the money, and never see the waste again. There is no

inconvenience, other than maybe a waste bin on their property, and no interaction with the waste. Only a small portion of the population knows the waste coming from the CRD sector and can comprehend what CRD waste is. This demonstrates the disconnect in society to waste and the copious amounts of waste being produced daily, thus a growing concern and increased efforts placed on waste reduction and diversion.

2.1.1 Solid Waste and Sustainable Development

As society has become increasingly wasteful and our actions have become increasingly harmful to the environment, we have begun questioning our actions and how we can move forward in a more conscious way – a more sustainable way. Sustainable development is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Visser & Brundtland, 2013, p. 37). More recently, the United Nations released 17 Sustainable Development Goals, which are aimed at “peace and prosperity for people and the planet, now and into the future” (United Nations, 2021d). Of these 17 goals, goal 11 and 12 are closely related to waste reduction and the impacts waste has on people and the environment. Goal 11, to “Make cities and human settlements inclusive, safe, resilient and sustainable” (United Nations, 2021a) discusses the importance of sustainable urban development as the global population increasingly moves to urban centres (United Nations, 2021a). Goal 12, to “ensure sustainable consumption and production patterns” discusses the importance of sustainable consumption and production alongside the unsustainable use of natural resources, and waste, including solid waste management (United Nations, 2021c, 2021b).

Waste is an important consideration in sustainable development due to the large impacts it has on environmental health from resource extraction to waste management and disposal, further demonstrated through the United Nations including it in the 17 Sustainable Development Goals. In 2002, this was further supported at the World Summit on Sustainable Development and

special attention was requested for the management of solid waste (United Nations, 2021b). Waste is part of society and inevitable, but it is important to recognize that there are better and worse ways to manage waste and society must work towards producing less waste. Member states agreed that attention must be given to waste reduction and better management to reduce further impacts on the earth and people (United Nations, 2021b).

One important consideration with waste is the resource extraction required to create each product from the cradle (United Nations, 2021c; Visser & Brundtland, 2013). Ultimately, as society discards more, more resources will need to be extracted to create the same, or similar, products for future generations. Reduced disposal of waste and increased salvage through rethinking, reusing, and recycling will lower the demand on natural resource extraction for the creation of new products, in turn supporting the movement to the circular economy (Visser & Brundtland, 2013). Further extraction of natural resources requires an increase in energy and has a larger impact as those resources become more scarce. Another important factor when considering the needs of the future are the industries and operations that impact our waste (Visser & Brundtland, 2013). As discussed, individual waste reduction is important, but the systems in place and the industries involved in the larger systems must be at the forefront of action. Waste reduction should be encouraged across all industries as it ultimately increases efficiency and decreases demand on natural resources and/or increases demand on renewable rather than non-renewable resources (Visser & Brundtland, 2013).

2.1.2 Moving to a Circular Economy

The main tenets of sustainable development supports the movement from a linear to a circular economy. The linear industrial economy, also known as take-make-waste, is represented in figure two below, where natural resources are viewed as limitless and earth has boundless regenerative capability (Circle Economy, 2023; RPS, 2021). This is becoming increasingly

problematic as we deplete the world of natural resources and run out of room to store our waste (e.g., landfills).

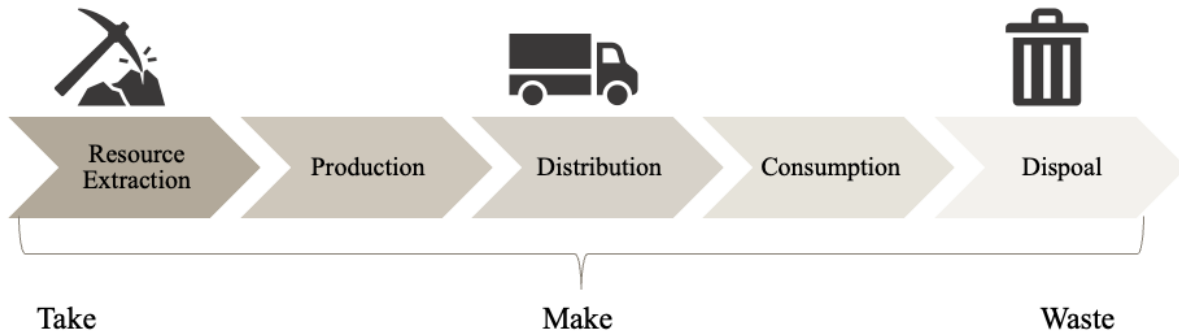


Figure 2: The linear economy, from natural resources to waste disposal (RPS, 2021)

More recently, as a result of many factors, such as the development of the Sustainable Development Goals, there is a push to move towards a circular economy and a recognition that this needs to happen in order to sustain human life. The idea of a circular economy is built on the premise that end-of-life items or goods are put into resources for new goods, closing the waste loop: what can be reused, repaired, or recycled should be, and what cannot, should be remanufactured (Stahel, 2016). In relation to the built environment, the circular economy can be defined as an economy that,

Aims to keep materials, components, products and assets at their highest utility and value at all times. In contrast to the ‘take, make, use, dispose’ linear model of production and consumption, material goods are designed and produced to be more durable, and to be repaired, refurbished, disassembled and reused in perpetuity - thereby minimising resource use, eliminating waste and reducing pollution (Delphi, 2021).

Although the movement from a linear economy to a circular economy has predominantly emerged within the past decade, the concept can be seen on small scales dating back to the 1990’s and is seen directly in the natural world (Stahel, 2016).

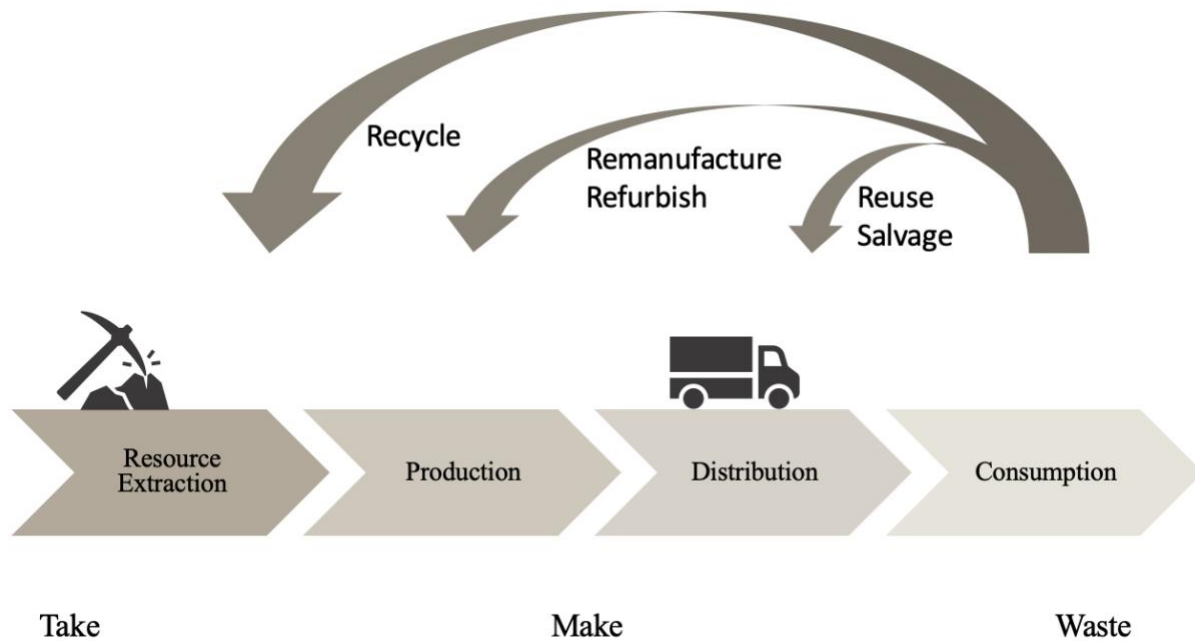


Figure 3: A diagram of a simplified circular economy concept.

This shift to a closed-loop system is important for the future of waste and makes both economic and environmental sense (Ellen MacArthur Foundation, 2013). The rate at which society creates waste will increase with a linear economy as populations increase and if we continue on this trajectory, resource extraction will increase, landfills will pile higher, and valuable resources will be lost. A circular economy will not only help with reducing greenhouse gas emissions by as much as 70%, studies have shown that it will also contribute to job creation as our population increases - it is estimated that deconstruction could provide up to five times more jobs than demolition (Circle Economy, 2023; Delphi, 2021; Stahel, 2016). However, the idea of a circular economy goes against fundamental organizational behaviours and structures, as well as scarcity values, making the societal shift in more affluent countries difficult due to the pushback against change (Circle Economy, 2023; Stahel, 2016). For example, it poses questions to the traditional

understanding of GDP, where capital flow is measured over time, but with a circular economy capital is preserved (Stahel, 2016). As well, scarcity drives consumer behaviours by creating the false understanding that there are limited resources available, and in our take-make-waste society, valuable resources are being lost. In the consumer/capital driven society this is ideal as it benefits producers by increasing consumption. The circular economy model overcomes scarcity by demonstrating that there are plenty of resources and that we are simply mismanaging them – this is waste (Stahel, 2016).

Deconstruction is one of many methods that target closing the loop and encourages a circular economy within the CRD industry through more responsible ways to handle and use the materials. By physically deconstructing the built environment, much of the materials can be salvaged, reused, and repurposed. This reduces waste production, decreases stress on natural resources, provides jobs, and promotes a more sustainable future.

2.2 Waste Management and Governance

As is examined in the previous sections, waste management is a complex field that is always changing and varies at different levels of government. It involves many actors and requires action and input at all levels of government, as well as the public. The following sections discuss how governance and policy play a crucial role in sustainable development and more specifically, waste management. It also dives into how complex the regulatory environment is with solid waste and how important it is to consider the impact and role that all levels of government have.

2.2.1 Governance as a tool for Sustainable Development and Waste Management

Not only should the operational component of industry, through the shift to a circular economy, be making necessary changes to reduce consumption and the waste generated from their products, industry and government must integrate needed new practices into governance,

decision-making, and the regulatory systems (Visser & Brundtland, 2013). In the waste context, many encourage that regulatory changes occur at a national level, holding local governments to minimum standards (Visser & Brundtland, 2013). Although federal and provincial governments can set standards to be met for waste management, municipalities are responsible for implementation of programs and management of waste, which also arguably differs for certain processes related to waste management.

However, it is not uncommon for municipalities and provinces to exceed national standards, driving a national approach. The National Packaging Protocol (NaPP) is an example of a national guideline from the 1990's that was designed for provinces and much of the action required in the guideline needed the provincial and municipal levels to implement regulations and bylaws (CCME, 2000). Many of the standards and policies from the NaPP remain incomplete due to budgetary constraints nationally and provincially, provincial unwillingness to adopt true stewardship, among other issues. However, provinces and municipalities have exceeded what was recommended in the guideline by implementing their own programs, policies, and standards apart from the NaPP through programs such as recycling (CCME, 2000). Thus, it is evident that local action can drive initiatives set by higher levels of government.

Deconstruction is another example. Currently, programs and bylaws aimed at deconstruction in Canada have been implemented at the municipal level, with municipalities reporting to provincial governments through necessary approval processes. At this time, there are no federal standards for deconstruction, so implementation of programs has no accountability to higher levels of government, although any facility receiving deconstruction waste would have to meet approval standards of the province or territory that they are operating in. This research will focus on the implementation of policies at a municipal level.

Moving forward with the introduction of standards and regulations for deconstruction, Visser & Brundtland (2013) indicate that provincial and territorial governments should be encouraged to allow for flexibility in implementation, not limiting local governments to particular processes due to varying capacity to implement the regulations and enforce them (Visser & Brundtland, 2013). Any provincial or territorial regulations must also consider the economic drivers of industry. Uniformity across industry is critical to ensure equality and to encourage positive uptake, compliance, and success (Visser & Brundtland, 2013). Visser & Brundtland (2013) also suggest that governments should consider incentives as a tool for reducing waste and resource extraction in the deconstruction context. They note that economic incentives and disincentives can push industry to consume and produce less waste and increase efficiency (Visser & Brundtland, 2013).

With the current ad-hoc state of actioning sustainability in terms of deconstruction in Canada, a national call to action may be necessary and possible, but a local application is more realistic in the short-term and can still have a large impact. A national approach could be very important though for promoting the scaling up and strengthening of local markets for success (CCME, 2019).

2.2.2 Policy Implementation and Complexities in the Waste Sector

Policy implementation in the waste sector can play a large role in the shift from a linear to a circular economy (see Figure 2 in section 2.1.2 for the circular economy). However, it is very complex due to the number of players, as outlined above, and notions of shared responsibility, including with the general public that disposes of things they no longer require. For example, waste policies that have been implemented in many jurisdictions across Canada, such as source separated organics (SSO), play a large role in the shift to a circular economy. As well, they impact homeowners, business owners, the construction and demolition industries,

waste haulers, waste sorters, waste management facilities, and municipal government. When considering all the actors, policies must be carefully planned, communication must be extensive, and education is critical for effective uptake and successful implementation.

In Canada, the waste management system is run and governed by a combination of municipal, provincial, and federal government involvement (Canada, 2021a). While federal and provincial governments may provide policy direction through regulations and standards for waste reduction and management (e.g., extended producer responsibility (EPR); development of waste management facilities), regional jurisdictions, First Nations, and municipalities are in charge of collection, management of, and disposal of waste and may implement standards, which must meet (but can exceed) the provincial/territorial government standards (Canada, 2021a). For example, for waste reduction of organics, single-use plastics, or e-waste; municipalities would be the ones enacting policies, programs, and bylaws at a local level while abiding to provincial standards. Regarding action on deconstruction, policies and programs may be implemented at the municipal and/or provincial/territorial levels of government, with the federal government likely to only provide recommendations for action (Canada, 2021a).

The federal government, namely the Canadian Council of Ministers of the Environment (CCME), has implemented standards or requirements for hazardous waste, but in other areas of waste management they have only recommend best practices (Canada, 2021a). In collaboration with other levels of government, the federal government will aid in waste management by providing funding for projects, operations and programs that help with waste reduction and will collaborate on future policy development (Canada, 2021a). For example, the Green Municipal Fund helps municipalities by equipping them with the money and the tools necessary to shift to a green future (FCM, 2021). As part of the Green Municipal Fund, municipalities are eligible for

grants up to \$500,000 for pilot projects related to waste reduction and diversion (FCM, 2021). As an example, a textile recycling pilot project in Markham, Ontario collected 1,360 tonnes of materials in 80 donation bins (now expanded to over 150), resulting in 28,000 tonnes of GHG avoided, along with high water and chemical diversion rates (FCM, 2021). This is one of many successful projects funded.

In respect to policy implementation of deconstruction, the Canadian Council of Ministers of the Environment released a guide outlining recommendations for the demolition and deconstruction industries (CCME, 2019). This guide focuses on selecting various policies, programs, and voluntary measures to reduce waste from the CRD industry, of which deconstruction is one option. There are no standards set in this guide, rather it serves simply as high-level set of recommendations for provinces/territories and municipalities to act on as they wish. It also does not dive into barriers associated with deconstruction, or specific policy approaches within deconstruction. As such, the complexity of policies and players involved in waste management and the CRD sector demonstrates that it may require all levels of government to address and factor into implementation.

Under the provincial regulations, municipalities enact policies, programs, and bylaws that, at a minimum, meet those regulations. It is important to note that municipalities work closely with and are creations of the provincial government (Stefaniuk, n.d.). This includes being governed by provinces in Canada although they are given the legal ability to act by passing policies and bylaws at the local level on specific areas of governance (Stefaniuk, n.d.). Provinces give municipalities responsibilities, such as managing and governing certain public services (The Canadian Encyclopedia, 2021). Various public services, such as waste management and public transportation, are best provided at a local level due to the understanding of the local climate,

including the social, political, and economic climate, yet this is still done alongside provincial regulation, standards, and codes of practice.

The municipal decision-making process for the implementation of strategies, policies, programs, and bylaws is also complex, highly variable, and includes many factors to consider and analyze. It is also a lengthy process. Larger municipalities across Canada often develop waste management strategies that encompass a longer period of time and can direct future policy development and program implementation. Generally, the process includes identifying a problem and organizing the issues, goals, and stakeholders, evaluating the problem, and building a model (Soltani et al., 2014). Following that, an action plan is developed which includes synthesizing all data collected, weighing the pros and cons, and balancing all perspectives and views on the topic (Soltani et al., 2014). The strategies include extensive public and stakeholder consultation which heavily influences the direction that the strategy will take. The strategy, when passed through multiple levels of municipal council, will include a financial provision, but getting to this stage can be lengthy. For example, the City of Edmonton released a 25-year Waste Strategy in 2019, which includes a new source separated organics (SSO) program for all homeowners (Edmonton, 2019). This strategy began with extensive research done by staff in the solid waste department, was developed into a proposal, and included the results of a multi-year pilot program for SSO demonstrating justification for city-wide implementation. The proposal was then brought to the utility committee of Council and eventually made its way to the full Council and was passed. Once the proposal was passed, city officials could then start the implementation of the SSO program which was recommended to start in summer of 2020 and end by summer 2022 – a two-year period (Edmonton, 2019). This demonstrates how extensive and lengthy the process is and how this process can be a barrier to broader implementation in

municipalities. Furthermore, when municipalities choose to exceed provincial or federal requirements, the process for proper and successful implementation can be lengthy, requiring dedicated resources (time and money) and effort that not all municipalities may be able to afford.

2.2.3 Waste Policy Implementation in Alberta

For the sake of this research, it is important to understand the waste policy implementation process within the province of Alberta. In Alberta, the Ministry of Environment, previously Alberta Environment and Parks, is in charge of policy direction and setting municipal goals and standards for waste management and recycling (Government of Alberta, 2021). Waste regulations, standards, and codes of practice are legally enabled by the Environmental Protection and Enhancement Act (Government of Alberta, 2021). There are many regulations within Environmental Protection and Enhancement Act related to waste management and reduction, although few that apply specifically to the CRD sector.

Along with regulations, there are select areas that Alberta Environment and Parks has completed extra research on and provided resources on waste reduction, of which the CRD sector is included (Government of Alberta, 2021). In 2006, the AEP released a report titled, “Construction, Renovation and Demolition Waste Materials: Opportunities for Waste Reduction and Diversion” (Government of Alberta, 2021). However, there have been no updated reports released on the CRD industry since 2006, nor are there any specific regulations or code of practices.



Figure 4: The governance structure for waste and recycling in Alberta (Government of Alberta, 2021).

2.3 Deconstruction and Demolition Today

Recognizing the complexities around waste management and governance of waste policy is crucial to understanding how complex policy around deconstruction and demolition, as well as how difficult changing current practices can be. This is important because deconstruction has the potential to have large, positive impacts on the environment and the Canadian economy.

However, the process from moving toward deconstruction, from demolition is not easy and there are barriers that municipalities have to overcome.

To understand the impacts, one example comes from a study conducted in Portland. This study analyzed a deconstruction bylaw pilot project, which demonstrated an overall net carbon benefit from deconstruction, revealing the potential to help the City of Portland reach its climate change and carbon dioxide reduction goals, as well as helping offset the associated costs of carbon dioxide emissions (Nunes et al., 2019).

The rest of this chapter applies the previously discussed complexities around waste management and governance to the CRD industry. It looks at where the CRD industry is today, the life cycle of a building and why CRD waste diversion and reduction is important, and the benefits of deconstruction. This is followed by a section presenting information gathered via a document review on current policies, programs, and initiatives within the deconstruction sector across the world, with emphasis given to data collected on the Canadian and American context.

2.3.1 The CRD Industry Today and the Importance of Resource Recovery

Improved waste management and waste reduction regulations began including the CRD sector post WWII in an effort to reduce the environmental impact of the waste sector (Yeheyis et al., 2013). This included incentives, increased taxes, penalties for not meeting regulations, recycling and reuse of products, and landfilling charges (Yeheyis et al., 2013). However, although regulations increased, it has not been enough. Much of the CRD waste that we still see

today comes from a lack of planning, lack of enforcement or ambition within regulations, poor design and material handling, improper procurement of materials, a lack of financial incentives, and a lack of contingency planning, to name a few (Yeheyis et al., 2013). There remains considerable room for development in the CRD sector for further waste reduction, ultimately benefiting the health of both the environment and future generations.

In Canada, it is estimated that on average 27% of MSW, or four million tonnes annually, comes from the CRD sector (Canada, 2021b; Service & Kelleher, 2020; Yeheyis et al., 2013). A report published by the CCME found that up to 95% of CRD waste can be salvaged, reused, or recycled, but currently only an insignificant portion is salvaged, reused, or recycled (2019). When considering strictly wood waste, one of the most valuable materials salvaged from deconstructed homes, approximately 1.3 million of the 4 million tonnes of CRD waste is wood waste (Canada, 2021b; Service & Kelleher, 2020). Within that, it is estimated that 50% is clean wood, 23% is engineered, 20% is painted, and 8% is treated (Service & Kelleher, 2020). This demonstrates the mass quantity of materials that could be salvaged from deconstructed buildings, which does not include other materials like steel, cement, and hardware as examples. As Ted Reiff, President of the ReUse People of America, stated in an interview, “frankly, I don’t know why people haven’t thought about reusing building materials. We reuse everything else from clothing, furniture, and automobiles,” further stating that one of the biggest problems we face is the construction, renovation, and demolition industry.

Materials often recovered from deconstructed homes include, but are not limited to, cement, wood products including lumber and plywood, concrete, steel, doors, and fixtures (Delphi, 2021; Yeheyis et al., 2013) When homes are demolished, most of the materials end up in the landfill with the level of material sorting and recovery varying across jurisdictions. Clean

wood products, in particular, hold high market value in deconstructed homes. The wood does not have to be further dried out and is more durable due to its low moisture content, unlike new wood, and many old homes were built with valuable old-growth lumber (Delphi, 2021; Service & Kelleher, 2020).

This becomes even more important when considering the percentage of the world's natural resources that go into construction activities. According to Yeheyis et. Al. (2013, p. 81), "construction activities consume 32% of the world's resources including 12% of water and up to 40% of energy. Approximately 40% of all raw materials extracted from the earth and 25% of virgin wood are used for construction." To demonstrate the need for action and increased regulation, if considering only wood waste, Canada annually recycles less than 22% of the 1.3 million tonnes, with the remainder likely being landfilled (Yeheyis et al., 2013). This further shows the exponential room for growth in waste diversion policies, programs, and regulations in the CRD industry.

2.3.2 The Life Cycle of a Building

When considering sustainable practices and waste reduction in the CRD sector, it is important to understand the average life cycle of the built environment in North America. With deconstruction practices, this process can become increasingly circular through prioritizing the implementation of deconstruction policies, programs, guidance, and regulations. Figure 4 below demonstrates the building material life cycle which demonstrates the circularity of deconstruction materials and how complex the system can be. It also emphasizes how much an increasingly circular system can contribute to workforce development, various policy development and implementation, and other human/socio-economic impacts (Minnesota Pollution Control Agency, 2022). However, municipalities must recognize the importance of considering effective policies at each point in the cycle.

Building Material Management System Map

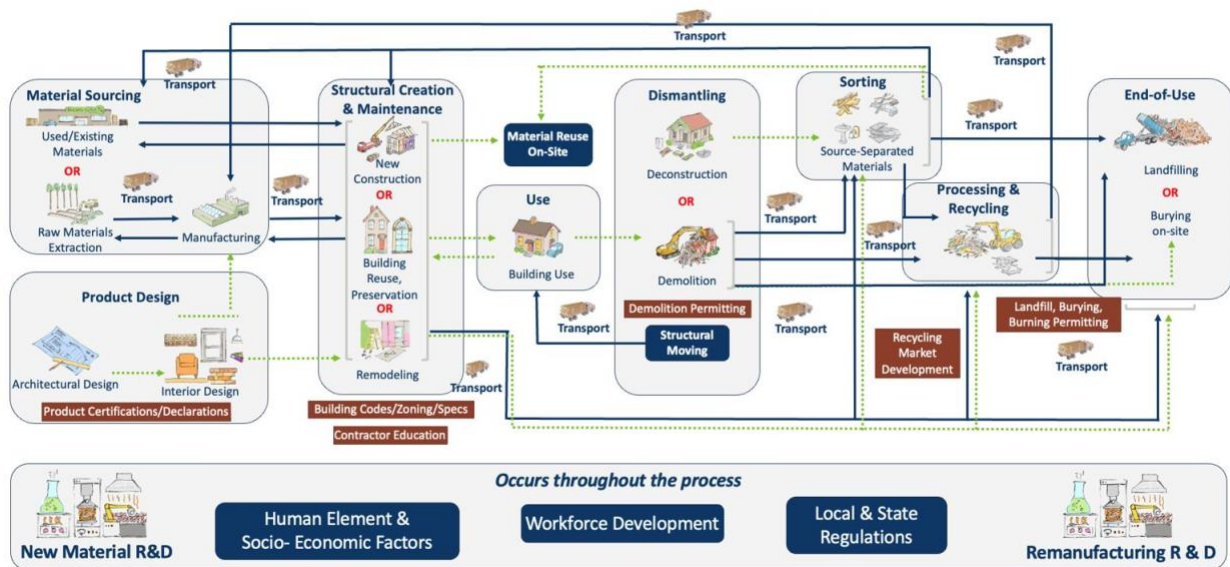


Figure 5: The Building Material Management System network demonstrating the complexities of building waste materials (Minnesota Pollution Control Agency, 2022).

Waste diversion goals have a large impact on waste reduction, as is explored further in chapter 4, and these can be established by all levels of government. It is important to consider how to include programs and policies that are oriented to all stages of the building life cycle. One area that can have large impacts is at the beginning of the life cycle through building development and design. This is also known as designing for disassembly and adaptability (DfD/A), where buildings are designed with end-of-life in mind (CCME, 2019). This allows for easy and effective disassembly and renovation within the life cycle of a building, resulting in greater resource recovery and increased waste reduction. One barrier for jurisdictions regarding implementing standards in building codes, is the level of authority they hold to implement such actions, and this will vary across different jurisdictions. It is important for jurisdictions to have the ability to require reporting and performance standards, but without the ability to implement

performance standards there must be incentives put in place to increase compliance of stakeholders (CCME, 2019).

Through the past decades there has also been a shift to designing indestructible buildings to make them as safe as possible (Coast Waste Management Association, 2021). Although safety must be prioritized, this has come at the cost of the end-of-life implications due to an increase in chemically dense adhesives (Coast Waste Management Association, 2021). For example, wood with adhesives cannot be stripped but a nail can be removed. Depending how the wood is treated and what is on it, will impact whether the wood can be reused and diverted from a landfill (CCME, 2019). An avenue that must be pursued are discussions with the industry to find viable, safe alternatives for building construction to allow for deconstruction.

While policies such as DfD/A and around building codes are important and play a large role in how easy buildings are to renovate and deconstruct, policies throughout the entire life cycle are crucial. This work focuses on the end-of-life part of the life cycle through deconstruction. The following sections look more closely at current deconstruction initiatives and what policies are in place in North America, to understand where the deconstruction industry is at today and what municipalities are currently doing.

2.4 Leading-Edge Deconstruction Initiatives

The following section presents examples of various deconstruction programs and policies in North America. This includes programs specifically designed to target and enforce deconstruction of homes and programs designed to reduce CRD waste through sorting and processing. It is also important to recognize that deconstruction is evolving fast and the number of municipalities exploring their options and becoming involved in the industry is constantly changing. The following municipalities may not be inclusive of all currently involved and is continuously evolving.

Table 1: A summary of current deconstruction initiatives in North America

Deconstruction/Salvage Requirement (some lumber salvage)

- Portland
- Victoria
- District of North Vancouver
- Vancouver
- San Antonio, USA
- Palo Alto, USA
- Pittsburgh

Recycling Requirement

- Coquitlam
- New Westminster
- Port Moody
- Richmond
- Surrey
- Burnaby
- District of West Vancouver
- Halifax
- Cook County, USA
- Orange County, USA
- Foster City, USA

Deconstruction Financial Incentive

- Seattle

Other

- Baltimore (Proposed Rebuild Act in 2022, \$4 million annually for deconstruction efforts of pre-1970 homes, focus on abandoned buildings)
- Toronto (exploring)
- Cleveland (various projects)

2.4.1 International Deconstruction Initiatives

The following are examples of various deconstruction programs and policies internationally. This includes programs specifically designed to target and enforce deconstruction of homes, which is considered leading-edge.

Table 2: A summary of current, leading-edge deconstruction initiatives in the United States with highest regulations at the top and lowest at the bottom. Photos taken by myself while visiting sites with a Mitacs grant and are not all from the same city described. Photo 1: Sledge Warehouse, Seattle; Photo 2: Store front for GoodWood Deconstruction in Portland; Photo 3&4: Single-family home deconstruction in Portland.



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

2.4.1 Diversion Requirements

Portland, USA

Portland is a leader for deconstruction as the first jurisdiction in North America to implement an ordinance (bylaw) in 2016. The requirements for their ordinance are as follows: Residential houses that are single dwellings and are built prior to 1940, or a home that has been designated as historic that is of any age, and simply requires them to be deconstructed rather than demolished (Portland, 2021b).

- A municipally certified deconstruction contractor must be used (a list can be found online),
- All projects must submit a pre-deconstruction form in order to receive the permit (Portland, 2021b).

This process does not cause an increase in permitting costs (Portland, 2021b). Unlike other jurisdictions, there is no defined amount of material by weight that must be salvaged, and they chose not to do it because it was more admin work (they have one person doing everything) and it is more work for the contractors. They also considered that if there was a minimum salvage rate per sq ft. and no market for the material, then it would defeat the point of the ordinance. They did not have the finances or staff to do a market analysis prior to the ordinance and believed that the market would find an equilibrium (Shawn Wood). This program has been very effective in part due to having certified contractors who keep each other in check as competition to one another (companies have told on others when they were not doing things properly, resulting in a company being fined and losing their certification). The idea is that it will remain competitive because companies will bid lower because they will salvage more material, thus feeding into the salvage industry. Portland has been seeing more deconstructions for homes that are not required to be as all dwellings must be abated including asbestos and lead siding. If a

home is built prior to 1978 it is assumed that it has lead paint and tests must be done to prove otherwise if contractors want to demolish the dwelling with the exterior on. Once these are removed, you are left with the bones of the house, making deconstruction competitive.

San Antonio, USA

San Antonio's deconstruction ordinance is unique as it is backed by the Office of Historic Preservation and went into effect on October 1, 2022 (City of San Antonio, n.d.-a). The ordinance requires the following:

- Effective October 1, 2022: deconstruction is required for a residential structures and accessory units that is a four-plex or smaller and is built in 1920 or earlier, or 1945 and earlier for historic properties or conservation districts,
- Effective January 1, 2023: deconstruction is required for 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 (City of San Antonio, n.d.-a)
- A certified deconstruction contractor must be used. All contractors are certified through the "Rehabber Club" that is run by San Antonio's Office of Historic Preservation and also certifies contractors for historic rehabilitation, wood window repair, and historic house specialists (City of San Antonio, n.d.-b).

Alongside the deconstruction ordinance, the Office of Historic Preservation runs some community initiatives in partnership with local organizations that are focused on reuse, salvage, and historic preservation through the Rehabber Club (City of San Antonio, n.d.-b). They run many programs, which are discussed in more detail in chapter five on education and workforce training.

Palo Alto, USA

Palo Alto began CRD diversion requirements back in 2017 that was influenced by the CalGreen Building code, which was to achieve 65% diversion for demolitions and new construction projects (AuYeung, 2022). Since then, Palo Alto's deconstruction ordinance has come into effect. It was effective as of July 2020 and is unique as it applies to all residential and commercial full structure removals – there is no build date applied (Chapter 5.24 Deconstruction And Construction Materials Management, 2019). It is estimated that they will get approximately 115 deconstruction projects per year and will be introduced in phases (AuYeung, 2022). The requirements of phase one of the ordinance are as follows:

- All projects must have a salvage survey (with estimated weights for each material) done by an organization approved by the city prior to a demo permit,
- All materials must be source separated,
- All salvageable materials must be donated or sold for reuse and documentation must be obtained,
- Only authorized containers for collection or self-hauling is allowed,
- Proof of salvage is required to be submitted at the end of the project and all materials must be received by organizations approved by the city,
- Weight tags must be obtained for any remaining debris that was sent to other facilities (Chapter 5.24 Deconstruction And Construction Materials Management, 2019).

Going forward they are considering other options for phase two, such as requirements for large remodeling projects, requiring source separation for all projects, having different requirements depending on building size or project value, expanding to and working with regional governments for more consistent requirements, and more (AuYeung, 2022).

Pittsburgh, USA

On April 20, 2021, the mayor of Pittsburgh passed an executive order to move forward with city-led deconstruction and started working on a pilot program for city-owned condemned buildings (The City of Pittsburgh, 2023). The executive order called on the directors of five municipal departments for various actions and research regarding deconstruction (The City of Pittsburgh, 2023). For example, public education, waste assessments, purchasing opportunities, waste diversion requirements, exploring incentives, categorizing properties, working together between departments and with other agencies, researching regulations, data collection and analysis, etc. (The City of Pittsburgh, 2023). With the executive order, there is a requirement to pilot deconstruction for city-owned, condemned buildings, developing an engagement plan and marketing strategy, and the development of a Deconstruction Action Council (The City of Pittsburgh, 2023). It also calls all departments and authorities to work together for everything outlined in the executive order (The City of Pittsburgh, 2023). They have also developed a framework for advancing policies in Pittsburgh.

It is important to recognize that this approach was chosen in Pittsburgh because of the high rate of condemned properties in the city in comparison to many other cities. Their website states that they spent over \$12 million from 2015 to the time the executive order was placed, on demolishing structures (The City of Pittsburgh, 2023). This was put in place to address the over 1,700 condemned buildings in the city (The City of Pittsburgh, 2023).

2.4.2 Unique Case Studies

Seattle, USA

The city of Seattle tried to take an incentive approach to deconstruction, where those looking at deconstructing a residential building are given an extended period to begin construction on the new building in 2019 (Seattle, 2019). At the time, codes otherwise required a

construction permit to be issued prior to a demolition permit, but due to a greater time commitment to deconstruct the permits are made to allow for proper deconstruction and thus the city will issue a deconstruction permit before a construction permit (Seattle, 2019). There were also requirements that came with being issued a deconstruction permit, which include:

- Waste diversion plan alongside the permit and a waste diversion report after project completion
- 20% reuse of building materials, some exclusions apply
- 50% minimum for reuse or recycling of building materials, some exclusions apply
- Asphalt, brick, and concrete are required to be 100% recycled or reused (Seattle, 2019)

This incentive was soon negated due to Seattle uphauling their entire permitting system and making all permits easier to obtain (Interview 18). Regardless, to demolish a building in Seattle, a waste diversion plan must also be submitted while applying for a permit and other stringent rules to prevent unnecessary demolition (Seattle, 2019). Although this is an initiative to reduce building material waste, it is important to note that deconstruction is not required but is rather optional.

In October 2022, Seattle introduced a new incentive program which issues \$4,000 for any eligible (see eligibility below) projects to offset the cost of deconstruction (Seattle Public Utilities, 2022). This program's goal is to increase deconstructions in Seattle, gather data on it, increase familiarity, and see what innovations are out there (Seattle Public Utilities, 2022).

Projects are eligible if they meet the following criteria:

- “Are residential, wood-framed buildings,
- Must use an approved deconstruction contractor,
- Must be associated with the complete removal of a house of duplex,

- Require a demolition permit before work begins. Projects classified as alterations are not eligible,
- Historic landmarks are eligible, however, additional criteria will apply” (Seattle Public Utilities, 2022).

This is most often a step in the direction of requiring deconstruction.

Hennepin County, USA

Hennepin county, on the outskirts of Minneapolis, introduced grants in 2020 and have since updated them in 2022. They have grants for four different actions related to building reuse and recycling (Hennepin County, 2023). They are:

1. Residential deconstruction: \$2 per sq. ft. up to a maximum of \$5,000. This includes full removal of a building, renovation, or remodelling. It is applicable to pre-1970 builds up to four units,
2. Commercial deconstruction: \$2 per sq. ft. up to a maximum of \$10,000. This is for full removal of a full commercial buildings, renovation, or remodeling. This is applicable to all commercial properties of any age as well as apartments over 4 units,
3. Used building material installation: \$2 per sq. ft. up to a maximum of \$5,000. This is for project that incorporate used building materials and can be for new builds, renovations, or remodeling. This is applicable to both residential and commercial buildings. This can be used on top of the deconstruction grants,
4. Full structural move: \$5 per sq. ft. up to a maximum of \$15,000. This is based on the full cost of the move. This is applicable to both residential and commercial buildings (Hennepin County, 2023).

Properties must be owned by residents or a developer, this is not applicable to publicly owned buildings, nor can it be used for accessory buildings (Hennepin County, 2023). Each of

the four options have different requirements for amount of material salvaged by weight and has to submit proof of meeting the criteria (Hennepin County, 2023).

New Orleans, Mercy Corps, USA

After the catastrophic hurricanes that ripped through New Orleans in 2005, Mercy Corps, a non-profit based out of the USA, implemented a deconstruction program in three weeks to salvage and recover materials from 275,000 homes (Denhart, 2010). A study conducted by Denhart used 20,000 points of reference for four homes that were deconstructed because of the hurricanes and found between 38% and 75% salvage rate by weight (2010). Of those four houses that were deconstructed, Mercy Corps was able to use the salvaged materials to build three new homes, consisting of approximately 44 tons of salvaged materials (Denhart, 2010). Along with reducing waste and rebuilding the community, deconstructing the damaged homes was an economic investment into the previously devastated economy through lumber products and labour, providing upwards of five times more jobs than that of demolition (Denhart, 2010).

This is an excellent example of a successful deconstruction project in a post-disaster environment. It makes environmental and economic sense and supports the UN sustainable development goals (Denhart, 2010; WHO, 2021).

2.4.2 Canadian Deconstruction Initiatives

The following are examples of various deconstruction programs and policies in Canada. This includes programs specifically designed to target and enforce deconstruction of homes, which is considered leading-edge. This is defined as a program that requires reuse and salvage, not recycling.

Table 3 A summary of current, leading-edge deconstruction initiatives in Canada with highest regulations at the top and lowest at the bottom. Photos taken by myself while visiting sites with a Mitacs grant. Photo 1: Brentwood Bay Church, Vancouver Island; Photo 2: Lumber from a

single-family home in Vancouver; Photo 3: 4 days from project completion for a single-family home in Vancouver.



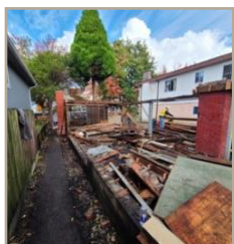
Victoria

- Pre-1960 single- or double-family homes, being replaced by single-or double-family homes require 3.7 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

2.5.1 Diversion Requirements

Vancouver, British Columbia

City of Vancouver Green Demolition Bylaw (Balca, 2018; City of Vancouver, 2021; Metro Vancouver, 2018):

The City of Vancouver was the first Canadian municipality to implement a bylaw that requires minimum recycling and reuse of building materials from homes that are being demolished or deconstruction. Although this is primarily a recycling requirement, it is placed under diversion requirement due to point number three listed below. The bylaw requirements are as follows:

1. Minimum recycling and reuse for materials for residential homes built pre-1950: by weight 75% of materials must be reused or recycled. This excludes any hazardous materials.
2. Demolition requirements for character houses built pre-1950: 90% of materials must be reused or recycled, by weight. This excludes hazardous materials.
3. Deconstruction requirements for a residential home built pre-1910 or a heritage listed building built pre-1950: 90% of materials must be reused or recycled and 3 metric tonnes of wood must be salvaged. This excludes hazardous materials.

It is important to recognize that for all dwellings except per-1910 or heritage home, this is a recycling bylaw, and no amount of material is required to be salvaged for reuse. This means that the materials, such as old-growth lumber, can simply be chipped and used as biofuel, a process that many municipalities already do. These targets can be reached through traditional demolition. There is a clause that allows traditional demolition if the materials cannot be recycled due to safety, fire, floods, etc. There is one major deconstruction company in Vancouver which is Unbuilders. However, due to the lack of regulation, it is possible that other companies are taking on projects and using traditional demolition while still meeting the recycling targets.

[District of North Vancouver, British Columbia](#)

The District of North Vancouver adopted a demolition waste reduction bylaw in June of 2022, and it was effective as of January of 2023. This bylaw requires wood salvage of homes built prior to 1950. It requires 3.5 kg or 2.6 board feet of reclaimed lumber per square foot of finished floor space to be salvaged. With the application, contractors must submit a one-page wood salvage estimate and pay a refundable \$15,000 waste diversion deposit. This is returned based on performance for how much material was salvaged for reuse and if they met the requirement.

Victoria, British Columbia

The Victoria bylaw was passed by council and the first phase came into effect on September 12, 2022. This is a wood salvage specific bylaw, requiring reuse of material and recycling is not an option. They are introducing it by phases. The phases and requirements are as follows:

- Phase one is all single- and double-family dwellings (houses or duplexes) built before 1960 and a new single- and double-family dwelling (houses or duplex) is being built (Victoria, 2022). This means if anything larger than a duplex is being built on the property, the bylaw does not apply.
- Phase two begins on May 12, 2025, where the salvage requirements must be met regardless of what is being built on the property after.
- All phases include a required refundable salvage fee of \$19,500 to be paid when applying for the permit (this is exempt for the first year) and will receive it back if they proved that the salvage target is met by providing a report with receipts,
- All phases required the reuse of 40kg of wood salvage per m² of above-ground area (or 3.7 kg per sq. ft.) (Victoria, 2022).

2.5.2 Recycling Requirements

Some municipalities have taken the approach of instituting bylaws for recycling CRD waste, with various requirements. This research does not go into detail with these as they are not deconstruction specific requirements. A recycling requirement can be a step in the right direction although would not be considered a leading-edge program or bylaw. The materials that are diverted can be salvaged but it only requires that materials do not go to landfill at a minimum. For example, a recycling bylaw would allow wood to be burned as a method of recycling, when that is not ultimately working toward a circular economy and the product is at its end-of-life. These Canadian municipalities include:

- Halifax, Nova Scotia
- Coquitlam, British Columbia
- New Westminister, British Columbia
- Port Moody, British Columbia
- Richmond, British Columbia
- Surrey, British Columbia
- District of West Vancouver, British Columbia
- Burnaby, British Columbia

These municipalities all have varying requirements, most requiring a certain percent of recycling, some include refundable fees, and some require a compliance report to be filled out proving the requirements were met (City of Coquitlam, n.d.; City of New Westminister, n.d., 2023; City of Port Moody, 2022; City of Richmond, 2020). It is important to recognize that although these are important steps in the right direction, these bylaws only require recycling and not salvage or reuse.

2.5.3 Provincial and Federal Aids

In Canada, management of municipal solid waste falls under the responsibility of municipalities, although higher levels of government can also create policies and programs for proper management of waste, reduction, and diversion (Canada, 2021a). As well, higher levels of government are responsible for regulating and monitoring waste management facilities (Canada, 2021a). There is opportunity for collaboration between all levels of government, with programs and funding provided by the provincial and federal governments to help communities improve management, and implement standards (Canada, 2021a).

Provincial and Federal aids can play a large role in policy implementation and influencing policy at the municipal level. Although waste management falls under the municipal level of operations, it is important to not forget that the provincial and federal levels of government can and should effect change. Currently Canada has several agreements and broad policies that impact the built environment and concurrently support the adoption of deconstruction related policies and programs (Delphi, 2021). In 1995, the CSA (Canadian Standards Association) developed standards related to the circular economy in Canada. “These are:

- CSA S478:19 Durability in Buildings¹⁸ - Released in 1995 and was updated in 2019 (and referenced in LEED Canada for Durable Building Credit).
- Z782-06 Guideline for Design for Disassembly and Adaptability in Buildings¹⁹ – Was released in 2006.
- Z783-12 (R2016) Deconstruction of buildings and their related parts²⁰ – Released in 2012 and updated in 2016” (Delphi, 2021).

These standards provide rightful jurisdiction for municipalities to call on the federal government for support in deconstruction-related initiatives.

One example of involvement and support from other levels of government is in Portland. When Portland was beginning their deconstruction ordinance, they received \$50,000 initially and another \$50,000 later on from the state department of environmental quality. The state also supported Portland by doing a study on the carbon and energy impacts of deconstruction in comparison to demolition (Nunes et al., 2019). As well, Oregon state and Washington changed their building codes to allow for salvaged wood to be used in new builds, which many participants expressed was beneficial to helping see reuse in the CRD industry advance. This

level of interaction and support from other levels of government is very important for advancing action on deconstruction.

In Canada, the federal government does provide support through financial and other means (Environment and Climate Change Canada, 2022). Available programs applicable to waste diversion, reduction and the CRD industry include:

- *Green Municipal Fund* provides communities with funding for various projects associated with being “innovative and impactful environmental projects that reduce GHG emissions and protect the air, water or land” with some more general grants and some available specifically for waste management and diversion (FCM, 2021).
- *Sustainable Development Technology Fund* helps fund innovations to “help solve some of the world’s most pressing environmental challenges: climate change, regeneration through the circular economy, and the well-being of humans in the communities they live in and the natural environment they interact with” (*Sustainable Development Technology Canada*, 2022).
- The Canadian Council for Ministers of the Environment created the *Guide for Identifying, Evaluating and selecting Policies for Influencing Construction, Renovation and Demolition Waste Management* in 2019 which is a guide that “provides decision-makers with high level guidance for identifying, evaluating and selecting effective policies for influencing CRD waste management” (CCME, 2019).

Provincial aids differ depending on the province. For example, the most recent report on CRD waste released in Alberta is from 2006, titled *Construction, renovation and demolition waste materials: opportunities for waste reduction and diversion* (Government of Alberta, 2021). This is a very outdated report and provides little direction for municipalities in Alberta, due to

how outdated it is. British Columbia has completed some case studies on construction and demolition waste in North America and a *Guide to Solid Waste Management Planning* that discusses the ability for EPR to play a role in CRD waste management (Province of British Columbia, n.d., 2020). Other provinces involvement varies, but ultimately waste diversion has been left to municipalities to act on.

2.5 Chapter Summary

Waste management and reduction has been prevalent in our society for decades and is constantly evolving. With a recent push towards achieving a more sustainable society, a big part of which is wasting less, and developing a circular economy, sectors that produce larger amounts of waste such as CRD are ripe for action. With a lack of current policy direction, guidance, or regulation, there is great opportunity to target this industry, increase standards, and reduce a significant amount of natural resources from wasting away in municipal landfills across Canada. Deconstruction can play a major role in this movement, by closing the loop and creating a circular economy through salvaging, reusing, repurposing, and recycling CRD materials. Deconstruction of the built environment can act as a solution to help reduce waste from entering landfills, reduce pressure on our natural resource and can even act as a solution to help the post-disaster economy and environment across the world. Through municipal by-laws to educational campaigns, incentives, and provincial/territorial or national policy, deconstruction should be at the forefront of waste discussions in the developed world. As is evident, there are many applications for deconstruction, and it should play a large role in municipal waste management in the near future.

Chapter Three: Research Design and Methods

3.1 Worldview

Waste, as previously described, is conceptually complex in that it can be interpreted and defined in many ways, is a continually evolving matter and can have individual nuance. With the fluidity of the topic and ever-changing perspectives, values, and philosophies, I believed that a flexible approach to my research was important. For this reason, and that I wanted to take a real-world, problem-centered approach to addressing CRD waste reduction, I felt that a pragmatic approach was appropriate (Creswell & Creswell, 2018). Such an approach allows the researcher to focus on what the reality at the time is and it recognizes that reality changes through time and space (Creswell, 2016). A pragmatic approach emphasizes the importance of the research problem rather than the methods for the research (Creswell, 2016). This allows researchers to define the issues and apply various strategies and methods of inquiry that best fit the issues being researched at the time (Creswell & Creswell, 2018), which fit well with the work I wanted to undertake. Furthermore, as Creswell and Creswell state, “pragmatism opens the door to multiple methods, different worldviews, and different assumptions” giving flexibility to what best fits to achieve the research goals and purpose (2018, p. 11).

3.2 Qualitative Approach

My research used a grounded theory qualitative approach. The qualitative research approach is understood as an exploratory method that allows researchers to use inductive reasoning and data analysis to understand the broader meanings associated with individuals, or groups of individuals relating to a real-world problem (Creswell, 2016; Creswell & Creswell, 2018). Given my objectives, qualitative research was used because my area of study is exploratory in nature. Qualitative research also allows for the flexibility to follow the emerging

themes (Creswell & Creswell, 2018). Furthermore, as my research is focused in used a grounded theory strategy of inquiry.

Grounded theory research was developed in 1967 and the intent is to develop a type of theory, or explanation, for a process or action (Creswell, 2013). Grounded theory research's main objective is "to develop higher level understanding that is 'grounded' in, or derived from, a systematic analysis of data" (Lingard et al., 2008). It is important that "participants in the study would all have experienced the process, and the development of the theory might help explain practice or provide a framework" (Creswell, 2013). For this research, this is demonstrated through the development of the framework for implementation of residential deconstruction programs, which is grounded in data from the interviews and the focus group. One myth surrounding grounded theory research is that

the name suggests that a fully fledged theory must arise... but we think it is important to acknowledge that while the application of the [grounded theory] method *can* result in a theory, in many cases, it amounts to a new or better conceptualization or a framework that links concepts but falls short of a fully elaborated theory that covers all aspects, stages, consequences, and likelihood of a process or a phenomenon (Timonen et al., 2018).

In my case, all participants were involved in some manner with deconstruction and the built environment, and I was able to use the research and data to produce a framework. For a comprehensive inquiry I conducted semi-structure interviews, a summary response sheet for interviewees, a literature review, a focus group, and site observations, as is describe below. Using multiple methods and sources allowed for broader applicability and data triangulation, which is valued in research and the academic community.

I used a mixture of sampling methods for my interviews. I began with convenience sampling, and this was followed by with some snowball sampling (Cassell, 2020). Convenience

sampling allowed me to pull from networks already made in webinars, workshops and working groups. I also used snowballing by considering recommended individuals from informants.

3.2.1 Case Example: Edmonton

I used The City of Edmonton (CoE) as a small case example for the consideration of the framework for deconstruction that I developed. The purpose of this was not to study Edmonton and how it might be implemented in their city, rather Edmonton served as a jurisdiction to assess the frame for deconstruction in the real-world case context of a large, Canadian municipality. The research conducted in the interviews was used to develop the deconstruction framework, which was then presented to the participants along with some city-specific data. The participants were then able to discuss the framework. This allowed for the assessment of the framework from working professionals to identify gaps, determine feasibility, and develop a stronger framework because of it.

Edmonton was chosen because I have past and present networks with the CoE Waste Department that provided easier access to necessary information, such as CRD waste statistics and documentation. Edmonton is a city of 1 million people, so representative of larger cities in Canada with an advanced waste management system that has developed over the past few decades, but still has room for growth in many areas, like other jurisdictions across Canada. As well, a roadmap for waste reduction was recently passed that focuses on single-use item reduction and organics collection, which follows a similar timeline to many jurisdictions across Canada, such as Winnipeg, Manitoba. This shows that they are in line with other large, Canadian municipalities with their current action items. The CoE was also interested in my project as they may look to implementing programs and policies for CRD waste reduction in the near future. For these reasons, Edmonton was well suited as a case study.

3.3 Data Collection Methods

Having multiple methods of data collection, also known as triangulation, contributes a higher level of data validation with research (Cronin, 2014). The primary methods for data collection that I used include a document review, semi-structured interviews, a summary response sheet for interviewees, personal observation, and a focus group discussion.

3.3.1 Document Review

The research began with a document review focusing on industry and governments that have implemented deconstruction-specific programs that were leading the field. Leading the field meant I was looking for documents from any organization that was actively engaged in a part of the circular economy model for the built environment related to deconstruction or working on related policy. This included municipal and other government reports on municipal waste, specifically considering CRD waste management and reduction. My goal was to determine the sorts of policies and programs that have been implemented, and depending on available data, include how successful they have been, what led to any success, barriers that were present, etc. Most of the data on success came from conversations, included semi-structured interviews, webinars and workshops attended, and the focus group. This helped with developing a good understanding of current deconstruction initiatives in North America. As I was conducting my research, I decided to not include programs aimed at recycling and reusing materials from demolition sites as this is more common than deconstruction (see section 2.5.2 on recycling requirements). With this in mind, I decided to define leading-edge as a program or policy that has a reuse/salvage requirement, not a recycling requirement.

The document review also included work done by architecture firms, construction companies, deconstruction companies, waste haulers and independent consulting firms that have been actively involved in deconstruction projects, policies, and CRD waste reduction.

3.3.2 Semi-structured Interviews

Semi-structured interviews were conducted with 24 subject experts 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 from the following sectors:

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

Semi-structured interviews were best suited for my research due to the flexibility they offer for following new leads as they arise during conversation, while still providing some structure through an interview guide (Bernard, 2006; Cassell, 2019). I took a thematic-exploratory approach for my semi-structured interviews. This allowed me to explore general themes identified through my objectives as well as specific themes within that came up over time, from many different perspectives (Cassell, 2019). I was able cover main topics, while

allowing conversations to flow in directions that the interviewee sees fit, ultimately gaining better knowledge, and understanding the entire picture. Due to deconstruction being a recent topic of interest in waste reduction, allowing for fluidity is important as all the industry leaders have varying experiences, and understanding the entire picture is critical for future success of deconstruction programs due to the interdisciplinary nature of the topic.

A list of interview questions can be found in appendix II. I developed these questions with the knowledge of my document and literature review and in consultation with my committee. I also pilot tested the interview schedule to test how the questions were working. The resulting interview schedules differ slightly for various actors within the CRD industry due to their differing responsibilities and roles. Most begin with a broad question to understand their current involvement in CRD waste and policy implementation. Throughout the interview I dove deeper to determine what actions have been taken and the barriers each industry has faced or foresees facing with deconstruction and how this has been or could be overcome. As well, they included actor-specific questions, such as DfD/A for those involved in pre-construction and construction phase of a building's life cycle. See appendix II for interview schedules.

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. The sheet was titled *Deconstruction Benefits, Barriers, and Recommendations Response Sheet*, and can be found in appendix VII. 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. Approximately three-quarters of the participants got back to me with a response to the summary document.

3.3.3 Personal Observation

In conjunction with semi-structured interviews and 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 was in conjunction with discussions with the people undertaking the deconstruction and 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.

3.3.4 Focus Group

Following the document analysis, semi-structured interviews, response sheet, and observation, one focus group was conducted. The purpose of a focus group is to discuss a particular topic, with a larger group following a semi-structured format (Oates & Alevizou, 2019). My focus group involved 6 participants, plus my Advisor, John Sinclair, and a colleague, Kelsey Margraf, who took notes. I included 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.

With the data compiled and analyzed from the previous methods, I developed a framework titled: *A framework for actioning residential building deconstruction for larger Canadian municipalities*. Before the focus group I prepared a short background information sheet on deconstruction to prepare the participants. This was sent out one week before the focus group and can be found in the appendix VI. The purpose of this was to set up all participants

with the basic knowledge on deconstruction, C&D waste in Canada, benefits and barriers, and current municipal actors. The framework was then sent out the day before the focus group. Although I wanted to get their reaction to the framework due to how complex the framework is and the level of detail, having it before allowed participants to take longer to read it and they could also reflect on what they read before our focus group. I also created a presentation which was used at the beginning of the focus group. This presentation started with a brief overview of the background information and then dove into some Edmonton-specific data. This data is presented in chapter six where I will go more in depth into the findings of the focus group. The presentation along with questions and a review of the framework took the first 40 minutes. A break followed and the rest of the focus group was spent discussing the framework. 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 best steps forward, bringing in their own unique experience and role within deconstruction.

3.3.5 COVID-19

It is important to note that the bulk of this research happened during the COVID-19 global pandemic, and it was difficult to predict whether in-person activities would be allowed to happen. All University of Manitoba guidelines were followed and for consistency in research methods and data collection, I assessed the situation at the beginning of each stage and completed all activities virtually, with the exception of my site visits. This was also due in part to participants residing across North America. It must be acknowledged that virtual and in-person methods differ substantially in the data that can be collected, for example being able to read body language in-person and lacking that ability online.

3.4 Data Analysis

Data analysis is the stage of research where the researcher organizes and interprets the data collected in a systematic way. This research took an inductive thematic analysis approach as it is exploratory in nature and inductive coding allows for themes and understanding of the data collected to emerge (Bernard, 2006; Nowell et al., 2017). As interviews were conducted, the data collected was organized into topics and themes and then analyzed within NVivo software from the University of Manitoba. I created topics based on my objectives which served as my parent nodes and child nodes served as themes, which were developed as I conducted my research. For example, one of my objectives is to discover barriers for deconstruction, so one parent node was titled “barriers” and themes surrounding barriers were the child nodes. After each interview was conducted, I took note of any themes that may have emerged, while some themes emerged as I began coding. This meant going back to interviews that were already coded to code any new themes. For coding, the nodes were broken up into the larger objectives of the research with the child nodes/themes.

The analysis included identifying patterns, such as seeing what participants spoke about in comparison to others and seeing how many people spoke about similar themes. Once analysis of the interviews and summary sheet was conducted, I was able to develop the framework. Data analysis was then done on the focus group and any necessary changes were made to the framework based on the data.

3.5 Data Validation

It is important that all research is trustworthy and credible work, which can be done through triangulation of methods and data. Triangulation is the practice of using multiple angles for research to ensure data validity and quality (Cronin, 2014). This can include various data

collection and analysis methods, perspectives, sources, and more (Cronin, 2014). For this research, I used multiple data collection methods and looked for information that is discussed and outlined in multiple data sets. I used multiple data sources for my document review, including international examples of deconstruction programs and policies, allowing for a well-rounded understanding of current programs and policies. I was able to send multiple transcripts to a randomized selection of interviewees for review to ensure accuracy.

3.6 Ethics

I received ethics approval from the University of Manitoba Joint Ethics Review Board before beginning interviews and the Focus Group. Participation in any of my activities was voluntary as per ethics requirements and all data was confidential, unless the participant requested otherwise. Every participant, whether being interviewed, observed, or participating in a workshop was briefed on the purpose, objectives, and the goals of the research. Each participant was required to sign a consent form, outlining the research, how the data will be used and participants confidentiality. This included discussing recording interviews for data analysis purposes, noting that all sources of data were destroyed after completion of the thesis and research. Participants were informed that at any time they may skip a question and not answer it as well as end an interview, observation, or leave a workshop at any point. For confidentiality, all participants were given a number or referred to by the organizational name. The only time a participant was referred to by their name is if they requested it on the consent form. The data was linked to the industry they work in, for research purposes.

Chapter Four: Benefits and Barriers to Deconstruction

The fourth chapter addresses the benefits and barriers to the implementation of deconstruction at a municipal level, mostly in the North American context. This chapter starts by discussing the benefits that deconstruction can offer, and this is followed with the barriers for both deconstruction practice and developing deconstruction programs and policies, as found through the document review, semi-structured interviews, and personal observation.

4.1 The Benefits of Deconstruction

The benefits of deconstruction can be grouped into four general categories, environmental, economic, social, and cultural. One participant who works at the state level of government summarized the importance really well, saying, “there are public health benefits, waste reduction, sustainability, and environment, historical and cultural preservation, workforce and economy and equity” benefits. Another participant, Shawn Wood, who was the main force behind Portland’s ordinance stated the overarching importance as well, saying, “it’s going to benefit our economy, it’s going to benefit our environment, it’s going to benefit people’s health, [and] it’s going to more equitably distribute these projects throughout the city.” Both of these participants shine light to the multitude of benefits. The following table gives a brief summary of the benefits and are based on the data collected from semi-structured interviews, literature, and site visits, and each section is explored further below.

Table 4: The environmental, social, economic, historical and cultural benefits of residential deconstruction.

Environmental	Social	Economic	Historical & Cultural
<ul style="list-style-type: none"> • Reduces waste entering landfills and methane emissions from landfills • Retains embodied carbon in the materials and reduces embodied carbon emissions associated with new materials • Conserves natural resources required to make new materials • Reduces emissions in the construction sector 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Provides up to five times more green jobs than traditional 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 maintaining landfills • Contributes to the local materials economy 	<ul style="list-style-type: none"> • 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

4.1.1 Environment

The environmental benefits of deconstruction are evident, with the two primary benefits being waste management and diversion, and sustainability and resiliency. With waste management, deconstruction significantly reduces the amount of waste going to the landfill, as its focus is to divert the materials back into the economy, while other materials that cannot be reused are at the very least properly separated so that they are not considered contaminated and can be recycled. For sustainability and resiliency, there are direct climate benefits through the

embodied carbon in the materials being diverted from the landfill as well as methane emissions associated with landfills. As well, it conserves natural resources required to make new materials, thus reducing emissions in the construction sector. The benefits through waste management and sustainability and resiliency are discussed in further detail below.

Waste Management

The benefits of deconstruction for waste management are very evident, namely keeping CRD waste out of landfills, reducing natural resources extraction, and reducing associated waste production impacts like methane emissions and energy consumption (Delta Institute, 2018; Frisman, 2004; NAHB Research Centre Inc., 2001). Although there is little recent data to be found, a tool developed by Metro Vancouver estimates that a 1,500 ft² home creates 75,523 kg of waste (Metro Vancouver, n.d.). These numbers demonstrate the grandeur of this problem. One participant emphasized the impact of deconstruction on waste, stating, “there are no clear answers, but there’s the ability to say what we do want. And if you start looking at all these things in deconstruction, it makes a lot of sense, because you are salvaging materials for the highest and best beneficial reuse. Keeping it out of the landfills and you are creating clean jobs as well.”

When we consider all of the materials salvaged in deconstruction, the environmental benefits are significant. However, wood tends to be a focus in deconstruction due to the quality of old growth lumber coming out of older homes. As well, Jeff Wint, a participant working in municipal waste management explained that “wood waste in our landfill is a major concern obviously there are the environmental concerns but there is also space and volume, and wood waste doesn’t compact like other MSW.” Another one interviewee working in sustainable

governance stated, speaking closely to wood, a highly sought after salvaged material from deconstruction,

We are talking about wood and we all can see the damages of harvesting new wood and throwing it away or burning it at the end of its life... When you pull it out of buildings, it makes a ton of sense to reuse that material, and most of it, you know most of the buildings, especially in vivacious, urban economies, buildings are not coming down because they are failing. It's because there is more demand or more money to be made by tearing it down, so it's not like the wood is at the end of its useful life.

Wood of course is one of many resources that comes out of a home, but this points to the environmental considerations of traditional demolition in comparison to deconstruction and the importance of salvage and reuse for natural resources management and sustainability.

When considering the amount of waste created by traditional demolition, it is also important to consider the impact of landfills on the environment (Delta Institute, 2018). As one participant, Claire Lewis, went on to emphasize the problems with this waste entering our landfills using a common saying in waste management, "no one wants a landfill in their backyard." Deconstruction helps by diverting these materials away from landfills, reducing possible methane emissions, and the need for more landfill space.

Sustainability & Resiliency

Climate change is at the forefront of many conversations as we run out of time to act. Deconstruction can play a role in reaching emission reduction targets through embodied carbon (EC) and material carbon emissions (MCE). When considering climate change targets, deconstruction policies and programs can play a role in helping municipalities reach their greenhouse gas (GHG) and EC emission reduction targets. Current conversations are often

focused around reducing operational energy, that is, what we typically refer to as a “net-zero” home and it is not truly “net-zero” until it has offset the carbon input from building it. Current policies and programs that are aimed at this “net-zero” home but often focuses on operational carbon, not embodied carbon. The Canadian Government has set a goal to reduce emissions from the building sector by 37% by 2030 and attain net-zero emissions by 2050 (Government of Canada, 2022). However, it states that this means “reducing GHG emissions from operations to as close to zero as possible” accounting for operational emissions only. This demonstrates that as we work towards reducing the operating carbon emissions, we will still be left with embodied carbon emissions, and it will account for the majority of emissions related to the built environment. A big question to consider is “how do we get to lowering generation as we go up the hierarchy in zero waste from recycling and composting to reuse and waste prevention?” (James Slattery).

A report published in 2023 from Circular Economy, stated that,

Much of the environmental impact that has occurred in the past 100 years can be attributed to rising greenhouse gas (GHG) emissions—and our Circularity Gap Report 2021 found that 70% of global GHG emissions are tied to material handling and use (Circle Economy, 2023).

When further broken down, studies have shown that buildings alone are responsible for an estimated 39% of all global emissions (UN, 2017). This is divided between the operational emissions, which account for approximately 28%, and embodied carbon, which accounts for 11% (UN, 2017). With the global population increasing rapidly, it is expected that the building stock will increase by as much as 50%. Therefore, embodied carbon emissions should not be forgotten and must play a larger role in conversations and policies (UN, 2017).

For waste management, waste reduction and prevention, diversion, and reuse is key to reducing atmospheric carbon. The higher on the waste hierarchy, the less atmospheric carbon

generation. This is where deconstruction can have a large impact on climate change. By salvaging materials from the built environment and reintegrating them into new projects, we can reduce the amount of virgin materials needed. Considering the CRD industry uses approximately 40% of all virgin material extraction and production on earth, this will not only reduce the embodied carbon going into new builds but also help maintain carbon sinks.

To get here, we need to shift our perspective of old homes from useless to resource banks. Not only is the embodied carbon important to consider, but it is also important to recognize that carbon that is captive in building materials, known as biogenic carbon storage (BCS). When a home is traditionally demolished, little can be salvaged resulting in the material being burned for energy, what is called waste to energy (WTE), or it will decay in a landfill. Thus, by protecting and salvaging these materials so that they can re-enter the economy, we can lock this carbon into the materials and prevent it from entering the atmosphere. This is why buildings should be views as resource banks and carbon sinks (Breton et al., 2018).

In a study done by *Builders for Climate Action* and *Passive Buildings Canada*, they looked at 190 residential single-family homes across Canada to determine the average net material carbon emissions and found it to be 150 kg CO_{2e}/m² (Magwood et al., 2022). Another study using data from nine builders in the Greater Toronto Area found the average to be 191 kg CO_{2e}/m² (Magwood et al., 2022). This number may vary across provinces, but this gives a good estimation for the emissions associated with the extraction of resources, transportation, and production of materials. This is a significant number of emissions that can be significantly reduced if we deconstruct homes and use salvaged materials for new builds in combination with choosing low emission products.

4.1.2 Social

The social benefits of deconstruction include improving health and safety of communities through reduced exposure to hazardous, airborne pollutants such as asbestos, lead, and toxic dust. It also can provide a sense of place and community in neighborhoods and help with equitable redistribution of materials. Other social benefits include providing meaningful jobs and opportunities in trades and workforce entry.

Public Health

Deconstruction can play a large role in protecting human health through managing hazardous materials and preventing airborne pollution. The primary hazardous materials that are better controlled in deconstruction sites include toxic dust, airborne lead from lead paint and lead in concrete, and asbestos (Shami, 2006). Studies have shown that these airborne lead particles can travel anywhere from 400 to 800 ft off site during a traditional demolition posing health risks to entire communities (Feldman & Langston, 2014; Jacobs et al., 2013; Reynolds, 2018).

Deconstruction ensures that these materials are properly handled and disposed of, reducing the risk for both workers and the communities. All contractors that participated in the study said that in as many as 90% of their deconstruction projects they will find asbestos that has not been removed in the initial abatement (site visit). This is because it is often found behind materials that have not yet been removed at the initial abatement stage. Shawn Wood discussed this, saying that “all houses had to be abated for asbestos and almost every time they come across unabated asbestos, under the cabinet, in a wall. Work stops, they call in the experts and they safely remove it and work continues. That doesn’t happen in a mechanical demolition.” He went on to discuss how the neighborhoods were happy that these houses were not being demolished, but called for an increased in requirements because there were still homes being demolished,

leading to asbestos and other toxins being released in the air. This led to the permitting bureau being called to increase requirements alongside the deconstruction ordinance, as Shawn Wood mentioned,

Today, if you mechanically demolish, you have to hand remove all the exterior painted non-structural elements: windows, doors, siding, trim, porch, decking, anything that has lead paint on it is hand removed. That kind of sounds like deconstruction and so now mechanical demolition contractors have to pay a crew to go and pull all of that stuff off, so that raised their costs, the new regulations also require that you hose it down while you are crunching it and while you are loading it, that adds yet another crew member because the guy running the excavator can't hose it down at the same time, so you are paying someone else. And I can't put a number on this but you are soaking the material and you pay per tonne to expose of it so their costs went up, deconstruction because of competition, because a lot of our contractors have got certified to remove asbestos. All of this work and the requirements ensures the safety of workers and the community.

For lead paint, only some municipalities have policies around the removal of this hazardous material, meaning in some communities it becomes airborne during a traditional demolition. It has been proven that demolition causes an increase in lead-contaminated dust exposure and that “dust emissions from housing demolition have been found to contribute to adverse health effects other than lead poisoning, such as asthma exacerbation” (Jacobs et al., 2013). It has also been found that dust from 1 square foot of a surface that was painted with lead-based paint can result in 232% more lead dust than the EPA's limit (Jacobs et al., 2013). This is especially true of children in these areas, as the Centre for Disease Control concluded that “there is no known level of lead in kids' blood that isn't harmful” (Feldman & Langston, 2014). Another study found that blood lead levels in children were significantly raised in children who lived in one census block of demolitions, a significant finding demonstrating the dangers of traditional demolition (Rabito et al., 2007). Deconstruction reduces these risks for communities and workers by ensuring all hazardous materials are handled correctly and disposed of in a safe manner.

Community Development

Community development is one of the areas that deconstruction can have large benefits on but can be sometimes forgotten as environmental and economic benefits tend to be discussed more. Some benefits include preserving a sense of place and community in neighborhoods, providing meaningful jobs, a more equitable distribution of services in communities, and a more equitable distribution of environmental impacts. Shawn Wood, the primary municipal driver behind Portland's ordinance, stated this well saying,

It's going to benefit our economy, it's going to benefit our environment, it's going to benefit people's health, it's going to more equitably distribute these projects throughout the city because up until [the ordinance], deconstruction was really only happening because production builders were getting a bad rap in affluent neighbourhoods ... but in lower income neighbourhoods they would go back to demolishing it, so at least it levels the playing field.

James Slattery, a public servant with San Francisco who is leading their deconstruction efforts spoke on the importance of equity as well, stating that we are seeing a shift in the zero-waste movement as what is defined as success involved many layers including "the disproportionate impacts and burdens felt in certain communities." He went on say, "yes, you're recycling great, but you are sending all this truck traffic through one community," further demonstrating that the movement to a healthier environment and a circular economy cannot come at the expense of certain communities.

However, it is common to see these environmental risks be taken more seriously and be accounted for more often in affluent areas, as Shawn Wood mentioned is the case in Portland. When considering the health risks previously mentioned, the CDC did a study on health hazards, including those caused by lead paint, and found that low-income areas, minority children are disproportionately affected (CDC, 2002; Rabito et al., 2007). Deconstruction reduces these risks substantially, by requiring proper management of materials, regardless of location.

Deconstruction can also play a large role in a more equitable distribution of materials in municipalities. One participant, Ted Reiff, stated the importance of this for communities, stating one benefit is “the re-distribution of materials back into the back end of the community to revitalize the community and have them save money so they can use that money for better health, better living conditions, etc.” By deconstructing and salvaging homes, there is an influx of reused materials entering the market. Although some materials will still sell for a high cost, such as old growth lumber, many of the materials are sold for lower costs than what is found at big-box stores. As seen through site visits in Portland, through this process, communities can also focus on restoring lower-income homes helping to increase affordable housing in their communities. As well, by working with non-profits in our communities and contributing to the market for salvaged materials, deconstruction also provides opportunities for lower-income community members to purchase affordable and high-quality building materials for personal projects and home renovations. These are huge benefits of deconstruction by supporting our local communities.

Another community benefit is providing more and meaningful jobs. While conducting site visits, participants spoke on the importance they felt of their job, the meaning they got from their work, and how they felt valued. The act of deconstructing, carefully managing the materials, and ensuring they can be reuse or reprocessed to re-enter the market, provides a level of meaning to the work being done.

4.1.3 Economic

The economic benefits of deconstruction are many. From contributing to the circular economy, to promoting innovation, contributing to the reuse workforce, prosperity, and the local reuse markets.

Contributing to the circular economy is a large benefit of deconstruction. This shift to a closed-loop system is important for the future of waste and makes both economic and environmental sense (Ellen MacArthur Foundation, 2013). The rate at which society creates waste will increase with a linear economy as the global population increases. We can expect to see a three billion increase in middle-class consumers by 2030 and an expected global population increase to 9 billion by 2050, there will be an increase in demand for jobs, homes, and the resources to support it (Ellen MacArthur Foundation, 2013). Estimates show that deconstruction could provide up to five times more jobs than demolition (Delphi, 2021; Stahel, 2016). Not only does deconstruction provide jobs directly through the work of deconstructing, it spurs business in other areas and provides jobs in the reuse field through transportation, warehousing, processing, value-added manufacturing, job training and skill-building etc. (Delta Institute, 2018).

All of the deconstruction companies that were part of the study mentioned that they are able to provide more entry level jobs with living-wages, benefiting low-income, post-incarcerated, and what society deems unskilled populations looking to enter the workforce (NAHB Research Centre Inc., 2001; Northwest Economic Research Center, 2016; Romeril et al., 2011; Shami, 2006). Ben Pearson with Sledge, a deconstruction company in Seattle discussed the economic benefits of deconstruction very well, saying,

the impact on the society, on the community, in terms of economics, what we've done is employed people that would not have gotten those jobs with a living wage. Provided them with better than a living wage that has funneled into their community, whatever community - why don't we care about that, why isn't that seen as an incentive to our site?

The city of Portland is also a good example of how deconstruction can provide green jobs and the benefits to the community. They conducted their own workforce training prior to implementation of their ordinance and their "training was focused on BIPOC communities, so

black, indigenous and people of colour, women, and post-incarcerated ... working with what the world would characterize as vulnerable population and that was by design.” Portland State University helped them understand their situation by conducting a full economic study on residential building deconstruction for the city and found that 130 deconstruction projects per year could result in “30 to 50 additional jobs and between one and one and a half million dollars in economic activity” (Northwest Economic Research Center, 2016). This demonstrates the economic benefits just for jobs.

Other economic benefits include the cost of maintaining, overburdening, and creating new landfills (Munroe et al., 2006; Northwest Economic Research Center, 2016; Shami, 2006). By diverting the materials from entering the landfill, governments will save a substantial amount of money and resources put into landfill maintenance.

4.1.4 Historical & Cultural Preservation

An important benefit of deconstruction that we must consider is the historic and cultural preservation component. Canada is the only G7 nation without any laws protecting built-heritage and deconstruction can play an integral role in giving life to structures in our communities through the reuse and preservation of building materials (Denhez & Grafton, 2021; San Antonio Preservation, 2021). As Ron Nirenberg, the Mayor of San Antonio stated in response to San Antonio’s deconstruction ordinance, “Buildings are living, breathing opportunities for us to tell our story ... being able to reuse materials even though a building itself and the facility may be failing, but to be able to reuse those materials in a way that preserves the fabric of a community is a very important part of historic preservation. In addition to that it allows high quality materials to be used in the community” (San Antonio Preservation, 2021). By deconstructing

older structures, we not only reduce our environmental impact, but we also show respect to the people and materials who build the structures and provide the opportunity for these locally reclaimed materials to be used in restoration and preservation of homes in our communities. As well, the materials salvaged from deconstruction sites can be used to maintain other structures with historical significance with appropriate materials.

4.2 The Barriers to Deconstruction

The identified barriers are based on the data collected from semi-structured interviews, literature, site visits, and my focus group. More generally, as Ted Reiff stated, the four overarching barriers when it comes to deconstruction are the capacity of industry and municipal staff, the willingness to commit and move forward, communication across the board, and accountability/measurement of program and policies.

4.2.1 Barriers to Deconstruction Practice

For the act of deconstructing, the four primary barriers established through my research were space/storage for materials, the cost of deconstruction, the capacity of industry to conduct deconstruction, and the age of homes that are coming down in municipalities as outlined in Table 5. Generally, these are organized from largest to smallest barrier, based on how many participants discussed them, their treatment in the literature and how difficult the barriers are to overcome.

Table 5: A summary of barriers to residential building deconstruction and policy for actioning residential deconstruction of the built environment.

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.

4.2.1.1 *Space/Storage*

Space for materials is one of the biggest barriers when considering the implementation of deconstruction programs and policies and came up in nearly every interview and in literature.

When a structure is deconstructed, it multiplies in size and often cannot remain on site due to a lack of space. This was very evident during site visits, where I was able to see the process of deconstruction and visit warehouses that these companies worked out of. John with Sledge, a deconstruction company in Seattle explained this, saying that when you disassemble a building “they just expand like this flower

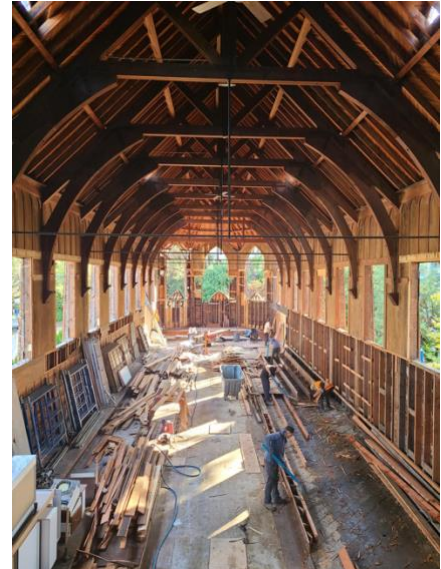


growing.” This is pictured in the image to the right, which is of the Sledge warehouse in Seattle and was taken while visiting. The space for contractors to hold this material before, during processing, and after can be difficult and costly to acquire (Rios et al., 2015). This can be especially costly when there is no direct use or final destination for the material (Jeffrey, 2011). Another participant, Jeff Wint, explained this by saying municipalities need “space for [wood markets] and other material reuse because if there isn’t that physical space, it will take a lot of space in any town and those markets have to be somewhat local.” Further going on to state that there was “concern from a few counselors just about the space requirements” when Squamish was looking into their now implemented material separation requirements.

Overall, space for the processing and storage of materials is a huge barrier that municipalities must recognize when considering deconstruction. I was able to attend a webinar titled Salvaged Lumber Summit: Building a Circular Ecosystem, put on by King County, where professionals gathered to discuss the importance and barriers to salvaged lumber. One of the primary discussion topics was space and storage, where we spent over half an hour brainstorming solutions. With representatives across North America, this demonstrates how prevalent this barrier is and although there are solutions, it is important for municipalities to work closely with industry to find localized solutions while recognizing that there is no one solution for this problem. This barrier is a hyper-local issues and municipalities will all have a unique way to overcome the barrier – from localized market investments, to providing space for no or low cost, or even helping to offset the cost through subsidies and grants – there is opportunity. Solutions to this barrier are discussed further in chapter five.

4.2.1.2 Cost

The cost of deconstruction is another barrier that was identified in many interviews and literature. This research has shown that cost can be a barrier, but it is a smaller barrier than often perceived, with some literature and participants speaking about the cost difference as more of a myth than anything (Shami, 2006). Deconstruction does cost more than traditional demolition, due largely to the cost of labour as more people are needed on site and it takes longer (Dantata et al., 2005; Nakajima & Russel, 2014). In the image to the right, I was able to capture a deconstruction worksite showing five workers on-site, more than any traditional demolition site. However, that is before considering the tax benefits and resale value of the materials, not to mention the environmental costs of demolition and the cost of managing the waste from traditional demolition (CCME, 2019). For homeowners in Canada, provincial and federal tax credits results in it being more costly upfront but cheaper after yearly taxes. This is because a lot of the materials are donated to non-profits, thus qualifying them for tax credits. For homeowners, the largest barrier is the upfront cost if it is not a requirement and recognizing the value in the action. As Ted Reiff, a participant, pointed out, in Canada it does not add a lot more cost to the homeowner and is cheaper at the end of the year when the homeowner receives money back in taxes. The ReUse people of Canada and Unbuilders have both done cost comparisons and have demonstrated that with tax credits, it is substantially cheaper for homeowners to deconstruct (The ReUse People, n.d.; UnBuilders, n.d.). This is not the case in the USA due to differing tax credit laws where tax rebates are tied to total income, meaning the



higher one's income, the more received back. Corporations also can donate the materials, although the tax credit is less substantial, but there is opportunity to reuse the materials for cost savings, sell the materials as-is, and remanufacture the materials to sell as new products. Further discussion on ways to overcome this barrier are discussed in Chapter 5.

4.2.1.3 Capacity

Capacity of Industry

The actual capacity of industry to adapt to deconstruction rather than traditional demolition and conduct the work is essential for a successful deconstruction program. Both labour and education play a large role and are barriers to building capacity. Labour can be viewed as both a barrier and an opportunity when considering deconstruction and it is also considered a pillar for a successful deconstruction program. A trained workforce for deconstruction must be available to see it happen. James Slattery described how San Francisco views this,

Labor is... I guess it's two sides of the same coin, a barrier or opportunity and we were really framing it as more of an opportunity through the city's office of economic and workforce development. It's a city department like the Department of Environment and within that agency is a group called 'City Build' and it's a construction training apprentice program, so it's the crew swinging the hammers and building out but it's also the construction managers, so getting that sort of estimations and managing the project at that level. They do apprentice training there and they were really keen to tack on a deconstruction component ... what we wanted to do is at least offer the training so that those operators could then promote their services as something different than just your general contractor.

Another participant, Shawn Wood, discussed how important labour was for the implementation of Portland's ordinance and explained how they recognized it was a barrier that the city needed to step in and help with. He stated that,

The only gaps that we were aware of that we felt we needed to play a role was in workforce development and training, so we held a contractor training before the ordinance went into effect and then six months later after it was already in effect we held

a workforce training to get more workers skilled at doing deconstruction. We could talk a whole another day about workforce development it's a tricky thing. ... Our workforce training was focused on BIPOC communities and women and post incarcerated. So, we were working with what I would characterize as a vulnerable, challenging population and that was by design, but it requires a lot of follow up and ... there's a benefit but if you've got a partner, with somebody that really knows how to work with those populations, that's important.

An article also expressed this, stating, “the lack of deconstruction training available is also a barrier to its growth as an industry” (R. CHINI, 2016). Lastly, multiple participants did bring up the concern of labour shortages as part of the barrier, as one participant stated, “you have one person operating a bobcat (for demolition) versus six people deconstructing – that's pretty significant” in terms of the workforce required (Interview 7). Further discussion on ways to overcome this barrier are discussed in Chapter 5.

Capacity of Municipalities

Participants also indicated that municipal capacity is very important for successful implementation of a deconstruction program or policy. It is crucial that a municipality has the staffing and resources to give to the program to properly implement and carry it out. One municipal worker explained that “the responsibility of administering this type of policy typically falls on the buildings department in a municipality and they are already very overloaded with other policies/regulations that they need to administer.” Another municipality discussed that,

Having the staff resource is a huge thing for ensuring success. So, you need staff to be able to carry out market research or you need financial resources to hire a consultant to carry out market research ... we spent a long time doing all the background research and getting all of our numbers and there's been a lot of fine tuning. So, there's been a lot of careful consideration going into it, it is definitely not something that we decided on the fly because it sounded good. There's been a lot of like blood sweat and tears in it and I would say and I think that's a big success as well (Interview 7).

Many participants spoke on the importance of this, while one summarized this well, stating, “Resourcing requirements for the administration, enforcement, and compliance would also have to be contemplated” (Interview 14). Ultimately, it should be recognized that this type

of policy and program is a large undertaking for a municipality and therefore it is crucial for the success that the municipality has the capacity to support the program, implement it, and see it through down the road. Further discussion on ways to overcome this barrier are discussed in Chapter 5.

Industry Push-back/Lack of Awareness

Part of the importance of building education and industry capacity is evidence with another barrier –industry push-back and a lack of awareness. Many participants and literature brought this up as a potential barrier largely speaking of the demolition industry – those most directly involved and impacted. This is due in part to resistance to change and the view that this ‘disrupts’ industry and the status quo, as well as the cost (Delphi, 2021). One participant who works in municipal governance stated that, “I can foresee there being significant pushback from industry members if deconstruction related policies were proposed. Work would need to be done to bring key stakeholders and decision makers along for successful policy implementation.”

Dylan Lock with Heritage Lumber spoke from the perspective of industry, stating that,

The biggest barrier with revamping bylaws and the current bylaws as well, is that the municipalities have a hesitancy to implement and disrupt the industry. So, I know that’s our biggest frustration – the municipalities don’t want to just for disrupt the industry. It’s kind of like ‘if it’s not broken, don’t fix it’ type thing. But we extended the analogy to – ‘Yeah it’s not broken but we’re driving it off a cliff, so we should still stop.’ So, they need to just make the changes and the industry will adapt – it has. Then on top of that is their ability to make sure people are compliant and forcing against cheaters. So, it’s the hesitation to make the change as well as the compliance... But again, all that ties into they just don’t want to disrupt industry.

There are many perspectives on this, but Lock was not the only participant to voice that municipalities just have to require it and industry will adapt.

The Delphi report, among other literature, also speaks to the lack of education, awareness, and training available and how that is a large barrier (Delphi, 2021; Olanrewaju &

Ogunmakinde, 2020; R. CHINI, 2016). The Delphi report states this well, saying, “where awareness and understanding exist, the focus remains largely on waste management and recycling rather than harnessing the full value through design, material and process innovation, and new circular strategies” (Delphi, 2021). Chandra Horth also voiced this, stating, “there needs to be a lot more awareness around waste management – that would address the problems at the beginning and the end, which is definitely part of the problem, like waste diversion.” This goes back to the idea of what human’s view as waste and what the way society has shifted to view something that is not want (Hird, 2021). For deconstruction, the perception of low value of salvaged building materials remains a problem (Delphi, 2021; R. CHINI, 2016). Many participants spoke on how lack of education is a barrier in multiple areas, including:

- Municipal staff education on deconstruction, circular economy, and related topics,
- Industry education on the value of the materials, benefits, and challenges of deconstruction,
- Workforce education on how to deconstruct, handle the materials, and processing of the materials.

Frank Baker expressed this while discussing barriers, stating, “I think one is education and education of the actual deconstructors and the construction companies themselves – they need to know how to do it, they need to be able to do how it do efficiently, and they had to do it cost effectively right.” Without the workforce and proper education, municipalities will struggle to implement a successful program as the work will be done improperly or not at all. Proper and effective education can make the make or break for this type of policy as was seen in Milwaukee where they did not have proper education, which plays a large role in not having a workforce to

conduct the work (Jannene, 2023). This should be emphasized in municipalities looking to implement deconstruction policies and programs.

The lack of awareness and education can also play a role in push-back from industry. With the appropriate methods of education, stakeholder engagement, workforce training, and working groups, there is opportunity to overcome this barrier. Further discussion on ways to overcome this barrier are discussed in Chapter 5.

Education

Chandra Horth, a participant who works for a deconstruction company on Vancouver Island explained this by saying, “the more deconstruction gets talked about and reclaimed products get talked about, the viability of that and how people see a pile of dirty wood” will change. Further going on to state that these products are no different from new wood, it’s the same thing, but we need to see a shift in how we view these products away from our traditional views and practices. Horth states that through “either training the old generation of builders or the traditional builders with these new principles or waiting for them to be pushed out of the system [by the new generation of builders] so that we can be making new grounds.” Sledge, a deconstruction company in Seattle emphasized the importance of education, stating that “you have to define uses for these materials in order to incentivize it. People just don’t know they can use it.”

To see success with a deconstruction specific bylaw, many participants voiced that education is one of the most important areas for municipalities to invest in. Frank Baker, a participant active in the salvage and reuse industry through Habitat for Humanity stated,

I think that probably goes back to education and in the absence of education or knowledge then you kind of make up your own story, so I would presume that the pushback already would be – well it's going to be more expensive, going to make what I

want to do more expensive. So, that education piece needs to be far better and far more plain so people can understand ... I think education is extremely important – I think if policies are too restrictive especially in the beginning what you are going to find is that people will just find a way around it and it might be worse than what we already have. So, I think you know we have to find a way to lead the horse to water and make them drink not just tell them here's water drink it now.

Another participant, a city representative with a background in urban planning, stated,

I always think there's an important role for education especially with something like this ... the number of folks who shared concerns about the demolition of older homes in their mature communities and you know some even brought up that there's still good materials that are on these properties and in these homes. So, I think yeah, helping foster that understanding is never a bad thing and I think ultimately would help us get closer to some of our waste diversion goals because it gets people thinking about the full life cycle analysis of stuff in our city.

Another participant voiced concern for this as some actors in the industry simply do not

understand what deconstruction means, how to do it, and what it takes to deconstruct properly

(Kinley Deller). They explained that there are contractors in their area that will take out a beam

that is a beautiful piece of old growth lumber and claim they are deconstructing, going on to

explain that there is confusion in the industry that needs to be sorted out, defining what it is and

what it isn't (Kinley Deller).

Jan Hastings discussed the importance of workforce training and education in terms of the relationship with market development. She stated, “education and skills for teaching are definitely important.” While Frank Baker expressed that education of contractors is essential, stating “education of the actual deconstructors and the construction companies themselves – they need to know how to be able to do it, they need to be able to do how it do efficiently, and they had to do it cost effectively right.” Further discussion on ways to overcome this barrier are discussed in Chapter 5.

4.2.1.4 Age/Design of the home

The age of the housing stock in a municipality can also be a barrier to action that most participants noted. The year a home was built is an indicator of the sorts of material used in

construction. My data, including interviews and published bylaws and ordinances, indicate that most municipalities have taken the approach of requiring deconstruction/salvage for homes built before a certain year (Chapter 5.24 Deconstruction And Construction Materials Management, 2019; City of San Antonio, n.d.-a; Portland, 2021b; The Corporation of the District of North Vancouver, 2023; Victoria, 2021). Palo Alto is the only exception as they did not put a year on their ordinance (Chapter 5.24 Deconstruction And Construction Materials Management, 2019). This is because newer homes have more materials in them that make deconstruction difficult, such as adhesives and spray foam insulation (Nakajima & Russel, 2014). A participant, Graham Casselman, also commented on this, stating,

I mean the biggest one, is just the age of the homes and is it worth deconstructing, right? And I know that that's why you have those bylaws in place, and you know Vancouver and North Vancouver and Victoria in terms of – OK, it's between these dates and these dates – because they know that there is old growth material in there and it's easier to take apart because of the general construction of it, right?

However, not all participants thought the age of a home is a barrier. As more research comes out, this barrier is questioned more. This argument is often linked strictly to the quantity of materials that can be salvaged rather the significance in terms of climate change. Palo Alto is the first municipalities, as mentioned, to introduce an ordinance that does not have an age limit.

Ted Reiff, supported the notion that age is not a barrier, stating,

I don't buy that argument, that's the lumber centric Canadian argument ... OK, last year I wrote an article about saving lumber only, what I did is at the house that I lived in now I assume we were going to deconstruct it and I went through and brought one of my employees to do the survey – not me. So, he determined what should be saved and what shouldn't and then I did a study on the embodied energy in the materials. OK, the lumber, while it is the largest single component, all the lumber together only represents 40% of the embodied energy within our house. The rest were windows, doors, granite, etc. right, but in order to get the lumber out you've got to get rid of those items. Now some of them aren't salvageable you know... I understand, but those are old houses. But newer houses have that, they've got Gaggenau appliances, they have engineered lumber, they have thermal pane windows that are triple glazed, right? So, those items should be salvaged, but again you'll let the lumber people talk to you and they say nah, nah. Sure, they are correct ... I know there are walnut, oak, hickory, and maple flooring in rooms that I

would just love to have. But I am 80% convinced that they are glued down and I also know that the second floor of the house has 1/8-inch plywood which is now selling for something like \$50 a sheet. Right? I'm afraid it's glued to the floor joists, so yeah, we run into that, but it's also got all these other things that are valuable.

Reiff brings about an important point here in saying that the perspective around deconstruction is often focused on lumber. And although lumber is important and the old-growth lumber in older houses is strong and highly sought after due to its aesthetic value, the items that cannot be salvaged in these homes, such as the windows, can be in newer homes. Not only that, but the embodied energy in the other materials, aside from framing and structural lumber, makes up over 50%, according to Reiff's calculations (Reiff, 2021). The barrier and argument around the suitable age of a home for deconstruction could significantly depend on what angle a municipality decides to take with any given policy. Municipalities that have taken a wood salvage approach have also taken a waste diversion and volume of material perspective. However, for municipalities wishing to strictly reduce climate change impacts and are considering embodied carbon, age of home might be less of a barrier. Regardless, more research in this area will help municipalities make more informed decisions going forward. Further discussion on ways to overcome this barrier are discussed in Chapter 5.

4.2.2 Barriers to Developing and Implementing Deconstruction Policy

4.2.2.1 *Markets and Materials*

A major consideration for deconstruction policy and program implementation is the market for the materials that are coming from a deconstruction site and whether or not the material can be diverted from the landfill (CCME, 2019). The markets for this material must be sufficient to handle the material (R. CHINI, 2016).



Faisal Miraz, a participant working in municipal waste management, stressed this while stating his recommendations, “my second recommendation is the market and again that wasn't as big of an issue for us, but I know it is for other cities so you can't, you really can't have one without the other so you've got to figure it out.” The availability of markets for deconstructed also changes per region, given that it is dependent on the regions market, although we are seeing a shift in this. The ReUse People, a company based out of the United States with recent expansion into Canada, is an example of a company contributing to the large-scale market (The ReUse People, n.d.). The ReUse People focus’ on diverting waste from deconstruction and demolition projects and distributing the materials for reuse on the market (The ReUse People, n.d.). Beginning operations in 2018 in Canada, they have completed 63 projects in Canada and diverted over \$2,263,418 worth of materials through donations (The ReUse People, n.d.).

With requiring a market for the materials, it is important to consider how complex the material is to reuse for the same purpose, reuse for a new purpose, repair, or recycle, and whether there is a developing market for the material to enter. There needs to be an adequate market and demand for the salvaged materials that are re-entering the economy (Delphi, 2021; Teshnizi, 2015). Multiple participants did speak to the market and how it is important that the market is developing, but a fully developed market is not required.

When considering the markets needed, salvageable materials coming from deconstruction sites include wood (clean, engineered, painted, treated), asphalt roofing, drywall, concrete, bricks, architectural salvage pieces, metals, plastic, and cardboard. Some of these items have a larger market than others and better recycling and reuse technology. These will not be discussed in detail as that falls outside the scope of this research. Figure 6 demonstrates the approximate percent and weight of CRD waste materials in Canada as of 2014 (VanderPol, 2014). The

following sections describe each category and discuss benefits and barriers to salvage, reuse, and recycling.

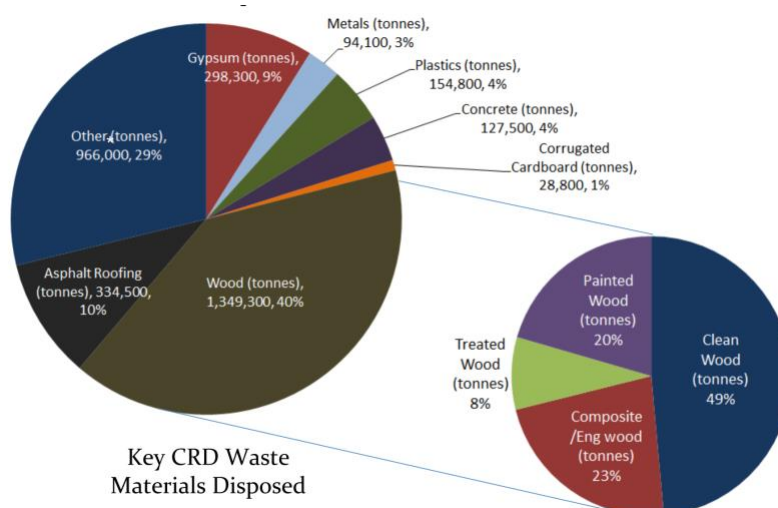


Figure 6: Percent and tonnage of CRD Waste Materials per material (Environment and Climate Change Canada, 2014)

It is important to recognize that waste management falls under municipal governance and therefore markets will be different in each municipality, meaning the ease of diversion will also vary.

If there is no market for the material to enter, then there is no point to salvaging the materials because it is unable to re-enter the market. This is a critical step for ensuring the circular economy functions effectively. It is important to recognize that this will differ for different regions and is dependent on the local reuse economy and how various materials are processed at waste management facilities. All of the programs and policies discussed in chapter five can have an impact on the market by making traditional demolition less convenient, more costly, and more difficult, and vice versa, making deconstruction cheaper and more convenient. This will be further discussed in section 5.2.2.3.

4.2.2.2 Enforcement, Compliance

Enforcement, compliance, and accountability are some of the largest barriers when considering municipal programs and policies, according to my participants. This is not necessarily unique to deconstruction as it plays a role in any program that has specific requirements. However, without some level of enforcement, compliance for a deconstruction policy is difficult. Deconstruction takes more time and is more expensive than traditional demolition (upfront), and for these reasons, if enforcement is not rigorous enough, companies will find a way around. However, finding the right method of enforcement to ensure compliance can be difficult and require a lot of resources. Many participants spoke about enforcement being one of the largest barriers. Dylan Lock stated that industry can and will adapt, but municipalities must have the “ability to make sure people are compliant and forcing against cheaters.” Faisal Mirza emphasized this, stating that cities “need somebody to actually monitor how it’s actively going with compliance, but also advocacy to make sure it’s running well, and that people are doing the right thing. And the spirit of which is intended to show success.” With current practices and standards there are multiple approaches that municipalities have taken for enforcement and accountability. This largely depends on how the bylaw/ordinance is set up.

The primary approaches taken for enforcement are:

1. Proof of Salvage: weight receipts, donation receipts, photos
2. Contractor Certification
3. Refundable Salvage Fee.

Ultimately, enforcement, and compliance are very important for a deconstruction related policy and/or program. Although this is a barrier, there is no one solution for municipalities. The approach taken to overcome this barrier will significantly depend on the municipalities current reuse and salvage market and the capacity of the municipality and industry. However, as

participants expressed, it is crucial to address this barrier in order to find success. Further discussion on these approaches to overcome this barrier can be found in Chapter 5.

4.2.2.3 Building Codes

Building codes can be a barrier for the use of salvaged materials once they re-enter the economy, depending on the location. The most discussed barrier here is the use of salvage lumber for structural purposes in new builds or other projects where lumber is required to have an engineered stamp. This means that salvaged lumber requires re-grading with the current building code, which is costly, unless it is done in large quantities (R. CHINI, 2016; Teshnizi, 2015). Heritage Lumber in Vancouver has had engineers out to do large quantity grading showing that it can happen. However, this is “a barrier to the implementation of deconstruction by raising costs and reducing the possible applications of salvaged wood” (R. CHINI, 2016). When considering building codes strictly related to the use of salvaged lumber, it is important to remember that there are many non-structural uses for it. Salvaged lumber is often sought after due to it being old-growth and beautiful to use as a finishing product. These uses are consistent with the building code and requires no grading.

The other aspect to be considered with building codes, is assessing the materials that are allowed to be used or not in construction and revaluating these. As one article states, “Currently, the lack of design for deconstruction in the buildings that are coming to the end of their useful lives is a major barrier to efficient and profitable deconstruction” (R. CHINI, 2016). This is tied closely with DfD/A as changing this would drastically change how we build homes going forward and their ability to be deconstructed easily. As Jeff Wint stated, “I think that's kind of what we see now with spray foams and more adhesives – they weren't built for deconstruction.”

Building codes however do not fall under municipal jurisdiction, making it a multi-jurisdictional barrier. Further discussion on ways to overcome this barrier are discussed in the following Chapter 5.

4.3 Chapter Summary

This chapter discussed the benefits and barriers for deconstruction and deconstruction policies and programs based on literature, observations, and interviews with twenty-four participants. Research has shown that accelerating the circular economy through deconstruction has many social, environmental, economic, and historical/cultural benefits (Bertino et al., 2021; Couto & Couto, 2010; CROWD, 2023; Delphi, 2021; Delta Institute, 2018). Although participants were not directly asked about benefits, it came up in many conversations as they spoke to these benefits in their own communities, saying they have seen them firsthand. As well, the social benefits were made clear during site visits, such as worker moral, creating meaningful jobs, and fostering a sense of place and community.

However, deconstruction also comes with many barriers. Discussion around barriers played a large role in this research as the second objective and therefore was a substantial portion of the interviews. Barriers were split into two larger categories, both deconstruction practice and actioning deconstruction-specific policies and programs. Splitting these into two categories allowed for a more in-depth analysis of each and a clearer understanding of each, although all barriers are intertwined due to the complexity and interdisciplinary nature of deconstruction.

With deconstruction practice, barriers that are evident based on literature, participants, and current deconstruction efforts include space and storage to hold the material and process it, the cost of deconstruction in comparison to traditional demolition, capacity of industry and municipalities, education, and the age of home (Couto & Couto, 2010; CROWD, 2023; Delta Institute, 2018; Nakajima & Russel, 2014; R. CHINI, 2016). There are also barriers for actioning

deconstruction-specific policies and programs that must be recognized. The largest barriers that came up include the markets for materials coming out of deconstruction sites and ensuring there is a reuse and salvage market that will accept the materials, enforcement, compliance, and accountability to ensure that industry is following all requirements set in place, and building codes which can restrict how easily a building can be deconstructed and the use of the materials when they re-enter the market (Bertino et al., 2021; Couto & Couto, 2010; Delta Institute, 2018; Nakajima & Russel, 2014; R. CHINI, 2016; Teshnizi, 2015).

All these barriers have been seen in municipalities that have introduced various municipalities and many participants spoke on the importance of overcoming these barriers to action deconstruction. As participants emphasized, these barriers must be accounted for when municipalities are considering implementing deconstruction specific policies and programs, in order to find success in this.

In summary, deconstruction boasts many benefits, but also comes with a host of barriers. These barriers can make or break successful policies and programs depending on how they are handled and considered in municipalities. This is evident as seen in successful programs, such as in Portland, San Antonio, and Victoria, to name a few cities. However, a lack of recognition for all of the necessary barriers can lead to an unsuccessful program, as seen in Milwaukee, where the proper workforce to conduct the work was not in place, it was not embraced, and they did not have the proper salvage market in place (Jannene, 2023). With various supporting policies and programs, these barriers can be overcome as will be discussed in chapter five.

Chapter Five: Policies, Programs, and Initiatives for Moving Forward

Chapter five considers my data related to what policies, programs, and initiatives are essential for acting on the implementation of building deconstruction at a municipal level and for

overcoming the aforementioned barriers. This chapter also includes a related consideration of the potential requirements or aids that can be implemented at a provincial or federal level in Canada. I begin with broader considerations that help guide policy development and provide the foundation for further policy and program development, as shown in figure 6. This is followed by specific policy actions and tools for actioning deconstruction and includes both the primary policies and complementary policies. The complementary policies are shown in the middle in the following figure as they provide further support to the primary policies.

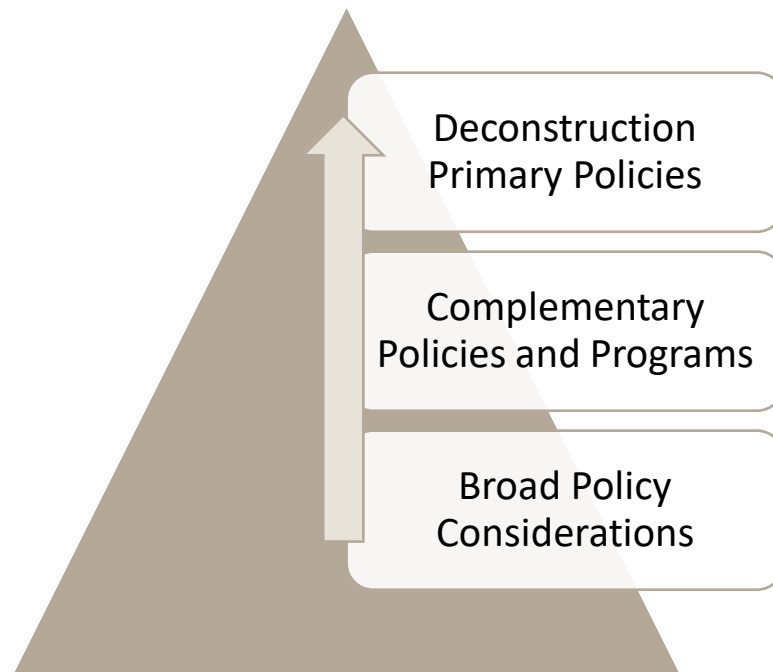


Figure 7: The three layers of policy development for actioning deconstruction.

5.1 Broad Policy Considerations for Deconstruction

The broader policy considerations and conditions to consider for developing deconstruction related policy outlined below came about from interviews and the literature. When considering deconstruction policy there are some foundational elements that are important

to consider. These considerations are important because the suite of policies applicable and useful in one municipality will not be to another municipality. It is important to understand that deconstruction is a hyper-local issue with hyper-local considerations. Although there are some foundational considerations, each municipality will need a different suite of policies and programs used in their city depending on their situation. One participant who works in waste governance captures this, stating,

There is a set of pillars about what you need in place in order to do deconstruction. ... So, I think those are contractors and markets for wood, or whatever your primary materials are you need processing as well. You need political feasibility, I guess. Yeah, I think those are primarily the things, and cities can influence those two to a point (Interview 18).

There is no one combination of policies that will work for every municipality. For example, one topic that was raised during the focus group was the question of, how many homes being demolished a year justifies developing a policy and requirements for deconstruction. However, as Christina Radvak stated, “I’m not sure there’s a magic number as to when certain communities are going to be ready for the bylaw.” This depends in large part on the municipality’s priorities, their political climate, and many other factors. One municipality estimates that they will see about twenty homes deconstructed as a result of their bylaw to begin, allowing the industry and municipal capacity to adjust with the changes (Interview 24). Many participants also stated that regardless of the number of homes, municipalities should be working in all areas that support waste reduction and climate impact reduction – it is not a matter of if, but when. One participant working in municipal waste management stated, “the landfill is filling up, you know climate change is pushing, so there is a sense of pressure to have quicker results, and this just seemed like – why waste time?”

Another important consideration with the idea that no one policy fits all is the noted importance of taking a phased approach. One participant, David Greenhill who co-owns a deconstruction company in Portland, stated in this regard, “I think the best way to do it is to take time to get it set up.” Shawn Wood also spoke to how Portland’s deconstruction requirement came about, emphasizing the importance of municipalities taking a phased approach. He said:

In our advisory group we certainly talked about – should we just require deconstruction and the neighborhood groups said yeah required for everything, development groups said just make it voluntary and give us some incentives. We met in the middle and we said let's go back to City Council and recommend a grant program, we concede it with money from our solid waste fund, we will provide grants for projects that are voluntarily choosing deconstruction, the grant money will help offset any cost difference and it will be a jumping off point for requirements – so let's do that grant project first, followed by requirements that can be ramped up overtime. Because what we were hearing from the deconstruction and salvage industry was that you can't flip the switch on this – we can't go from two contractors in the city and doing 20 projects a year to flipping the switch and doing 100 projects a year and the amount of material that will come from that – is there demand?

Another municipality spoke on the importance of a phased approach. As they were describing their bylaw, they said that,

It's a requirement but, like what we were saying about our market capacity – it's a fine balance because you don't want to have a bylaw and then create lots of material and then there's not enough places to salvage it or not enough market that people are consuming this material. So, we're doing it in a phased approach (Interview 7). It is important to have the base set up well, such as ensuring the market is developing and ready to absorb the materials, and ensuring there is an adequate workforce to handle the work. If municipalities use a phased approach for requirements, as the requirements increase, the industry, if set up well, will be able to adapt over time. But, if a phased approach is not used, it is likely that the market will be overwhelmed and there will be too much work for industry to handle. For example, a municipality could phase in the year-built requirement, starting with

homes built prior to 1950 and slowly increasing it. These details are discussed more below in the framework.

The following sections discuss five important considerations for municipalities that help to guide the direction of the policy selection and implementation.

5.1.1 Primary Demolition Driver

One consideration that can heavily influence how a municipality sets up a requirement for deconstruction is looking at the primary demolition driver and who owns most of these properties. Considering data such as, does the city own most buildings coming down, are they homeowners demolishing to rebuild, is it corporations that are buying out properties to redevelop? These are all important questions to consider. For example, some municipalities in the United States that have historically seen an influx of people moving into the city and then lots of people leaving, have looked at municipal directives for deconstruction, since there are many abandoned homes (The City of Pittsburgh, 2023). In some situations, municipalities own those homes and chose to require deconstruction for all the city-owned properties, which accounted for most homes coming down. However, in a city where this is not the case, the same approach would not make sense.

A municipalities approach would be different if most of the homes coming down are owned by residents. In Canada, as previously mentioned, homeowners who choose to deconstruct and rebuild are set up well with provincial (differs slightly in each province) and federal tax rebates. Therefore, if a municipality has a higher percentage of homes coming down that are from property owners, the approach to implementing a deconstruction or salvage requirement may include more education for residents, and they may consider whether they need a grant or subsidy program based on provincial and federal tax rebates for homeowners.

Another side is if most of the residential buildings coming down are owned by corporations, such as infill companies. The tax rebates are not as high and therefore it is more costly to deconstruct than to demolish for corporations. This might mean a municipality may consider more corporate education and whether or not they need a grant or subsidy program for these corporations to offset the cost, or if these corporations can afford the cost difference. There are also other ways to offset the cost, such as providing space/storage for materials. Regardless, this will impact what a municipality considers essential for their suite of policies.

5.1.2 Political Climate

Participants indicated that recognizing the political climate in each municipality is very important for implementing any policy or program. For deconstruction, recognizing what the local appetite is for reuse regulation or policy, and understanding what the mandate of the government is based on each election cycle will direct what actions that government is willing to take based on their constituents. So, there is politics to consider when trying to advocate for policy change related to deconstruction.

Another important aspect that needs to be discussed, within this, is that, like any policy, deconstruction will have to be sold to government, and particularly individual city councils. As was discussed in the focus group, this is important to get the 'go ahead' to move forward and develop any program and policy, and the political climate will largely influence the angle taken in order to sell deconstruction at the city level to decision makers. As discussed in chapter two, deconstruction has many benefits, and therefore various angles may be taken, e.g., waste reduction and limiting waste going to the landfill, climate change and emissions reduction, supporting the local economy through the reuse market and workforce development, etc. Although this research has a heavier emphasis on waste management and diversion, there are

many other benefits from deconstruction that must be recognized and that were discussed in chapter two, and this plays a major role in selling it at the political level. For example, Claire Lewis, a participant who works in concrete remediation and reuse, stated that “at the political level, so not at the public level, you know the city people will be coming back and saying, ‘I don't want to do this, this is so stupid, you're going to slow down construction.’” But she goes on to say that “the reality is, it's not really going to slow down construction a lot and it'll get figured out like all the same.” However, that is always going to be a concern at the political level.

Another participant, Faisal Mirza, who works in municipal waste management, stated his experience working municipally saying that “it’s all great stuff, but we don’t really have a clear direction of what’s important and in the end, it always comes down to the money and what you are going to fund.” This is important to recognize and demonstrates why understanding the political climate and how to sell deconstruction in that particular political climate is important.

Ted Reiff, who has been working in deconstruction, reuse, and salvage for decades, said that,

OK, so I'm standing before City Council and I say, “Councilman A, have you received any donations from the construction industry? Councilman B, have you received any donations from the demo or from the construction industry?” Because I want to flush out who's beholden to who. On top of that, and they probably do that at the end, I probably did more with the soft sell in the beginning. Then the environment – I can talk all sorts of different ways on environment like dust not going everywhere from an excavator, lead paint in those issues falls into the ground, anyway, it can't be recovered in the dust as well. Yeah, or noise, or it is overburdening the landfills and we've now got to find sites for new one. Where are we going to put it? Or no, who's real estate taxes are going to go down because they put a landfill in their backyard? So, those are the economic issues to work out, but further economic issues are the differences between demolition and deconstruction which is about five workers right? So, there's an employment, especially at the low end which is where the problem in the construction trade industry. It is now down 25 to 30% of where the employment base should be for all the contracts that are already written. We have the stuff in the future there already behind 25% so this is beefing up employment and at the lower end, where we really need to help those kids get ahead, so employment certainly is one. And then re-distribution of materials back into the back end of the community to revitalize the community and have them save money so

they can use that money for better health, better living conditions. The result there is quite a litany of potential sales which to me are quite obvious or just quite obvious after 30 years of business.

Many participants described the many benefits that deconstruction can provide. The importance here is that each municipality recognizes what the current priorities are and demonstrate how deconstruction will help with that priority. For example, if a cities priority is waste management, but they sell it through a heritage preservation lens, there is less likelihood of council being on board and willing to provide resources to this issue. It is very important to understand what the local climate is.

This can also be said for other levels of government and could determine whether or not municipalities can call upon those governments for support or not. Determining if their priorities align with how the municipality wants to move forward could mean support in various areas, such as financially, with research, policy, or legislation, etc. This can significantly alter how a municipality decides to set up their own policy and programs depending on other support received.

5.1.3 Local Government Structure

Local government structure is important for the implementation of successful deconstruction policies and programs, as was emphasized by multiple participants. This is because it is important for different departments to be able to work together due to the overlapping and interdisciplinary nature of deconstruction. Regardless of what department heads the policy or program, it will likely impact, and therefor need to involve other departments. For example, if the utilities or solid waste department heads the initiative, there is a high chance they would need to work with permitting, zoning, climate change, heritage preservation, etc. departments, or would want to involve them to ensure higher success rates. If these departments

cannot work together, there will be gaps in the policy and program. One participant spoke to this regarding a municipality, stating,

I mean if you talk about what level we do this at, even within this city [in North America] each department is like a separate country. Literally the utility company doesn't talk to the parks department, there is nobody that crosses over all their different departments and can get stuff done.

Due to the interdisciplinary nature, it is beneficial to work with a governance structure where departments can work together to see the policy and/or program through and communicate effectively.

5.1.4 The Role of Other Levels of Government

Although many participants noted that deconstruction-specific policies and programs are best implemented at the municipal level, they also established that other levels of government can play an important role. This can be through research, funding, or supporting policies and programs. The literature and research at this point is focused on municipal action and that's where we have seen the most action, but when asked about the role that other levels of government should play, all participants voiced that they have some role to play. For example, one participant who works in municipal waste management expressed this, stating;

I think it'd be really hard to require it on a provincial level, because a lot of things just aren't available in every community, right? They wouldn't all have the infrastructure... I mean everybody can't even get curbside recycling or curbside compost, and you know that probably comes first. But there's got to be ways you could support it at the State or Provincial level.

When discussing the involvement of various levels of government, many participants who worked in areas where there was a regional government spoke about the importance of action at that level. As Dylan Lock with Heritage Lumber stated; "So, the first step is definitely the regional waste policy. So, separating all the clean wood and that stuff, having the fines for

cheaters to be more expensive than the cost difference.” While another participant who works for a municipality in waste management stated;

I also think that the regional level has a strong role especially because they tend to oversee landfills and things like that. So, managing fees, like for example, for a long time our local landfill fee for mixed waste was lower compared to like individual waste and so now our regional government is actually switching that so that mixed waste is going to have a higher fee as an incentive that people will hopefully sort their waste. And that kind of works in a partnership with our bylaw whenever they change the fees so it will also help encourage people to salvage and sort material.

And Faisal Mirza expressed, “I think having more of a regional approach and having the regional government take more of a leadership role and actually enforcing that is going to be more valuable.” The participants demonstrated the importance of a regional government getting involved. There is also importance with recognizing how having a regional government being involved can provide the benefit of having consistency in a larger area, where there can be a lot of movement between municipalities in the region and actors that work in entire regions rather than only certain municipalities. This can be very beneficial for accountability, consistency, and compliance so that actors do not have different expectations and requirements to follow when moving between municipalities. When thinking of a region such as Metro Vancouver, this is demonstrated as the ‘borders’ between municipalities do not exist when it comes to industry.

Another common comment from participants was on the role of the provincial and federal governments in providing financial support. Some ways for these levels of government to provide financial support, that were mentioned by participants, included subsidies and grants, rebate programs, and programs such as certification help for contractors or for salvage audits which would alleviate the financial burden on municipalities. Todd Johnson discussed further the supporting role of the federal and provincial governments in stating;

So, I think the federal government does play, you know, a broad strokes role of kind of leveling the playing field across the country so that you don't have tons of variation between each province. You know making it the rule, but also providing the financial supports for people to transition. And I think the province gets into more detail, so you know we've got federal regulations for landfills, but they're really, really high level. But it's the province that writes up that specific authorization or operational certificate for us and they get into – at this site you can do this, but you can't do it at that site – so, I think the province would play a similar role in that they would need to start rolling out these programs, but in a more detailed way. And specific grants that the regional districts or the municipalities could apply for. And then you know, at local government you're face to face with your customers so you're staffing it, you're renting that site for sorting, or a yard or whatever it gets into the minutiae of detail.

Another participant, Kinley Deller, spoke about the support from the provincial/state and federal levels stating, “there’s definitely things that the state/provincial and federal can do, especially in terms of incentives for programs.” And another participant that works in municipal waste management went on to state;

In terms of programs, I think there's a huge opportunity for a provincial rebate program. All the incentives for you know, getting a heat pump, there has to be an incentive for people to if you're going to build a new home and you're going to use all salvaged materials. You can get a rebate for using reclaimed lumber. You can get a rebate for having deconstruction, like on top of what the municipality is doing – on top of the bylaws, on top of what the building code is doing. Like a provincial level or even a federal level grant for doing the thing that's going to contribute to them being globally recognized for meeting UN requirements and climate initiative recognition. You know? That sort of thing.

One participant who works in municipal governance also spoke on the call for federal support in this area, stating;

I think especially federally, you know, there is a stated priority around climate action and then I think this falls very clearly under that banner. So, I would assume that there would be good alignment federally. There might be some challenges currently provincially but yeah, I would see a role for all levels.

It is also important to call upon higher levels of government when there is a noticeable lack of action in a specific area that has been defined as an area of importance for municipalities. This could also be the case for an area that falls under the jurisdiction of another level of government,

but it is evident that they are not fulfilling their duty. For example, the Government of Alberta has previously supported Albertans by providing and assisting with generating various resources. One of these resources is the *Construction, Renovation and Demolition Waste Materials: Opportunities for Waste Reduction and Diversion*. However, this document was developed and released in April of 2006, yet it remains on the provincial website with no further action having been taken. This is an outdated document, so this is one area where municipalities could call on the provincial government to provide a more up-to-date version with current research to better support municipalities going forward.

This demonstrates that although deconstruction-specific policies and programs are best implemented at the local, municipal level, there are many ways that other levels of government could get involved and support deconstruction initiatives. It is important to talk with all levels of government regarding issues that directly impact the goals they have set and how they can support those goals. Municipalities can call on other levels of government for support in these cases, especially when it fits with the goals that those governments have made for themselves already.

5.2 Deconstruction Programs, Policies, and Initiatives for Actioning Deconstruction

The following sections outline deconstruction related policies and programs and is broken down into deconstruction-specific policies and programs that directly result in salvage, reuse, and diversion of CRD materials. In the section that follows, complimentary policies and programs are discussed. These ultimately support the primary policies and can be crucial for the success of primary policies and programs.

5.2.1 Deconstruction Primary Policies Overview

A substantial portion of participants expressed support for municipalities to adopt deconstruction-specific policies. Such policies are most often in the form of a salvage requirement or deconstruction requirement. The deconstruction-related bylaw that has been most often implemented in Canada is a salvage requirement (Victoria, District of North Vancouver, City of Vancouver). This means salvaging certain materials are required and the only way to achieve that is to deconstruct and separate the materials.

Another policy option is a deconstruction requirement. A deconstruction requirement policy may be set out in a bylaw that requires homes of a certain age property type (e.g., single-family, multi-family, etc.) to be deconstructed but does not necessarily require the achievement of a defined salvage percent requirement. A deconstruction requirement is the more common approach taken in the United States. Both of these are explored further below, along with details for what technicalities are often included in the bylaws/ordinances, a summary can be seen in table 3.

Regardless of whether a municipality adopts a deconstruction requirement or salvage requirement approach, this type of action will require a lot of planning, work with the community, and policy action in areas such as the reuse market, workforce, partnerships, networks, and more. Christina Radvak, who worked for Light House Consulting stated, “I think the deconstruction bylaws are really good start. I think they help build a market before, it helps push the industry into a direction of having these reuse stores, having people who are skilled or who can begin that upscaling process.”

Other strategies for policy and programs include complementary policies, such as incentives, disincentives, and market related policies. Table 6 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 three of these (as discussed in more detail in chapter two), 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. Each of these are explored further in the following sections and complementary policies are discussed in the following sections.

Table 6: A summary of the two primary deconstruction policies for actioning residential deconstruction of the built environment with three primary components of the policies that are typically included in the requirement.

Salvage Requirement	Deconstruction Requirement
<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Refundable salvage fee • Proof of salvage 	<ul style="list-style-type: none"> • Set in policy for homes of a certain age and zone to be deconstructed. May include some of the following requirements: <ul style="list-style-type: none"> • Refundable salvage fee • Require the use of certified deconstruction contractors if there is not a salvage requirement by weight. • Proof of salvage

5.2.1.1 Salvage Requirement by Weight and/or Material

According to the current bylaws in place it can be considered that the best practice is to have a ‘by-weight per square foot’ requirement in Canada (this is different in the US). If a municipality is going to take a salvage requirement approach, this approach will ensure an appropriate salvage rate is being met on each project. Vancouver, the first municipality in Canada to introduce a requirement began by requiring that 90% of materials be reused or recycled and 3 metric tonnes of wood must be salvaged on any historic house deconstruction,

regardless of size. All other requirements for non-historic homes are recycle requirements. The problem with that approach, as Dylan Locke from Heritage Lumber stated,

The major difference between the Vancouver one is that it requires recycling of three tons of lumber period. So, no matter how big the house is all you need is three tonnes and then you're good. Whereas the per weight per size of house or footage, which essentially you extrapolate the board footage from a weight scale, but that per size of the house is where that drive is. So, the board footage per square foot means in order to reach that you have to salvage more of the house where the three tonnes is very easy to get to and a very pathetic amount depending on the size of the house. Depending on the outcome uh that they want to achieve... having the wording right, like what we're working with the city of Victoria right now with the board footage per square foot of salvage and reuse. So, trying to define it so that it forces them to take better care and get a higher salvage out of it.

Therefore, having a requirement per square foot ensures an appropriate amount of material is being salvaged for each project, regardless of the size.

It is also very common for salvage requirements to apply to lumber specifically.

Although this only requires lumber to be salvaged, the result is that all materials will likely be salvaged since deconstruction is required to get to extract the lumber. Salvaging the other materials also saves the company money through selling and/or donating the materials. In one Canadian Municipality, it was decided that focusing on wood salvage was the best approach and for other materials "there's no requirements. But [they're] hoping that with the nature of deconstruction and focusing on the wood that it will just make sense for [industry] to salvage all the remaining things – that makes sense." They also stated that lumber constituted the largest percentage of CRD materials entering their landfill (Interview 7). It was also stated that,

We heard through our engagement that a lot of people already salvage things that would be valuable products so before they would demo a house, they would pull out certain items that could be resold, so we decided to not include that within the bylaw because wood is the major thing that goes to the landfill that shouldn't. With this requirement then they would probably end up salvaging these other materials anyway, but that'll be something that we monitor for sure (Interview 7).

As more municipalities begin programs like this, there will be more data to see how effective this approach is, but it remains the most commonly adopted approach in Canada.

5.2.1.2 Refundable Salvage Fee

Another common requirement with Canadian municipalities is including a refundable salvage fee. This fee is paid by the contractor in order to get a demolition permit (although there are salvage requirements, it is most often still referred to as a demolition permit). This is then refunded at the end of the project, based on the percent salvage achieved (City of Vancouver, 2021; The Corporation of the District of North Vancouver, 2023; Victoria, 2021). Every municipality that has a salvage requirement has a fee attached, ranging from \$15,000 to \$19,500 (City of Vancouver, 2021; The Corporation of the District of North Vancouver, 2023; Victoria, 2021). Municipalities that adopted recycling requirements, not salvage requirements, also have included a fee structure (City of Coquitlam, n.d.; City of New Westminster, n.d.). This acts as a disincentive as there is a large financial penalty for not following the recycling or salvage requirements. One municipality spoke on their process to determine why they chose what they chose, saying,

We know that through a lot of behavioral research that disincentives, like fees, actually motivate people more than incentives. So, you're looking at something like getting \$0.25 off or a dollar off of your coffee versus paying a dollar more for a single use cup – the fee will actually motivate people more than the savings. So, we applied that behavioral research across all of our work and incentives are something that we've looked at a lot, but we've always come back to having this fee – if you're not able to salvage then you don't get your money back and that had shown to be a pretty powerful (Interview 7).

Shaw Wood also spoke to this, but describing why they chose not to take this approach. He said,

We actually considered it pre-deconstruction conversation for C&D recycling, and we were aware of other jurisdictions doing a deposit. That would have required a lot more admin support to operate something like that, so it was kind of a deal killer. I can see 100% value in that, and I know some places where people choose not to come back and get that deposit. It's like, OK, that's the cost of doing business and the city generates

income that can help support that industry, so I would love to have something like that, but it would be a big administrative lift ... And our development community right now is very much like, 'hey Portland, you are really business unfriendly environment and we are having a hard time affording this,' we call them system development charges other jurisdictions call them impact fees, so it's the incremental cost of what you are going to burden the system with ... so, we never really strongly considered it and I see a lot of value in it, but it would add admin costs, but it also might be covered by the people who don't meet their reuse thresholds, you have a self-funded program.

Something important that many participants did voice, was that the fee had to be large enough to not be 'cost-of-business' and end up on the homeowner or whomever contracted the project out. One municipality did discuss this with stakeholders and arrived at a set cost by working together with local industry. Another participant, who works in municipal governance emphasized this by describing the conversations had over a similar policy structure for another program. They said, "we got to a place in the conversation where it really got down to, 'are they just going to eat that cost' and it ends up the cost of doing business.' It really begs the question, what's that threshold where it's going to be enough of a disincentive that they're actually going to stick to it?" (Interview 14). One participant argued that "people need to be punished, not persuaded ... there needs to be a fine for when you don't deconstruction, not persuasion to deconstruct," finishing by saying that individuals and companies need to be held accountable for their actions, so that the next person does end up with the responsibility of dealing with their mess (Interview 23).

This approach, however, is less common in the USA, where more municipalities have chosen to certify deconstruction contractors as an alternative to help with accountability, as discussed below.

5.2.1.3 Certified Deconstruction Contractors

As an alternative to having a salvage fee, many municipalities in the USA have chosen to certify deconstruction contractors as a means of enforcement and accountability (e.g., Portland,

San Antonio). This means that the municipality provides a certification to specific companies that have obtained training, allowing them to deconstruct and that only contractors that are certified by the municipality can conduct any deconstruction. Developers and homeowners in the area then must use contractors from the list provided by the municipality to deconstruct their structure. There is typically no requirement on the back end for contractors to prove what they have salvaged by weight. As Shawn Wood described, this acts as a self-regulation tool as contractors hold one another accountable as they are direct competitors. Contractors will inform the municipality if they see malpractice, which would result in an audit of the reported company and practices and can result in the certification being revoked. He stated,

Without a doubt that's number one because it has so many benefits in terms of quality control, accountability, ease of communication ... there's just so many benefits from having a select certified pool. It also helps strengthen the industry, so if everybody and their brother is deconstructing houses and selling crap out of their backyard nobody is going to be successful - you've got too many cooks in the kitchen.

And Dylan Locke from Heritage Lumber expressed support for this saying, “I think that a specific certification is where the municipalities are hesitant to have that hammer approach but it’s definitely what would make the difference.” Both certifying deconstruction contractors and refundable fees are most often paired with proof of salvage.

5.2.1.4 Proof of Salvage

Proof of salvage is a very common method of accountability which municipalities tend to include in their bylaw or ordinance. Proof can be determined through weight receipts, donation receipts, pictures, and other similar types of proof. However, it must be noted that although all municipalities require some level of proof of salvage, not all actively have staff checking this to ensure it is happening due to staff capacity. Participants did indicate as well that municipalities are trying to work with business and industry to not make this requirement too much of a burden and be pro-business.

Some municipalities worked alongside contractors and industry while developing their bylaw and came to an agreement on what would be acceptable proof of salvage. It was emphasized that “in terms of the bylaw, ensuring enforcement is rigorous and also being able to measure and track those materials that are being salvaged,” was very important (Interview 7). They also spoke about how they are allowing for a certain percent of the material salvaged to be proven through photographs (Interview 7). This is to allow for the informal market (e.g., Facebook marketplace, people walking down the street, etc.) to do its part and promote salvage and reuse within the community. As well, certain organizations are allowed to provide a non-weighted receipt because they are non-profits who do not have the ability to weight the material but rely on donated and salvaged materials. Due to these businesses working in good-faith with the municipalities, contractors can work with them and not provide a by-weight receipt. Some ‘informal’ practices are important alongside the more stringent practices. The combination of salvage receipts by weight and some ‘informal’ practices is the most common approach and would be considered the best practice, but it does take municipal resources and staffing to ensure this is done correctly. Squamish, a city that does not have a salvage or deconstruction requirement, but does have a recycle requirement, took a similar approach when defining their bylaw. Jeff Wint, a participant that works in Squamish stated that,

There was some concern about reporting requirements, how particular it was and how that could be proven so we tried to be as flexible as possible on that – like accepting pictures and rough estimates at our landfill and we waved the scale fee if you're weighing an empty truck or a full truck for the purpose of reporting on reuse. ... So, we waved that if people are doing it for the purpose of the bylaw – trying to be more flexible on understanding that all of those material reuse networks aren't formal at this point and trying to be flexible. So, there is not a ton of pushback, but doesn't necessarily mean that there's full compliance.

For Vancouver, Faisal Mirza mentioned that proof of salvage can be difficult in saying,

You pay \$15,000 deposit and you don't get it back unless you show all your receipts that you recycled everything you were supposed to and salvage what you're supposed to and

some of these entities are less credible than others and they'll just say – yeah we 100% recycled it, but we don't know. Or it's like – oh you know we are lying, but you know, what can you do? Especially where it's Metro Vancouver's jurisdiction.

Some municipalities, such as Palo Alto, have also included a salvage survey (Chapter 5.24 Deconstruction And Construction Materials Management, 2019). This will be discussed in further detail below as a complimentary policy. Although it is sometimes incorporated in a deconstruction or salvage requirement, it can also act as a stand-alone policy.

Closely tied with this is the development of the reuse and salvage market as that will help industry adapt and comply as there is a market to receive the material. Mirza stressed this, stating “as soon as [companies] lie about the receipt, they're lying but they are not going to be transparent about other stuff as well, so I've been really focused on markets and trying to really enable markets to the point where the market wants to grab this stuff. So, making sure that policy is there, but recognizing it's just more as a as a backstop.” He later went on to say that “the unintended consequences are that if there no markets to receive it then the stuff ends up... well they lie on the receipts.” It is very important for municipalities to have resourcing for both the market and compliance side of a bylaw to see success – these two go together and support the other.

5.2.1.4 Age Criteria

As discussed in section 4.1.4, the age of a home is sometimes perceived as a barrier due to the materials used in construction and newer materials causing difficulties in clean deconstruction. Defining the age of home in the policy or program appears to be the most direct way that municipalities are dealing with the age issue. Multiple municipal representatives discussed this.

We landed on the 1960's because of things like glues and materials that are now not super salvageable. Whereas for 1960 and older, all that wood is very valuable and very

salvageable. I'm not sure if we will extend the age, that kind of depends on what future deconstruction technologies become available. If there is a way that they can recover wood that has adhesives, gluing, and all those composites and if markets pop up for recycling. That is something I think we could potentially look into, but I think that's more dependent on what industry comes up with at first.

I assume we will do a similar year cut off like Portland has done like a year-built cut off. I don't know how else... I realized there's bad houses that were built in 1910, and there's good houses that are built in 1980, or whatever. But I think it's just like a better proxy, probably for valuable materials or for good wood than other things. So that's really um awesome.

Some municipalities also have a wood salvage requirement specifically, not a deconstruction requirement, which influences considerations such as age of home (The Corporation of the District of North Vancouver, 2023; Victoria, 2021). As mentioned above, it is important to recognize that this may be more of a perceived barrier than an actual barrier depending on a municipality's goal. If it is tied to climate change, it is likely that homes of any age are worth deconstructing. More research has been going into this as more municipalities begin discussing and introducing bylaws and ordinances and this barrier may change in the future.

5.2.2 Complementary Policies and Programs

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). Some complementary policies include financial and time incentives/disincentives (fines, fees, penalties, grants, subsidies, time), education, material bans, research, etc. These policy approaches can play a role in encouraging specific actions and are often considered 'hands-off' method to influence industry to act a certain way as it is not strict regulation of what industry has to do, rather it influences how they make decisions. Table 5 provides a summary of potential complementary/supporting policies with a brief description of each.

Table 7: A summary of complementary policies and programs for actioning residential deconstruction of the built environment.

<p>Time and Financial Incentives</p> <ul style="list-style-type: none"> • Permitting • Subsidies & Grants
<p>Time and Financial Disincentives</p> <ul style="list-style-type: none"> • Removal of Toxic Materials • True Cost Landfilling
<p>Education</p> <ul style="list-style-type: none"> • Public Education Programs • Workforce Training
<p>Other</p> <ul style="list-style-type: none"> • DfD/A • Building Codes • Salvage Assessments/Material Management Plans

5.2.2.1 Time and Financial Incentives:

Permitting

Incentivizing deconstruction and salvage through quicker permitting than demolition. This acts as both a time and financial incentive, as time is money to contractors. This may look like deconstruction and salvage permits being accepted day-of (or soon thereafter), with traditional demolition permits taking significantly longer to be accepted. This means work can start immediately on deconstruction/salvage projects saving contractors time and money. In this instance it is important that the time is large enough to encourage deconstruction and that contractors will not eat the time waiting for the traditional demolition permit as cost-of-business. This will depend on the municipality and current practices.

Some participants expressed support for this type of approach as an alternative incentive.

Dylan Locke with Heritage Lumber said,

I can definitely see that being more of a motivator than a fine that doesn't make a difference. Yes, it would be beneficial because the City of Vancouver is famously bad for long development or long permit application. So, that I don't believe they have that right now, but we have multiple jobs that we have the contract, and we are good to go but we are sitting and waiting to get those permits. So, if there was an incentive to fast track, I can definitely see that being more of a motivator.

A time of permitting incentive may also be required to bring change to the current system.

Seattle tried this method in 2017 in offering deconstruction permits immediately when they were applied for. However, soon thereafter their entire permitting system went through an overhaul and every type of permit was streamlined, thus taking away the incentive.

Subsidies and Grants

For deconstruction, there are multiple ways incentives can be put into practice such as financial (subsidies, grants) and time incentives. Many municipalities, such as Portland, began their deconstruction ordinance with financial incentives, offering companies a lump sum of money to offset the cost of deconstruction if they choose to go ahead with deconstructing. This was followed by a requirement to deconstruct. This can be a great tool to help incentivize companies to start deconstructing, helping them to offset the cost as they enter into the deconstruction industry, learn about best practices, and develop company practices for effective deconstruction. Seattle is another example of a municipality beginning with this approach. However, in Portland's case they had a plan for implementation of a deconstruction ordinance and Seattle is still developing theirs. This exemplifies how different municipalities may implement a similar program in a different way depending on their current situation (markets, workforce, etc.) and financial means.

Financial incentives in the form of grants or subsidies can also play a major role in helping to alleviate start-up costs for companies wishing to enter the deconstruction business. It

is likely that most municipalities would need to see the development of more deconstruction companies if they chose to require deconstruction or salvage of materials. Financial incentives can play a huge role in developing the industry and workforce to support the primary policy.

Another opportunity for incentives is in research and development, specifically for materials where there is not a huge market for in your area. Funneling resources into finding alternatives for these materials is very important, but research at this level can happen at all levels of government and municipalities can call on other levels for support.

Financial incentives for materials that can be recycled or reused but do not generate high economic returns is another opportunity for support for industry and market development. This can also help offset the cost of deconstruction as selling the materials back into the economy is the goal and a large source of income for deconstruction companies.

5.2.2.2 Time and Financial Disincentives

Removal of Toxic Materials

Requiring the removal of toxic materials from job sites pre-demolition is a policy tool that is already common in most municipalities that have actioned deconstruction. Removal has been implemented for asbestos in the majority of North American municipalities, and in some cases is a requirement of a larger body of government due to the toxicity of asbestos. In Canada, the federal government banned the “import, sale and use of asbestos and the manufacture, import, sale and use of products containing asbestos” in 2018 (Government of Canada, 2020b). Each province and territory individually regulates asbestos products, including what, if any, asbestos containing products may be used in construction and whether abatement is required prior to renovations or demolitions. In Alberta, abatement of asbestos containing materials is required prior to renovation or demolition (Government of Alberta, 2019). There are also very

stringent requirements for how to conduct abatement related to occupational health and safety, due to its toxicity.

A similar argument can be made for lead, which is often found in paint, and toxic dust created by traditional demolition. Portland, for example, requires the removal of all lead paint siding prior to demolition on top of asbestos abatement (City of Portland, 2017). If a home is built prior to 1978 it is assumed that it has lead paint and tests have to be done to prove otherwise if contractors want to demolish the dwelling with the exterior on (City of Portland, 2017). Contractors are required to have their Oregon Construction Contractors Board (CCB) Lead-Based Paint Renovation (LBPR) license in order to properly handle the material (City of Portland, 2017; State of Oregon, n.d.). If they do not have their LBPR license, they can be subject to fines (State of Oregon, n.d.). It is also required that “during mechanical demolition activities, including transfer and loading of materials, the structure, equipment parts that come in direct contact with building materials, and debris must be continuously wetted with a water spray sufficient in volume and force to prohibit airborne emission of dust and particulates from leaving the site” (City of Portland, 2017). There are some exceptions associated with unsafe structures, such as fire or flood, but contractors are required to present a letter from a city organization (fire, police, structural engineer, development services, etc.), a statement proving there is no interest in the property, and supporting evidence as to why it is unsafe to follow any of the above requirements (City of Portland, 2017).

By requiring abatement of asbestos and lead paint siding, homes are then stripped to the bones, providing an incentive for contractors to choose deconstruction (Shawn Wood). Due to the extra cost of abatement, deconstruction presents an opportunity for the contractor to make some money out of the process. If municipalities require watering down of demolition site as

well, this provides further incentive to deconstruct as the materials collected and brought to landfill become substantially heavier, therefore costing more in landfill disposal fees.

Both the abatement of lead paint siding and watering down of demolition sites act as a financial and time disincentive for traditional demolition. It costs more and will take much more time. Because of this, Portland, for example is seeing more voluntary deconstruction due to the ability to make financial gains when deconstructing in comparison to the extra costs associated with traditional demolition and increased regulations.

True Cost Landfilling, Disposal Fees, and Landfill Bans

An important concept that is often pushed to the back due to difficulty to define and thus is ignored, is the true cost of our actions (Eshet et al., 2006; Hirshfeld et al., 1992). One policy approach to consider is putting an accurate price on the landfilling of our waste. This can come in the form of tipping fees and landfill tax (Nakajima & Russel, 2014; Sonnevera International Corporation, 2006). Both mechanisms result in a financial burden and therefore a disincentive to disposing waste in the landfill, thus incentivizing efficient design to enable better reuse and recycling (Nakajima & Russel, 2014; Sonnevera International Corporation, 2006). Fees can be applied across the board or there can be different fees for different types of materials, depending on the impact of that material and the reusability and recyclability of that material (Sonnevera International Corporation, 2006). For true cost landfilling, the price would include the environmental costs, social costs, and negative externalities associated with landfilling our waste (Eshet et al., 2006; Hirshfeld et al., 1992). One approach is a landfill tax that is paid on top of regular disposal and landfilling fees. It is also recommended that the allocation of the funds is written into policy, so that it can be reinvested into research, management, education, and other

related initiatives and not into municipal general revenues (Sonnevera International Corporation, 2006).

Many participants spoke about the urgency of reducing the amount to waste going to landfill as many are filling up very fast and noting that governments need to start making changes to prevent materials from entering the landfill unless absolutely necessary. Multiple participants spoke on this.

In King County they would do it by saying the landfill is almost full and we're passing on the true cost to the people that are filling it up too quickly. I guess what I'm hearing, and I believe it to be true – sometimes leadership is doing what's right without you having to say, 'I know this is right and we're going to do it and we're going to benefit from it' (John Benavente).

Cost is a tricky one. In the short run, because we don't pay enough for garbage, the cost of the labor and cost to deconstruct is quite high versus the 'cost' to demolish - and I say that in quotations because it just represents present dollar value, not cost to environment or society or anything like that. The present dollar value of throwing something out is way cheaper (David Greenhill).

Another participant, Dean Romeril, who works in Lethbridge, AB, discussed that this type of policy can be very beneficial for the market of recyclable and reusable materials, but it does not come without complexities. He expressed concern for contractors considering these fees, 'cost of business' and deferring it to the client. He stated,

A lot of cities will start putting their tipping fees up high because they want people to recycle rather than just go and dump. They're trying to force them to recycle by making it too expensive just to put it in the landfill. Some contractors will just charge the client extra for that. I mean, I understand the process behind it, but how effective it is I don't know. But it does open the door for somebody that's like the one person in town here that now crushes concrete too and sells for aggregate. It opens door for people like that to be a receptacle for a lot of materials. So, it can generate more private industry as well. There is opportunity here for other levels of government to step in and introduce legislation such as material bans for landfills. A report done by CCME in 2014 also identified legislative bans and tipping fees as an opportunity for higher levels of government to help with waste diversion and reduction (Giroux Environmental Consulting, 2014). If municipalities consider this, look at

introducing landfill bans and making the cost of landfilling more representative of those factors, this would disincentivize landfilling, and incentivize deconstructing by leveling the playing field. These can also have an influence on the market for these materials as less materials would be landfilled.

5.2.2.3 Education

Most participants suggested that municipalities must consider the role that they need to play to ensure the community and workforce is prepared and educated on deconstruction. This will largely depend on where the current workforce is at in any given municipality, but participants in interviews recommended that municipalities may consider the following ways to support the development of industry capacity:

1. Public outreach and education as part of program implementation;
2. Work with local reuse and heritage companies to set-up local educational programs for the community;
3. Stakeholder engagement as part of the program and policy development;
4. Work with local educational institutions, such as trades schools, to develop training programs for deconstruction related jobs; and
5. Develop a municipal certification program for deconstruction contractors, which could be in partnership with local reuse companies or educational institutions.

Public Education Programs

Participants and literature speaks to the importance of education as a tool to overcome many barriers for ensuring the success of a deconstruction program or policy (CCME, 2019; Delphi, 2021; R. CHINI, 2016). Investing in education can be crucial for deconstruction and developing the local reuse market.

As mentioned before, San Antonio is an example of a municipality that has invested a lot of time and money into public education. This is through local reuse courses, refurbishment courses, and more (City of San Antonio, n.d.-b). San Antonio also partners with local reuse organizations to provide these courses and workshops. These are tangible ways to increase public education.

A few municipalities that have or are looking to implement deconstruction and/or salvage requirements voiced the importance of having stakeholder engagement and including them in the process of program development, as a way to overcome many barriers (Shawn Wood, Interview 7, James Slattery). James Slattery described this, explaining the plans for San Francisco saying, “[Industry] will be in the working groups, they have not been convened but they will absolutely be there because we have an existing infrastructure of demolition contractors and deconstruction contractors.” Ultimately, education can help foster the shift in mentality to seeing buildings as resource banks, holding valuable materials and hold meaning, which will help strengthen the market.

Workforce Training

On top of education, skills teaching is also crucial for industry directly involved in deconstruction. Many participants discussed the importance of some level of apprentice training for contractors and those working on deconstruction sites. Ted Reiff spoke on this and explained that his company, The Reuse People, has “trained over 50 contractors and trained over 500 students, typically at-risk youth or students looking to get into a job somewhere – deconstruction is an ideal job and it's a really well-paying job.” Reiff is not the only participant who spoke on the quality of deconstruction jobs. Participants spoke on this at job sites that I visited, voicing

that deconstruction companies have been able to provide entry-level jobs with competitive wages for workers and a good work environment.

The idea of working with local institutions and larger governing bodies to provide a base level of education was discussed as an option to overcome this. Christina Radvak, a waste consultant stated that “we definitely need like more education in the area in general just for like trades like we don’t have any good deconstruction training.” And Chandra Horth, a participant who works for a deconstruction company also voiced this, saying,

That, and that comes down to like a really, really fundamental level of apprentice education. So, Camosun [College], MBCT, and Simon Fraser – all these awesome facilities or institutions are pushing apprentices out. There needs to be a fundamental education part or an entire semester worth of waste management comprehension. ... There needs to be a lot more awareness around waste management. Contractor education is crucial for successful programs, and it is important for

municipalities to consider where their workforce is and what they might need to do to develop it. Municipalities have the opportunity to provide or partner with local non-profits or educational institutions to provide this education. San Antonio has done an excellent job of providing trades training to equip their workforce. They run the REHABARAMA program which aims at prolonging the life of older homes in the city, while integrating trades education, and getting help from both sponsors and volunteers (City of San Antonio, n.d.-b). They also provide a Historic House Specialist certification for realtors in the area (City of San Antonio, n.d.-b). Lastly, they have the Living Heritage Trades Academy which was developed to “create opportunities for all to perpetuate traditional skills and crafts; to conserve and maintain existing building stock and materials; and to leverage living heritage for economic prosperity” (City of San Antonio, n.d.-b). The goal of this program is also to help build a workforce to support industry in San Antonio and to become certified, individuals must get over 400 hours of experience and training following a one-week course (City of San Antonio, n.d.-b). This program is supported by local contractors,

education partners, and communities (City of San Antonio, n.d.-b). On top of that, they are a hub for educational resources, videos, and demonstrations. This is all made possible through a partnership with the Power of Preservation, a local coalition for agencies, organizations, and communities in San Antonio (*Power of Preservation*, n.d.). These are all tangible ways municipalities can provide education and training.

5.2.2.4 Other Policies

Design for Disassembly and Adaptability (DfD/A) and Building Inventory Modelling (BIM)

Design for disassembly and adaptability aims at helping designers and architects design buildings to allow for disassembly at end of life, and similarly to allow for easy building renovations (Delphi, 2021). Implementing this would allow disassembly to be cost-effective, for lower end-of-life impacts, by providing ways to re-use, salvage, and recycle components and materials of buildings (CCME, 2019; Dams et al., 2021; Nakajima & Russel, 2014; Zizzo et al., 2017). In this system, designers consider the life cycle of each component and the best methods for adapting and disassembling each component.

Design for disassembly was introduced in 2002 by the CSA Group in Canada and played a major role in the development of the ISO Standard developed in 2020 (Delphi, 2021). The central idea of DfD/A captured in the ISO standard is that those who design the home create a plan that allows those at the end-of-life to disassemble through the methods laid out, and also includes a directory materials and components used in the building (CCME, 2019; Zizzo et al., 2017). This promotes efficiency and better equips those deconstructing the building with a better understanding of what they are working with and what will be required to deconstruct. However, since its inception in 2002, little has been put into practice for DfD/A (Delphi, 2021). Many participants did support DfD/A and emphasized that it is a practice that we should be considering, and that they were hearing more conversations in this area. Hortense Montoux, a

participant working with the Centre Centre D'études Et De Recherches Intersectorielles En Économie Circulaire (CERIEC) in Quebec, voiced their support while recognizing it is not the only answer, saying,

I mean obviously very early-stage measures like designing for deconstruction are very important – that's what we need to get to. In the meantime, we have this huge amount of existing buildings, so I don't think you can say that design DfD/A is going to be is more important. I mean eventually yes, but we need to take into account that we have a huge stock of existing buildings that definitely need to be deconstructed.

This is an important realization, that principles and policies such as DfD/A are very important going forward, but it's important to not forget about our current infrastructure that will age out.

With the development of modular housing, similar principals and thinking to DfD/A has been considered and used, but actual adoption in industry has yet to be done, other than small individual projects (Delphi, 2021). A report released by The Delphi group states that the major areas that need more focus and attention are “developing construction best practices, investing in material and component innovation, or supporting policy and educational/training resources at a broad scale” (2021).

There is also opportunity to reduce waste and design for disassembly through pre-fabrication. Jeff Wint described this, stating how pre-fabrication makes sense “definitely from a waste perspective because you're building it in a much more controlled environment where the waste can be managed much more exactly.” With pre-fabrication, components of homes are built to spec in an indoor setting and then trucked to site and assembled. This process allows for better tracking of materials and planning, it is a controlled environment, and ultimately can create much less waste at the inception of a home, but there is also opportunity to plan for less waste production at the end-of-life. Because of this, there is opportunity to consider what role pre-fabrication can play in both DfD/A and deconstruction. Although pre-fabrication homes are

around, how they may play a role for addressing environmental concerns, such as waste management, needs more research and development.

Building Information Modelling (BIM), also referred to as Building Inventory Banks, Building Inventory, Material Banks, and more, is another tool that is used in the planning phase of home building to allow efficiency in the build and includes spatial coordination, labour, and planning for how the building materials can be reused (Yeheyis et al., 2013). With coordination of all actors involved through the entire lifecycle of a project, BIM can help with changing of information availability when it comes to the end-of-life for buildings that need to be deconstructed. This allows for contractors to know what they are getting out of a building (give or take when considering renovations), have better cost estimates, and know the value of the material in the salvage and reuse market. Hortense Montoux discussed the importance of traceability, stating,

Then we also have a lack of expertise and data on traceability in the sense that most of the work sites don't have the tools to know what's in the building they are currently deconstructing and so it's hard to assess the value of the materials that are there and what they might get out of them. ... If traceability is implemented a bit better on the earlier stage of buildings, then when it comes the stage of deconstruction obviously you have very detailed and technical information about what is in the building, where it is what are its technical features, and that would obviously give more value to deconstruction and reuse.

BIM was mentioned by a few participants, but there was indication this was a newer topic and that the research supporting it is lacking. One participant, Frank Baker, recognized the value in it but also acknowledged that it would be very difficult to develop a system to do this. He stated,

I think you may be able to do that with some of it, but I don't think all of it. I think that is a massive undertaking – I think not only to maintain that database but the deconstructors and contractors populating it properly and providing the right information. There is also the question of what level of government should be responsible for this type of policy. These conversations are beginning to happen, and policies such as inventory banks and

databases are important. However, there needs to be more research in this area as implementing these are very difficult and extremely complex.

Building codes

Building codes are also important to consider when it comes to the management of CRD materials. Building codes can play a large role in the practices adopted that impact whether buildings can be easily deconstructed, what can be used in new builds which impacts the salvage and reuse market, and more. One important consideration in relation to the modification of building codes is the larger overarching associations, like the CSA, that set rules in place. As well, according to Chandra Horth, it's important to note that there are associations that "are highly linked and highly funded by the logging industry." This is especially a consideration on the west coast, where logging is one of the largest industries. As Horth stated,

If we try to change the way that they produce, the way that they make money, by reusing things that they've already paid for or that they've already made a profit on. And they're going to want to keep making a profit, opposed to changing that, so it comes down to a very monopolized system. A very colonial, monopolized system. Those are big barriers. These associations have huge impacts on our best practices in the industry.

The language that is used is also very important to see future change. Horth also emphasized this, stating in reference to salvaged materials, "although our code doesn't say you can't use it, the code limits you to what you can use, so that language needs to change." Similar to DfD/A, as previously mentioned, building codes can have a lot of power in the trajectory of future development and waste management practices, thus having a significant impact on the environment.

One example of a change in language in building codes is in the state of Washington and Oregon. They worked alongside industry to change their building codes to allow for the use of salvaged wood for structural purposes (Shawn Wood). Participants explained that with engineers, they developed a guideline that defines the various types of wood coming out of

deconstructed buildings and equates them to certain levels of grading of new lumber. Builders and inspectors can then refer to that and use various types of used wood as an equivalent to certain grades. This was a huge shift and significantly supports their reuse and salvage markets – an important step in making progress. One participant, an engineer who has worked on green projects, stated that “as long as the structural engineer is OK with using it then [builders] would have no problem using it.” He also spoke on the importance of these changes happening at higher levels of government because they regulate building codes. He explained that,

The national building code in Canada typically is reviewed every five years and there is a new code that comes out – there will be a bunch of consultation and so as different engineers in different industries learn different best practices and figure out that this is a better way to do things that will suggest that that comes into the code. So, that's not so much on a grassroots engineering level or the common designer level but that is a way that certainly these things could be implemented into the high scope. That is ultimately who's making the code and they put it in there – then that's how everyone in Canada has to build, which obviously has a huge impact (Interview 1).

Changing the language can involve many different things, including allowing for use of salvaged materials in new builds, minimum reuse requirements on new builds (see images below for salvaged wood used in new builds), and building performance standards, which we are starting to see through certifications such as LEED.



Images from a new build by Sledge in Seattle where salvaged lumber was used for finishing, both inside and outside of the house.

In Canada, Vancouver is the only municipality that has its own building code, so although municipalities can push for these changes higher levels of government and industry will be needed to action change. Municipalities can call on other levels of government to effect change in this area. This has been done, in the state of Washington, they have created a group called the Regional Code Collaboration, which is a group of code writers from counties and cities in the area and they have come together to work on construction, demolition, and deconstruction codes (Kinley Deller). This level of collaboration is key to actioning change in this area, especially because these codes need to be changed but it falls more heavily on the provincial and federal governments.

These changes can also impact markets for materials, as it removes a barrier for these materials to enter the circular economy.

[Salvage Assessments/Material Management Plans](#)

As mentioned above, some municipalities have also included a salvage survey as part of their deconstruction program as a method to overcome the barrier of compliance. This can act as a stand-alone policy and requirement or as a precursor to the demolition permit and sets up projects so that they know what to expect to be able to salvage and recycle, and on the back end, they must prove that those materials were salvaged or recycled – depending on the bylaw specifications. This salvage assessment is typically done by a certified individual or company that is approved by the municipality and could therefore help with ensuring compliance. The City of San Francisco is also planning to incorporate this to some extent when they introduce their ordinance. A participant with the City of San Francisco, James Slattery, discussed how they are considering the extra cost of deconstruction and how a salvage survey or inventory might impact compliance by making demolition more expensive (Interview 21). They were discussing

these options with their advisory committee to determine the best steps forward, but he did emphasize that “the main tactic to offset cost is the tax deduction because the cost does go up and the reason it’s going up is because you’ve got 6 to 10 hands on the job site for multiple weeks.” A software program called Green Halo Systems is used by some municipalities as a tool to track materials. Ultimately, participants I spoke with expressed that compliance and accountability is one of the most difficult barriers with deconstruction, yet the most important to ensure a successful program and the answer will not be the same for every municipality.

5.5 Chapter Summary

Chapter five focused on examining the programs, policies, and initiatives that the twenty-four participants spoke about. This also included looking at what municipalities have done and are doing today with deconstruction, and they were grouped into two larger categories: primary policies and programs and complimentary programs and policies. The primary policies were grouped together as they require deconstruction or salvage of materials. There two primary ways that municipalities have approached deconstruction, one through requiring deconstruction of buildings and the other by requiring all projects to meet a specific salvage requirement. These both can come with a suite of tools and criteria to ensure compliance that municipalities are using today, including having an age requirement, a refundable salvage fee, proof of salvage, certified deconstruction contractors, and achieving a salvage percentage by weight. Second, there are complementary programs, policies, and initiatives which often serve to support the primary ones. These are important as they can help ensure the success of the primary policy by filling in any gaps, avoiding any unintended consequences, and helping industry and the municipality with seeing success and a return on investment (Northwest Economic Research Center, 2016).

Many municipalities have implemented a suite of these policies, programs, and initiatives locally with their deconstruction/salvage requirement. However, the right combination and application of what was presented in this chapter will differ for each municipality as this issue is very localized. It will depend on the current market, the workforce available, the type and number of buildings expected to come down, and many more factors. As well, it will heavily depend on the barriers present in each unique case.

For example, the City of Portland was the first municipality to implement any deconstruction-specific policy. It is in the form of a deconstruction requirement but does not require meeting a certain salvage percentage and they have seen a lot of success in their program (Portland, 2021; Shawn Wood). However, the city of Victoria and District of North Vancouver have both chosen to require all projects to meet a certain percent salvage per square foot of building space (The Corporation of the District of North Vancouver, 2023; Victoria, 2021). These are two very different approaches but were chosen based off of each municipality's local context. The approach taken is heavily influenced by the local barriers and context as well, and each municipality must assess their own needs to determine what suite of policies and programs best fits their context (CROWD, 2023; NAHB Research Centre Inc., 2001).

Both literature and participants have emphasized that a municipal deconstruction program is very complex to implement as it contains many moving parts, but municipalities have done it, demonstrating that it is possible. With time, it is likely that we will see more bylaws and ordinances come to fruition in North America and more answers will come as to what suite of policies and programs may work best together.

Chapter Six: Moving forward with Deconstruction in Canada

As an outcome of the literature reviewed, response sheets, interviews, and site observations as established in the chapters above, I developed a draft *Framework for actioning residential building deconstruction for larger Canadian municipalities* and presented it at a focus group with professionals working at the City of Edmonton. This framework was developed through the interview data, responses to a summary sheet provided by interview participants, and literature. A draft framework was then presented at the focus group with the City of Edmonton where it was discussed, assessed, and improved upon based on feedback from the municipal actors as outlined in Chapter 3. This data is explored at the beginning of this chapter. I then present the framework, developed through various drafts. This is presented to give context for the following section, which is the case example of applying the framework with the City of Edmonton case study. This section details the data collected regarding applying the framework within the City of Edmonton context that was discussed at the focus group. This section also applies the framework to the City of Edmonton with the data available, as an example. Lastly, it goes through feedback given from participants at the focus group on the framework, which was integrated into the final version of the framework presented at the end of the chapter.

6.1 Recommendations from participants that underpinned framework development

6.1.1 Policy Recommendations

As part of the interviews, participants were asked what they believed the best, or most feasible, policy approach is for municipalities wanting to action deconstruction. Many participants spoke in favour of some type of requirement (e.g., a primary policy as outlined in chapter five) alongside supporting policies, while recognizing the challenges doing this brings and taking note of the obstacles that will be faced. Participants that did not feel equipped to answer this question, often spoke in favour of moving forward, recognizing that what is currently

happening needs to change. Participants sentiment about the complexity of developing policy for deconstruction is captured well in the following quotes;

Yeah, I think the deconstruction bylaws are really good start. I think it helps to build a market before... like push just the industry into a direction of having these reuse stores having people who are skilled or who can begin like that upscaling process so I do think that's important but yeah we also have like a huge gap of like the other side of what happens to these materials or even how do we build buildings to allow for deconstruction and so I think there has to be some incentives too to use these materials in a new build or renovation or whatever but also think about how we're building buildings cause otherwise we're just going to continue to go down just like rabbit hole like not just not having valuable materials and then it doesn't become realistic to do construction so we did a little bit of work on design for disassembly (Interview 11).

Yeah, I really think it has to come down to a requirement because of all the challenges, ... you know, if we really think it's the right thing to do, then we should just require it. So yeah, I think I think we have to get to that (Interview 18).

I'm actually a believer in the hammer approach that government has to regulate because recycling and waste management has been left up to the private sector and you know that's what it's got is to 9% recycling of plastic leaving it up to the private sector it's so I'm in favor of regulating towards deconstruction. ... Yeah, I'm definitely in favor of bylaws that mandate deconstruction over demolition because we just can't be throwing away that much waste (Jan Hastings).

Just do it. It will disrupt things, but it will happen as well (Dylan Lock).

Another participant, Jeff Wint, spoke about the idea that different cities will require a different business case due to housing stock and the materials coming out of homes. Wint stated, "I like where the City of Vancouver has gone with theirs, but I don't think we (Squamish) necessarily have the information on our housing stock to implement something like that... Victoria has those beautiful old homes."

Dean Romeril, voiced their opinion, saying that moving in the direction of requirements has value, but there are hesitations around it, especially regarding compliance,

There would be value in it. I mean, in a perfect world, yeah, everybody's going to adhere to it, but this isn't a perfect world. So, if you put policies in place now you have to have a method of policing and beyond the method of policing, you have to have a method of fining or consequence, right? ... That's pretty hard to do.

They go on to state that there can also be benefit that must be acknowledged.

But it does open the door for somebody that's like... the one fella in town here that now crushes aggregate and concrete and sells for aggregate. It opens door for people like that to be a receptacle for a lot of materials. You know, so it can generate more private industry as well.

Not all participants felt they could answer the question by identifying a specific policy that was needed. James Slattery, with San Francisco, spoke to this while still stating that it is important to move forward, set examples, and help one another out.

I don't have a great answer for that, but I think we have precedent to look at which is what's happening in California right now is there's a new state law... it's basically designed to keep organic material out of the landfill and so now you have a law and it's speaking to every city and county in California. So, the model here is someone goes out on the bleeding edge and pushes for what's right, recognizing that the status quo is not going to help us and then slowly but surely what would follow suit is the recognition of other cities and counties saying, 'hey we to have climate goals, we have racial equity goals.' ... So, you know we have to meet people where they're at and in doing so maybe even have to help them leapfrog certain pitfalls or practices that we've moved beyond so that they don't stumble through it.

Another theme revealed in the data was the need to implement a policy or program in a gradual manner. This means having a phased approach to allow for more time to adapt to changes. This was not only a recommendation, but this is also a very common approach that municipalities that have implemented deconstruction programs and policies have taken.

Everything has to be gentle; it has to be done slowly. I think to do a dramatic change in policy anywhere is going to cause problems. No one knows what's going on. I think you have to have baby steps into anything. ... But do something (Sledge Seattle).

When we first started engagement on this (deconstruction bylaw) people wanted us to kind of take it slower and you know, slowly phase it in and start with an incentive (Interview 7).

So, we're doing it in a phased approach. To start the target is a requirement for single family homes and duplexes that are being demolished and then replacing that with another single family or duplex. So, that's going to be the first year or two and then eventually it will still focus single family and duplexes that are later going to be replaced

by a multi-family and eventually will go after the commercial market as well (Interview 7).

6.1.2 How to make it happen

Another critical question that was posed to interviewees was the idea of who will be driving this, pushing for the change, or simply put, how is this going to happen? Many participants voiced support for deconstruction policies, as established above, and programs. Most often, the push did come internally – meaning it was the municipality that identified C&D waste reduction as a priority and deconstruction as an action to take to reduce C&D waste. This was actioned by various municipal departments in different municipalities, but it was initiated through internal municipal action. One participant spoke to how they decided to move forward with deconstruction, stating,

Over a third of the waste that [our city] sends to landfill is C&D waste, so that's just a huge opportunity for us to reduce waste and we know that a lot of that is from demolitions and it's a lot of wood waste so a deconstruction bylaw that focuses on salvaging wood specifically makes sense.

Participants also stated that it was important to them to look at what other cities are doing to address this problem when they were considering the best steps forward themselves. One unique case was the City of Portland. Portland had community members protesting demolitions of older homes in the city, which resulted in deconstruction being internally identified as a way to divert C&D waste and a solution for heritage preservation – to show respect to these homes, the people who built them, and the materials (Shawn Wood).

There was also an emphasis on the importance of having a mix of stakeholders, including municipal and industry leaders to act as champions in moving deconstruction forward. Most participants spoke of these champions coming from internal actors within municipalities or council members. For example, Shawn Wood stated that “it'll have to have a champion at the

council level.” As for industry and municipal leaders, participants voiced their opinion for having strong leadership.

It’s a combination of industry leaders and municipal leaders. So, the municipality needs to take leadership in doing that with one or two industry leaders really trying to push and be the difference. And that’s the prime example of us – we’re the industry leader pushing the business side of it as well as consulting with the municipalities that want to make the difference to show that it can be done. It’s not a one or the other (Dylan Lock).

I think it always takes a champion that wants to make it make it happen whether it's a city manager or a council member (Faisal Mirza).

That's a good... that is a very good question. I think at the end of the day, it's probably going to be us (regional government). I don't want to put out any promises, but I feel that it's going to be us as the regional district starting internally. With our, you know, planning building departments and saying, OK, let's start somewhere. Where do we start right? And I think it's going to start with on-site educating, you know the people that are tearing down these buildings and residents. And hopefully getting that information into the actual hands of the owners (Graham Casselman).

Participants also noted the importance of working with industry and stakeholders to ensure success.

Some contractors may say I'd be happy to do it if others do it too cause then we don't have a market distortion for instance. So, yeah, I definitely think that municipalities do have a role to play, but again if they do it on their own it's going to take longer and that's not going to work in the sense that the market and the other stakeholders of the value chain are not going to be there yet and if there's going to be a disconnect between what the bylaw says and what the market can do, that won't work. Hence the need to sort of work together and sort of make sure that anything they put in the law is sort of back to at least know... or announced in advance so that you know the other stakeholders can get ready and can see that it's fair and make it work (Shawn Wood).

Yea, I think if you were on the ground, the people who are just doing the hard work of, you know, taking houses apart, trying to install material, like all those people who really have their hands in the ground and are doing the work - I think they really create community around it and change minds of what it means to do salvaging. They will have a big influence. Some people are better at it than others, but just looking at the way that Unbuilders has done it, they have all this experience on the ground but also use that to help drive policy and share their expert opinion which I think is really great. But, yeah that wouldn't be the same if they didn't have all that hard work put in and experience (Christina Radvak).

I think those government relationships too, like keeping the lines of communication open. Like our working group involves all of these, so working together like if industry knows the government is there to support them it kind of creates something together. I think that partnerships a big piece of it as well. Even encouraging industry to feel like it's something that can be done in a certain area is important (Interview 14).

Participants also spoke on a more technical level for getting a policy, such as deconstruction, initiated at the municipal level.

Yeah, I think I would love to ask some questions of our administration when the time is right and if there is you know the need to put additional motions on the floor for us to do further exploration of this. I think that can happen at the local level, I mean I think that can happen at our executive committee meetings (Interview 14).

Yeah, this sort of is the crux of the matter, right? It's like how do you make this thing actually happen? I think there's like a couple... like I think the model Portland did where they are just like, sorry guys, were doing deconstruction now and then that was just like, you got to do it, you know. That's the best way to do it as far as I'm concerned, but then there's like... it's not that simple, you have to be able to sell the wood and whatever to make money. So, it could easily tank and not work out and then the whole thing would fail, and you'd be in worse shape. They go 'well it didn't work' and so we just go back to the old destructive model that is terrible. So, I think the best way to do it is to take time to get it set up. You need years, like 2-3 years because ... once you say OK, we got to do this it's like now what... all the pieces have to be focused together for it to be a success (David Greenhill).

Participants representing the industry side also spoke to how government/municipal involvement is important in helping industry adjust, learn, and find success.

We worked alongside the city to get trained; we hired a contractor to go through the certification and get the certification with the company, and things like that to kind of built out what GoodWood could do. Then just basically got trained up by the city in terms of like, what do we need to do to satisfy your requirements. That was just like being in close touch with Shawn Wood who's like the dad of the work. Really it wasn't that complicated because we had a main line to the person who was running the show and then of course we had like a million things to learn about actually how to deconstruct the house, then what to do with the material, and the millions of moving parts. But just with the city side of it we just said, can you just tell us what we need to do and then they answered questions and we just followed what the rules were. That was basically all we needed to do and throughout that process we learned a lot (David Greenhill).

Throughout all responses, the biggest theme was that to move forward, all parties with an interest in deconstruction must work together to see action. In municipalities that have

implemented a deconstruction specific policy, they have had local champions help advocate for the matter. In Vancouver, Unbuilders, among others, have acted as champions for deconstruction through advocating for change, networking and providing expertise to local governments and other companies in the industry (Dylan Lock). In Portland there were multiple deconstruction companies operating that I had the chance to visit with, a few of which were doing deconstruction prior to their ordinance being passed, and one of the company representatives indicated to me that they jumped on board when they heard of the ordinance over the radio (Good Wood). In Seattle, a deconstruction company called Sledge has acted as a champion in the industry in their city as they have been conducting deconstruction projects for years and voicing their strong support for deconstruction, even though there is no requirement in place yet. These are a few examples of many champions in the industry who all play an important role. Dylan Lock, with Heritage Lumber spoke on this, voicing that it ultimately needs to be a combination of actors and seeing this happen in other municipalities requires all actors working together.

6.2 A Framework for Actioning Deconstruction

The following outlines the framework for actioning deconstruction that I developed. It works through the primary steps of introducing a deconstruction-specific policy with complimentary, supporting policies and programs. A framework was chosen instead of a model bylaw or implementation guide because of the response from my participants and the emphasis they placed on how localized the approach needs to be for each municipality. It was suggested that a framework would help municipalities walk through the process of developing a deconstruction program and bylaw that will be successful in their community.

It is important to understand that this framework is organized to not only help municipalities see through the development and implementation of deconstruction programs and

policies, but also determine if deconstruction is suited to their local context. The first two steps (see Figure 8): Initiate Deconstruction Conversations and Build the Foundation, are meant to help municipalities work through assessing their local context and determine feasibility. These steps are aimed at answering the questions: should we go forward, does it make sense for our city, can we do this and do it right? This is crucial, because if any of these questions cannot be answered, or the answers are no, a deconstruction or salvage requirement may not be the right choice in that moment, or more work is needed to initiate. If the answers are yes, the following steps in the framework help with addressing some crucial activities and questions that need to be considered in developing a deconstruction or salvage requirement that is best suited for that municipality. A high-level overview of the framework is captured in Figure 8, demonstrating that the process is a cycle and will require re-evaluation, and further development throughout. The primary steps for actioning deconstruction, which can be found in further detail in Figure 8 and Figure 9, are the following:

Table 8: Main steps in actioning residential deconstruction for larger Canadian Municipalities.

1. Initiate Deconstruction Conversations,
2. Build the Foundations,
3. Evaluate all Options,
4. Develop the Policies and Programs,
5. Implement the Policies and Programs, and
6. Improve on the Policies and Programs.

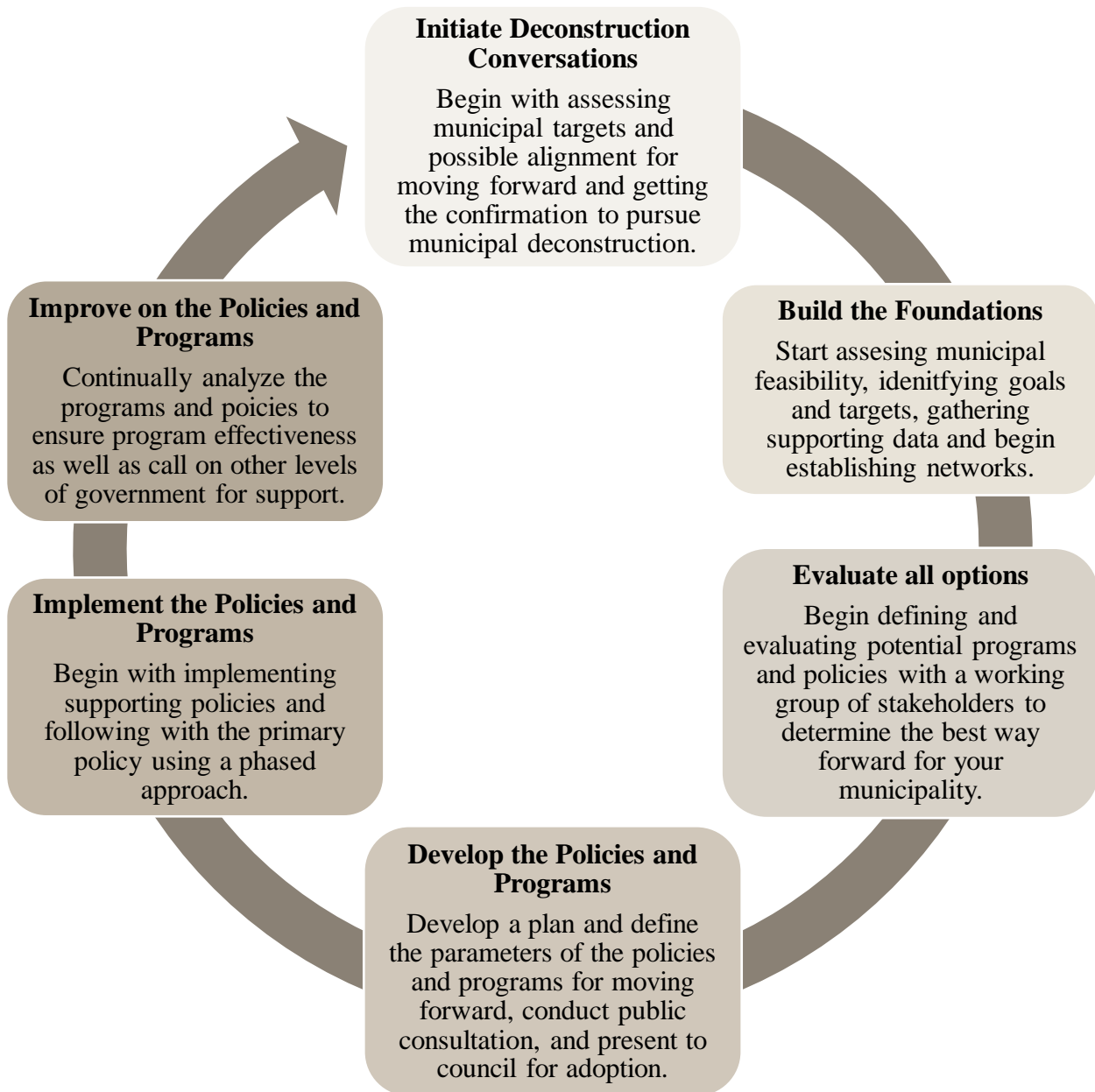
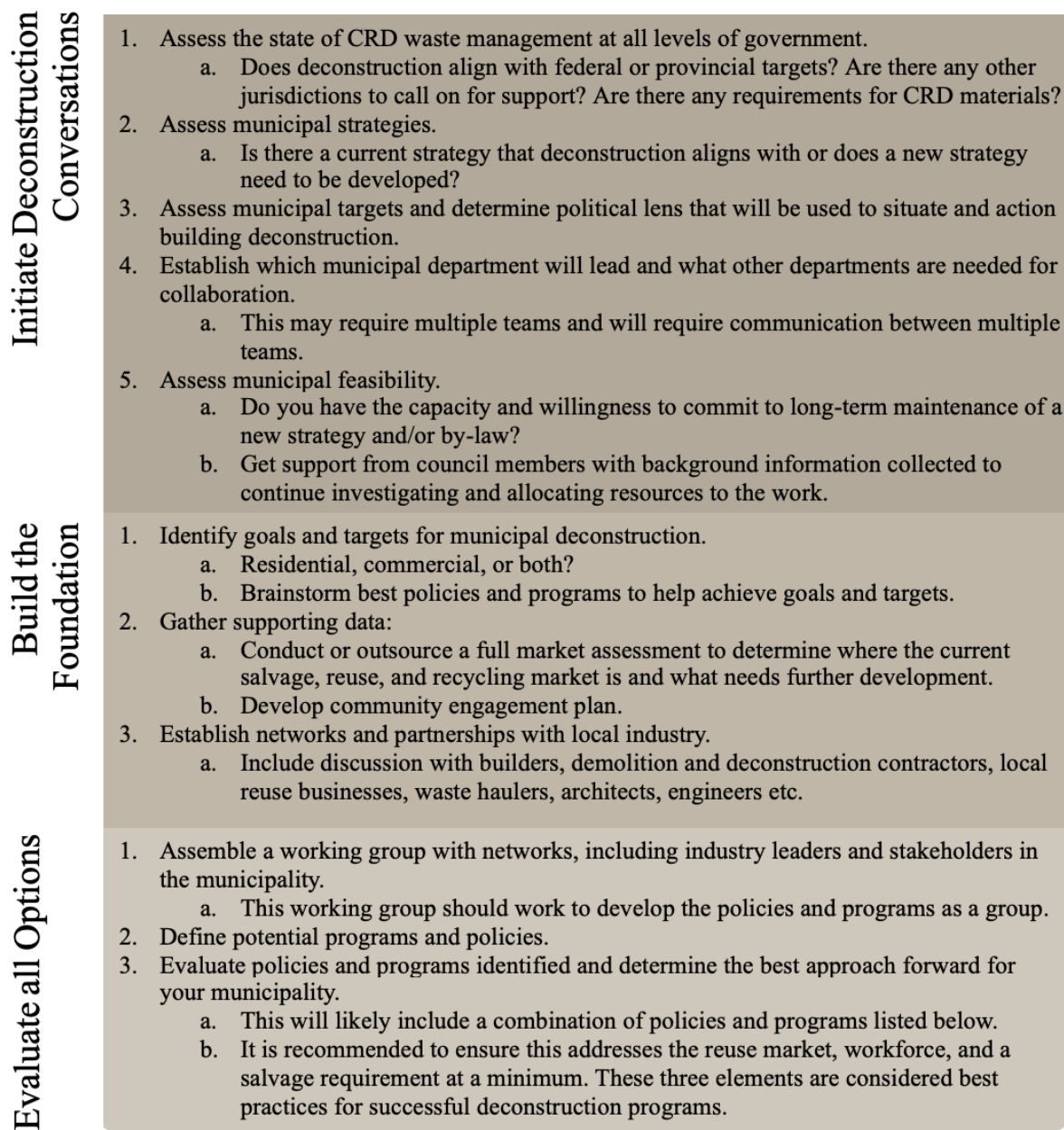


Figure 8: A high-level overview of the framework for actioning residential building deconstruction for larger Canadian municipalities

Figure 8 captures the final framework and actions necessary at each step, after input on various drafts:



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.

Figure 9: A framework for actioning residential building deconstruction for larger Canadian municipalities.

6.3 A Case Example of Applying the Framework: The City of Edmonton

The following information was presented to participants in the focus group to test the framework into an Edmonton-specific context. By presenting the context, it gave the participants an idea of where The City of Edmonton was at in relation to common characteristics of deconstruction policy, such as age of homes. This also set the scene for the focus group, while suggesting ways to get buy-in to start the process locally, the participants could better process how this may play out in a real-life setting. The current goals and strategies of the City were explored to see what ones align with deconstruction and where a program may fit in. As well, the distribution of demolition permits for single-family homes being demolished was assessed prior to the focus group. This data was grouped into thirds based on age, as many deconstruction policies and programs are developed based on the age the home was built, as noted in the framework and data in chapters above. This gave the participants a good understanding of what might be possible in Edmonton, and the following provides a summary of outcomes.

Edmonton municipal goals and strategies that align with deconstruction:

- Climate Adaptation and Resilience
 - Sustainable Communities
 - Emission Neutral Buildings
 - Low Carbon City
 - Solid Waste Reduction and Diversion
 - Reduced consumption of new material
- Building Redevelopment and Densification
 - Infill use reduction goals
 - Historic Building Preservation

- Reuse of local materials in historical preservation projects
- Health and Safety
 - Reduced toxic dust from job site
 - Reduced heavy metal leaching into soil
 - Reduced waste to landfills
- Community Development
 - Equity of affordable materials

Edmonton's Housing Stock: Demolition Permits

I assessed the demolition permits issued in 2022 for single-family homes only using publicly available data for presentation at the focus group. Of the permits issued where I could find data of the year that the original structure was built, I found the following about the age of homes:

- Youngest home in the oldest 1/3 was built in 1948
- Youngest home in the middle 1/3 was built in 1962
- Youngest home in the newest 1/3 was built in 2015
- Average age of all houses built before 1960 (common age cut-off) was 1954, and that included 73 houses.

Figure 10 was presented to show the type of target housing stock.



Figure 10: One city block in Edmonton with the house that was issued a demolition permit circled in red. This block is located in an older neighborhood, where a lot of demolitions are being issued to allow room for infills.

An important question to ask about this data is ‘How much waste is that?’ Unfortunately, that is very difficult to determine as Edmonton's data on C&D waste is not very detailed or readily available. In fact, C&D waste is not heavily considered in the waste strategy despite C&D waste constituting 27% of municipal solid waste on average and residential construction, renovation, and demolition accounts for 60% of C&D waste. (Service & Kelleher, 2020; Yeheyis et al., 2013). That is 16.2% of all waste generated in Edmonton in in 2015, based on the national average. In Canada, there was 684,300 tonnes of waste created from residential demolitions (Service & Kelleher, 2020; Yeheyis et al., 2013), and of all C&D waste, 84% went to landfill (that includes construction, renovation, and demolition waste from residential and non-residential sources).

The Framework Applied to Edmonton

The following outlines how the framework could be applied in the context of the City of Edmonton based. In the focus group, we worked through each step of the framework and the following presents the outcome of that discussion, as well as public data collected on Edmonton’s current context.

Step 1: Initiate Deconstruction Conversations

1. Assess the state of CRD waste management at all levels of government.
 - a. Call on Provincial Government to update C&D Waste management recommendations document.
 - b. Call on other local jurisdictions to consider a regional approach (Strathcona County, Leduc, Spruce Grove, St. Albert, etc.). This could remove some barriers as there is a lot of movement between jurisdictions. Similar to the public transportation regional approach with the ARC card.
2. Assess municipal strategies.

- a. Aligns with Climate Adaptation and Resilience, Building Redevelopment and
Densification, Health and Safety, and Community Development goals/strategies.
Also opportunity to assess integration into new strategies or renewal of existing
strategies.
3. Assess municipal targets and determine political lens that will be used to situate and
action building deconstruction.
 - a. City council is currently very climate change oriented. It would be recommended
to take this approach.
4. Establish which municipal department will lead and what other departments are needed
for collaboration.
 - a. Within Climate Adaptation and Resilience, it could fall within the Climate
Change or Waste Management teams. This will likely involve both teams as well
as heritage due to interest from that team and they can further support initiatives.
Teams such as Urban Planning will likely need to be involved for code changes,
permitting, etc.
5. Assess municipal feasibility.
 - a. This has to be done in real-time. Capacity will change.
 - b. Get support from council members with the information collected to continue
putting resources towards this project.

Step 2: Build the Foundation

1. 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.

2. Identify goals and targets for municipal deconstruction.
 - a. Residential to start. This is where most demolitions are in Edmonton. There is always room to grow this to commercial in the future.
 - b. Brainstorm best policies and programs to help achieve goals and targets.
 - c. 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, etc. Utilize available resources such as The Reuse People, who are interested in expanding more in Canada.

Step 3: Evaluate all Options

1. Assemble a working group with networks, including industry leaders and stakeholders in the municipality.
2. Define potential programs and policies applicable to Edmonton. Consider partnering with organizations such as The Reuse People to provide programming (workforce training).
3. Evaluate policies and programs identified and determine the best approach forward for your municipality.
 - a. Consider a salvage requirement as a primary policy that is introduced in phases.
 - i. Mix of grants and salvage requirement (by weight).
 - ii. Use a phased approach.
 - b. Develop appropriate enforcement plan.
 - i. i.e., salvage/donation/weight receipts required to prove work has been done correctly and look at possible use of Green Halo software.

- c. Ensure there are programs/policies that support the primary policy by filling in any market gaps, workforce requirements, research gaps, etc. These will vary according to what is found in a market assessment.

Step 4: 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. Given the distribution of homes demolished in 2022 in Edmonton, this might look like the following (you do not want too many homes immediately or the market may not handle the material well):
 - i. Year 1: single- and double-family homes built prior to 1950 being replaced by single- or double-family homes, with grants.
 - ii. Year 2: single- and double-family homes built prior to 1950 being replaced by any structure.
 - iii. Year 3: all homes built prior to 1960.
 - iv. Year 4: all homes built prior to 1970.
 - v. Year 5: consider adding commercial buildings.
2. Implement public consultation on the plan.

Step 5: Implement the Policies and Programs

1. Implement supporting policies first. This may include:
 - a. Educational programs (certifying contractors, workshops, training programs, etc.), market incentives, assessing landfill costs/fees, toxic materials initiatives, etc. These will help ensure the success of the primary policy.
2. Implement primary policy using a phased approach as mentioned above in step 4.

Step 6: 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 and assessments.
3. Use annual reports to assess deconstruction policy and program effectiveness yearly.

6.3.1 Focus Group Participant Reactions to the Framework

Overall, the framework was received well by participants, expressing that they felt it is easy to follow and laid out well. One participant recognized that deconstruction is quieter than demolition, requires less heavy equipment, and results in less damage to property, and marketing it that way can help. Another participant spoke on the fact that in Edmonton a Climate emergency was declared in 2019. Asking, ‘What are we doing in response?’ Going on to state that

Some people seem to be beginning to understand you can’t build your way to sustainability. We need recognition of the fact that it’s a privilege to develop – you don’t have a right to do whatever you want. And we need to have contributions to society in terms of betterment. This is one small piece of that puzzle. If we’re serious about the climate emergency, this is one way to take action.

One notable discussion about the frame occurred around the issue of whether this type of policy should be top-down or bottom-up. Participants voiced that a top-down approach will likely lead to the highest chance of success. This would look like council giving directive to go forward with such a policy. One participant discussed this, stating,

Who initiates this? Do you need the direction from council? And in my experience over the years, it has certainly been, and its fair, that you know upper management prefer to see direction from Council to do new things. Other than you know, creating those on their own and then seeking approval for Council out of the blue.

This discussion led to a change in the framework in the last step of initiating the conversation by adding a recommendation to prepare a brief case and present it to city council to get the OK to

move forward with the investigation stage. In this discussion, participants also voiced their recommendation that it is important to start with the awareness for change, and then to get buy-in. One participant voiced this, stating,

In my mind, the major challenges are the upfront stuff – the buy-in. Once that’s done, there’s confirmation that that’s what we’re doing, other groups will just get in line and join the program. If you can get through the front part, there will be logistical challenges, but those are more manageable.

Although getting buy-in is important, it does not mean there won’t be challenges ahead through the rest of the process.

Focus group participants also underscored the importance of setting up employees well with the support and resources needed to move forward with any deconstruction program or policy through actions such as staffing and budget allocation. This is demonstrated in the change to the framework in the initiating the conversation step, to get buy-in from council. Once council agrees to a project, it is easier to justify allocating time, people, and money towards it.

Another discussion that came up was the question of conflicting policies within municipalities. Namely, policies that support growth and development and ‘greener’ policies. In many cities, there is a culture of facilitating new builds above all else, which needs to be overcome and at the political level could be difficult. Although this does not change steps within the framework, it is a notable barrier. The argument around affordable housing is closely linked to this because new builds mean more housing. In this case, it would be important to look at what these single-family homes that are being demolished are being replaced with. As well, municipalities have voiced that affordability is not impacted by deconstruction like many assume. One interview participant that I spoke with voiced that in their case, if a homeowner could afford to purchase a house, demolish it, and build a custom home, they can afford the cost of deconstruction (Interview 7). Another interviewee mentioned, that if a city is really working

toward density, the cost is split among multiple units/homes being built on that plot of land, reducing the cost to as little as a toilet (Shawn Wood). In Edmonton's case, if these plots of land are being split and infills are being developed, the corporation can also afford it as infills are very expensive homes. And if the cost gets pushed to the home buyers – who can afford an infill home – the cost will not be substantially more.

One barrier that was brought up regarding the City of Edmonton, but is applicable to other municipalities, is that landfills are often privatized, which makes regulating them difficult. One participant voiced this concern,

Well, the genesis of [composting] was really that we were filling up our landfills and there was a big NIMBY [not in my backyard] approach. Nobody wanted a landfill in their backyard. So, we had to move to composting. It was something we had to do, right? We couldn't site a landfill, so we had to recycle. So, the issue we have in the ICI sector is that outside of the city, there's lots of landfill space and it's cheap and it's private. So that's the hurdle we have. We don't have provincial regulation like some other jurisdictions that say you can't, you know, landfill food waste or you can't landfill clean wood. So that that really is a barrier to putting some of these regulations in.

This places the onus on municipalities to take action and often they are more prone to push-back from the sectors responsible for generating the waste, underscoring again the importance of multi-party buy-in, especially if it's unlikely a province will regulate, which would be the likely case in Alberta. This is something that will differ for every municipality and region and needs to be considered case-by-case.

Market and cost as barriers were also brought up, but the discussion surrounding these just further verified what is established in chapter four (see table 5 in section 4.2). As well, the idea of a pilot program for implementation came up to help remove barriers. Through discussion, participants agreed that a phased approach, like most municipalities have taken, can result in piloting various aspects of a deconstruction program. A phased approach, as discussed, has been heavily emphasized by interviewees and is a strong recommendation as part of the framework.

Another question that came up in discussion was “how many homes being demolished annually makes this type of policy worth it?” In the end, participants agreed that this boiled down to priorities at the political level. Participants discussed how there would be conflicting policies within a municipality, questions around scale and what scale is worth it to put this many resources into the policy, the local and regional policy landscape, and more. Participants agreed that many municipalities have moved forward and made these policies work, meaning although these are obstacles, they have not prevented municipalities from moving forward. It is also important to recognize that these are all hyper-local issues. In this regard, a participant noted the following, making a good point that it is necessary for each municipality to assess where they need to start and what their priorities are,

That context is helpful. And, you know, when I think of this, I like how concrete and discrete this idea is. It's something that is easily doable. You can easily communicate it and move forward with it. But what I'm thinking about the broader context of what I call the ICI waste sector – in Edmonton, we do about 400,000 tons of residential waste collection a year. We estimate the ICI waste to landfill is about 800,000, so twice as big and it's largely unregulated, so the question would be where do we start if we're going to start regulating it, where do we start? Do we start here, or do we start with a broader policy approach? I think that'd be a question that we'd have to ask.

Lastly, there was significant conversation surrounding mindset. One participant discussed that its often “deemed that there is no value in a historical structure, just the land that it is on.” And that the mindset and cultural outlook around land development evaluations needs to change. We currently see the mindset that says, “it will cost money to fix up and it’s so easy to demolish – so that’s why there is not value in the building.” This ties back to the culture of facilitating new builds above all else. This is an important discussion that needs to happen in municipalities to assess what steps are best for them. Many participants in interviews voiced the need to act now, the question really is, where do municipalities start and how can we change the narrative?

6.4 Chapter Summary

Chapter six focused on presenting outcomes related to the development and application of my deconstruction framework, meant to help move deconstruction forward in Canada. As part of the framework development, this chapter discussed “how to make it happen,” asking the questions: who will be driving this and be pushing for the change? As Faisal Mirza stated, “you know the status quo is going to win every time unless there's some sort of change.” Although literature supports deconstruction, outlining the benefits and challenges, the most crucial question – how will this happen? – is little discussed. Moving forward with policies that aim to challenge the status quo is difficult. Deconstruction will force industry to change methods that have been standard practice for a long time, so there will be resistance to change the status quo and at the same time, there are few incentives to change. As Jan Hastings stated, “garbage is gold that’s the industry standard, so of course they make so much more money just by showing up with an excavator and driving away mixed bins of garbage. That’s their number one business model so that industry has to change a whole lot.” Companies and industry will adapt and change with requirements – they have before – but there needs to be someone or something that drives this change (Dylan Locke; Sonnevera International Corporation, 2006). Participants voiced that one of the most important factors is having leadership and champions both from within the municipality and from external stakeholders are important to push for change.

This chapter also presents the data in a case example with the development of a framework for municipal building deconstruction policy and program implementation. The Circularity, Reuse, and Zero Waste Development (CR0WD) network has also developed a similar resource, but in the form of a mock ordinance for municipalities to use (CR0WD, 2023). Based on participants’ feedback, I developed a framework due to the complexity of a deconstruction bylaw or ordinance and the idea that no one approach can be used for each

municipality, which is demonstrated through unique deconstruction ordinances and bylaws for each municipality (Chapter 5.24 Deconstruction And Construction Materials Management, 2019; City of San Antonio, n.d.-a; City of Vancouver, 2021; Portland, 2021b; Victoria, 2021). This was initially developed based on literature, the semi-structured interviews, and response sheets, and was then presented to participants of the focus group for an application of findings, which led to further changes of the framework.

Overall, participants supported the frame and felt that is provided a good road map for moving forward with deconstruction. The important information that the framework presents are the considerations throughout the process that municipalities must make when moving forward with deconstruction, such as who should be involved, key aspects, and more. Therefore, the framework can be used as a guide for the development of a suite of policies that are best suited to each municipality. It is suitable for guiding policy from the inception of discussions surrounding deconstruction, all the way to yearly upkeep to ensure long-term success.

Chapter Seven: Conclusions and Reflections

7.1 Conclusions

The purpose of this research was to explore the potential policies and programs for actioning deconstruction of residential homes at the municipal level. C&D waste management is a problem in most, if not all, municipalities since there are few regulations. To help understand the extent of this problem and how to overcome this through deconstruction, my research considered what barriers are present for actioning municipal residential deconstruction, how to overcome these barriers, and what the next best steps are moving forward for large, Canadian municipalities. Through municipal bylaws to educational campaigns, incentives, and provincial/territorial or national policy, deconstruction should be at the forefront of waste discussions in the developed world. To do this, I interviewed 24 participants, transcribed the interviews, and analyzed the data to determine preliminary findings and create a summary sheet of major themes and findings. The sheet was then sent back to participants for feedback, where that data was then compiled, analyzed, and informed the framework that was presented in my final focus group. In the final focus group, I was able to present findings and apply them in the real-world context of the City of Edmonton. I was then able to analyze the focus group data and use that to inform the major findings. This chapter goes through final conclusions in relation to each objective as laid out in chapter one and explores areas where further research could be done.

7.1.1 Leading Edge Examples of Actioning Building Deconstruction

There are many examples of cities and other local governments taking various actions towards reducing the amount of C&D waste entering landfills, but as per the scope of this research, I am identifying leading-edge examples. It was decided, with all the initiatives in place,

a leading-edge example is a deconstruction-specific and/or salvage requirement - not a recycling requirement – recycling was not considered lead-edge by participants in the context of my study. As chapter two establishes, the current municipalities that have a deconstruction-specific, salvage policy in place in North America include; Portland, San Antonio, Palo Alto, Pittsburgh, Victoria, District of North Vancouver, Vancouver. There are many more municipalities that have recycling requirements, including most municipalities in the lower mainland of BC. There are also other policies in place that are working toward C&D waste diversion, such as sorting requirements, increased landfill fees for mixed loads, bans of certain materials from the landfill, and more.

The deconstruction-specific, salvage requirements share some characteristics. In Canada, they share requirements such as meeting a certain salvage percentage by weight, reporting requirements via weight receipts, donation receipts, and more, refundable salvage fees refunded upon meeting requirements, specifying the salvage pertains only to wood, and applying to residential homes built before a specific age. In the US, the ordinances most often include the requirement that certified deconstruction contractors are used, but not all include meeting a specific salvage percentage, and one includes commercial properties and has no ‘built-before’ date. These differences may be attributed to the difference in tax rebates in Canada in comparison to the US, but the approach taken by municipalities in each country has slight differences. However, it should be acknowledged that there are still few cities and other local governments that have deconstruction-specific, salvage requirements when looking at how many larger municipalities there are in the entirety of the United States and Canada, but this number is increasing exponentially.

7.1.2 Barriers for Policy and Program Implementation for Actioning Building Deconstruction

Another objective of this research was to determine barriers to the implementation of local building deconstruction programs. Considering barriers to policy and program implementation are critical to identify so that ways can be found to overcome them. In this research I separated barriers into two categories, barriers to deconstruction practice, and barriers to developing and implementing deconstruction policy. I felt this helped with better understanding the barriers and how to overcome them. For doing deconstruction, the barriers were identified as space/storage of materials, cost, and capacity, which includes the capacity of municipalities, industry, as well as the education required to build that capacity, and the age of the home. Policy specific barriers were identified as the local reuse and salvage market for the materials, enforcement/compliance/accountability, and building codes. Although these are all substantial barriers, the research, and real-world examples, have shown that these can be overcome through the implementation of policies, programs, and education. However, as participants emphasized, these barriers must be accounted for when municipalities are considering implementing deconstruction specific policies and programs.

7.1.2.1 DfD/A

DfD/A is another area of research that can have huge implications for waste diversion and salvage of materials in the built environment. There has been some research done in this area and we are increasingly seeing more resources put towards determining how buildings can be built to be adapted/renovated and deconstructed at its end of life. This is an area of research that is rapidly expanding and can have huge impacts on policies for the built environment going forward. Although we are seeing more and more research in this area, the policies to support this are still lacking. For example, in 2006 the CSA developed a Guideline for Design for

Disassembly and Adaptability in Buildings (standard Z782-06) (CSA Group, 2023; Yeheyis et al., 2013). It is the first version of the guideline, but since there has not been a published updated document. The purpose is to “provide guidance on identifying, adopting, and integrating DfD/A principles in the construction of buildings” (CSA Group, 2023). This demonstrates that the conversations are happening, and research is being done in this area, but the impact on policies and best practices have yet to be seen. Relatedly, the role of architects in CRD waste management also needs to be more carefully considered since they make many decisions about home renovations and deconstruction, that are in addition to roles they could play in DfD/A

7.1.2.2 Commercial Deconstruction

Commercial waste accounts for a large percent of total CRD waste created in North America and more specifically, in Canada as noted in Chapter 2. Commercial deconstruction is crucial for reducing waste going to landfills, contributing to climate change, reducing embodied emissions, supporting the circular economy, and more. Residential deconstruction has been at the forefront of discussion due to the greater feasibility for salvage with current understanding and initiatives. However, some municipalities have taken the approach of either targeting commercial specific buildings or both residential and commercial. For example, Palo Alto’s ordinance applies to all property, regardless of age, and both residential and commercial (Chapter 5.24 Deconstruction And Construction Materials Management, 2019). This decision may rest on the current building stock of the municipality, where the majority of traditional demolitions are happening, the current market, resources, and more. There are more one-time projects for commercial deconstruction, such as the city of Lethbridge, Alberta, where the city has opted for deconstruction of multiple city-owned buildings (Romeril et al., 2011). However, there are few

policies and programs requiring commercial deconstruction than residential, which may be due to the increased complexities of deconstructing buildings at that large of a scale.

When considering commercial deconstruction, many of the barriers discussed for residential deconstruction exist but are larger. For example, the materials being salvaged are different from residential and the quantity of materials is much greater. This means the salvage, reuse, and recycle markets will be different, they must be able to handle a much larger quantity of material, storage space for the material has to be bigger, and there are more materials that may not be able to be reused due to commercial standards (fire safety codes, etc.) (Dankhara, 2019). The ReUse people state that unlike residential deconstruction, “only two to five percent can be salvaged from commercial buildings, as most of these structures are concrete” demonstrating the increased challenge with commercial structures (The ReUse People, 2023). This does not mean commercial deconstruction cannot happen – it is happening – but the challenges are greater, and more research will significantly help with overcoming them. Although this research is focused on residential deconstruction, it is imperative to recognize that commercial deconstruction is equally important, and that moving away from traditional demolition can have a huge impact on environmental and public health, the economy, and our communities, but more research needs to be done in this area.

7.1.3 Best Policy and Programs for Overcoming Barriers and Actioning Building Deconstruction

Another objective in this research was to reveal the policies and programs that are essential for a municipality to consider when taking action to implement building deconstruction. Discovering what the barriers are for actioning residential deconstruction of the built environment was a large focus of this research and helped with determining the best policies and

programs for municipalities to consider as they can help municipalities with overcoming the barriers.

Summary tables can be found in sections 5.2.1 and 5.2.2 for both the primary and complimentary policies and programs for actioning residential deconstruction of the built environment, respectively. A framework was also developed for municipalities which can be found in section 6.1 titled *Framework for Actioning Deconstruction*.

7.1.3.1 Building Preservation

I think it is very important to go back to the waste hierarchy and consider where deconstruction fits into that. Deconstruction now falls mostly into reuse and recycle in the waste in the 3Rs, but ultimately, we should be trying to reduce levels of waste of the waste. Before we consider deconstruction, we need to ask: why is this house set to be deconstructed? does this house need to come down? and, are there alternatives to deconstruction? A common saying that brings light to this issue is, “the greenest building is the one already built.” A study done by Lighthouse Sustainability Society found that, in Metro Vancouver, approximately 20% of the homes that are up for demolition can be relocated, which is equal to 9000 homes in the Metro Vancouver area from 2004-2021 that were high quality homes and could have been relocated (Yaron et al., 2023). As well, the cost to relocate and renovate is, on average, a quarter of the cost to build new (Yaron et al., 2023). Many of the homes we see being demolished today are in good shape, they are simply coming down because we want bigger, better, and new. These fundamental societal questions need to be addressed. We need to consider policies and programs to see more building preservation and home relocation before being slated for deconstruction or demolition. There is opportunity for municipalities and other levels of government to reassess

current policies and see how building preservation and moving can be prioritized with deconstruction happening when homes need to come down.

7.2 Concluding Comments

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 plays a huge 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). However, it is important to recognize that many policies must play together to result in the change that we need to see. As James Slattery stated, when Portland began their deconstruction ordinance it acted as a wake-up, he said, “hey, it is possible for a large metropolis in North America to shift its practices from quick and dirty demolition to systematic disassembly with the aim of salvaging valuable and scarce resources.” Although deconstruction can help reduce embodied carbon emissions through the reuse of salvaged materials, other policies such as home relocation, building preservation, using net-zero or even net storage materials in new builds, need to be considered and incorporated into policy as well. However, we can reduce the quantity of natural resources that a required to be extracted and processed into new materials to accommodate for the growing population worldwide. Deconstruction is one of many actions that must be considered as we move forward and move to a circular economy for the sake of future generations and the earth.

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Appendix I: Interview Schedule for Semi-Structured Interviews

Note:

It is important to recognize that this interview schedule is intended for semi-structured interviews, which in nature do not have a rigid structure. This allows the interview to take the natural path of discussion, while providing guidance on questions and themes. The order in which the questions are asked may change depending on the participant, questions may be added or omitted entirely. All primary and follow-up questions will remain in the subject area. If there are any major changes to the interview schedule, an amended schedule will be submitted to the Human Ethics Office.

To be conducted in: Canada
 Field season: Spring and Summer 2022
 Researcher: Alex Velsink
 Research Title: Deconstruction as a Method for Waste Diversion in Canada's Built Environment

Consent:

Before we begin the interview, I would like to review the consent form that I previously sent to you, which you were asked to review, sign, and send back. Please answer yes or no to each of the following questions.

- Do you consent to being interviewed by myself for research purposes?
(Yes/No)
- Do you have any questions about the consent form or any information on it?
(Yes/No)
- Do you consent to the interview being recorded for data collection and transcription purposes?
(Yes/No)
 Do you consent to the interview being recorded with a handheld audio recorder or with zooms local recording feature? This is a reminder that if you choose zoom, the video will also be recorded. You may turn your video off during the interview. I will only use the audio file at the end of the interview for transcription, and the video will not be downloaded or used.
 (audio recorder/zoom)
- Do you have any questions about the interview process, research, or confidentiality?
(Yes/No)

- Would you like to be contacted after the research has been completed with a brief summary and/or a link to the published thesis?
(Yes/No)

Introduction:

Hello _____.

Thank you for being here and agreeing to speaking with me today.

I am joining you today from Edmonton, which is located on Treaty 6 territory, the ancestral lands of the Cree, Dene, Toney, Saulteaux, and Blackfoot people, as well as the Métis homelands.

As we have discussed, I am interested in exploring deconstruction as a method for waste diversion in Canada, what the current barriers are for policy and program implementation, how to overcome them, and what the best policies and programs are for effective waste diversion and deconstruction. I am speaking with other individuals involved in a part of the life cycle of the built environment and deconstruction about their experiences in order to gain a well-rounded understanding and perspective.

The data that I collect today will be used to write my master's thesis. Let me know at any point if you want me to clarify or repeat something I say. You may also skip any question, without consequence at any point of the interview if you are uncomfortable answering it or prefer not to and you are able to withdraw at any time if you so choose. As well, please take your time in answering the questions, you may take as long as you would like. I ask that you not disclose any third-party information as you are here today representing yourself and your perspectives and knowledge.

Lastly, the goal is for this interview to be between one and one and half hours in length, is that an OK time frame for you?

Do you have any questions before we begin?

1. I understand your current CRD actions include and involve ... (add information based on document review) ... Is this accurate or has anything changed with your involvement?
2. Have you considered implementing policy or programs for deconstruction of the built environment, namely single- and double-family homes? Or, what made your municipality decide to implement deconstruction policies/programs?
3. How was this sort of policy direction/programming sold at the political level (i.e. benefits of waste reduction – others?).
4. What role do you believe municipalities play in the implementation of deconstruction policies across Canada? What about provincial, territorial, First Nations, and Federal Governments?
5. Based on your experience, what are barriers for implementing CRD policies and programs at a municipal level? How about provincial or federal levels of government?
 - a. Barriers for material transport
 - b. Barriers for markets of salvaged materials
 - c. Barriers for facilities accepting deconstructed materials for recycling and recovery
6. Based on your experience, have you overcome any of the previously mentioned barriers when implementing CRD policies and programs at a municipal level in the past? How about provincial or federal levels of government?

7. Are there any deconstruction-specific policies or programs that stand out as more or less feasible from the following?
 - a. (fill in according to research done in document review)
8. What are your thoughts on the current available markets for the materials and new markets that may need to be explored?
 - a. Where do you think there are gaps in the markets and how do you think we can overcome these?

Appendix II: Focus Group Schedule

Focus Group Schedule

Note:

It is important to recognize that this schedule is intended for a semi-structured focus group, which in nature do not have a rigid structure. This allows the focus group to take the natural path of discussion, while providing guidance on questions and themes. The order in which the questions are asked may change depending on the participant, questions may be added or omitted entirely. All primary and follow-up questions will remain in the subject area. If there are any major changes to the focus group schedule, an amended schedule will be submitted to the Human Ethics Office.

To be conducted in:	Canada
Field season:	Spring and Summer 2022
Researcher:	Alex Velsink
Research Title:	Deconstruction as a Method for Waste Diversion in Canada's Built Environment

Consent:

Before we begin the focus group, I would like to review the consent form that I previously sent to you, which you were asked to review, sign, and send back. Please answer yes or no to each of the following questions.

- Do you consent to participating in this focus group for research purposes?
(Yes/No)
- Do you have any questions about the consent form or any information on it?
(Yes/No)
- Do you consent to the focus group being recorded for data collection and transcription purposes?
(Yes/No)
- Do you have any questions about the focus group process, research, or confidentiality?
(Yes/No)
- Would you like to be contacted after the research has been completed with a brief summary and/or a link to the published thesis?
(Yes/No)

Introduction:

Hello everyone.

Thank you for being here and agreeing to participate in this focus group.

I am joining you today from Edmonton, which is located on Treaty 6 territory, the ancestral lands of the Cree, Dene, Toney, Saulteaux, and Blackfoot people, as well as the Métis homelands.

I am Alex Velsink, and this is _____ who will be taking notes for this focus group. I have a note-taker here today for data collection. I will also be recording via zooms local recording feature today that records both audio and video. I will only be using the audio file when this is over, but I would like to give everyone a chance to turn their video off. I ask that you turn your video off at this time if you would like.

For zoom etiquette, I ask that you keep your mic muted unless you are speaking and of course, unmute yourself whenever you would like to speak, as if we were in the same room. You can also place an asterisk in the chat if you would like to speak, and we will do our best to monitor that. I also ask that you make sure you are in a quiet, private space.

The data that I collect today will be used to write my master's thesis. Let me know at any point if you want me to clarify or repeat something I say. I ask that you not disclose any third-party information as you are here today representing yourself and your perspectives and knowledge. Lastly, I would like to remind you that with the nature of a focus group, your privacy and confidentiality cannot be guaranteed. However, I would ask that you keep the identities of other participants confidential, and that you do not share information you do not want others to know.

Lastly, the goal is for this focus group to be between two hours in length, is that an OK time frame for you?

I think it would be great to start with introductions. How about we go around, say our name and something you like about the season we are in?

Agenda

As we have discussed, I am interested in exploring deconstruction as a method for waste diversion in Canada, what the current barriers are for policy and program implementation, how to overcome them, and what the best policies and programs are for effective waste diversion and deconstruction. I have been speaking with other individuals involved in a part of the life cycle of the built environment and deconstruction about their experiences and perspectives in order to gain a well-rounded understanding and perspective.

I worked through the interview transcripts and audio files, made note of some themes and would like to explore those today.

We will begin with going over the research question again, so that it is fresh. I will then provide a summary of the themes that I have found in the prior interviews, and focus group. I do have a simple PowerPoint to go alongside, so that you can refer to each slide and the theme and question. However, the goal here today is to discuss the recommendations that have come from the data collection to assess

feasibility in a real-world, municipal level. A small period of time has been left at the end to bring up any other ideas that may not come up during the discussion that you would like to address.

Do you have any questions before we begin?

Potential Questions (this will of course differ according to data collected in interviews)

- 1. We will begin with a short review of the findings from interviews and a focus group for deconstruction policy, program, and bylaws at the municipal level.**

Insert data.

2. What are your initial reactions to the findings?
3. Are the recommendations feasible at the municipal level?
 - What is not feasible and why not?
 - What is feasible and why?
4. What could make the recommendations stronger?

Deconstruction of single-family dwellings: “It’s not waste, it’s just wasted” (Adam Corneil)

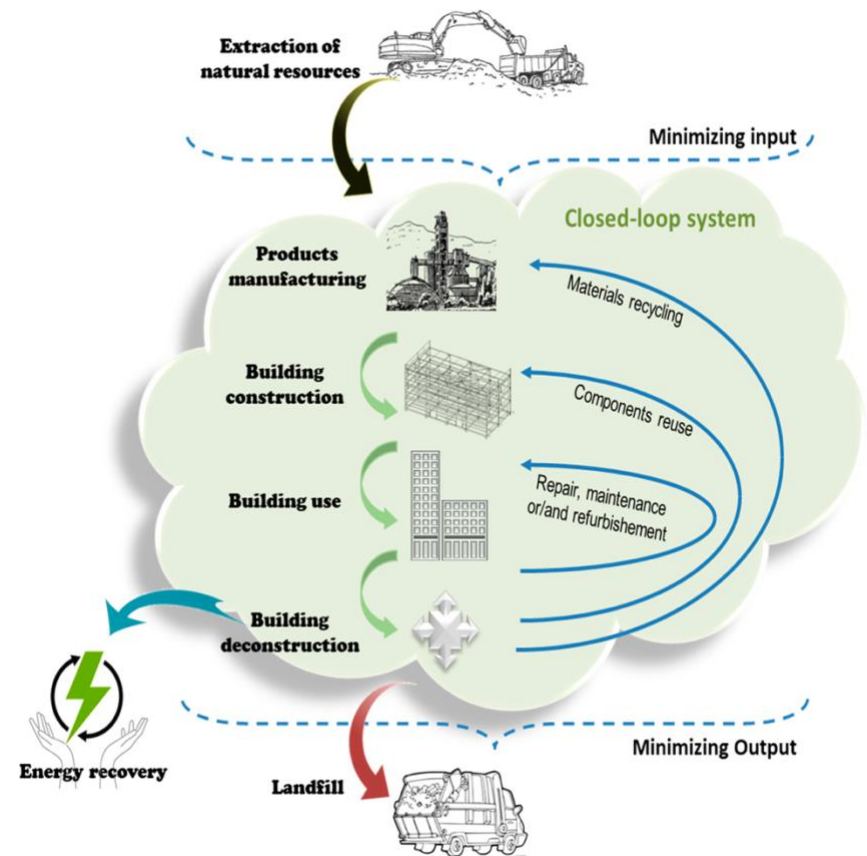
Appendix III: Focus Group Backgrounder Sheet

Backgrounder for focus group on Deconstruction in Edmonton

Alex Velsink

Introduction

The following pages present some background information on deconstruction and summary findings that are based on data I collected through semi-structured interviews with professionals involved in industries related to the built environment including, but not limited to, waste management, construction and demolition, and deconstruction sectors. It presents what I heard during interviews and read about the state of construction, renovation, and demolition (CRD) waste in Canada, the benefits of deconstruction, top deconstruction policy related barriers, barriers to conducting deconstruction, and current leading municipal actors in North America. Policy recommendations will be presented in the focus group. This sheet is to provide you with information to better discuss and understand policy and program considerations. Please do not hesitate to reach out if you have any questions.



(Rahla et al.,

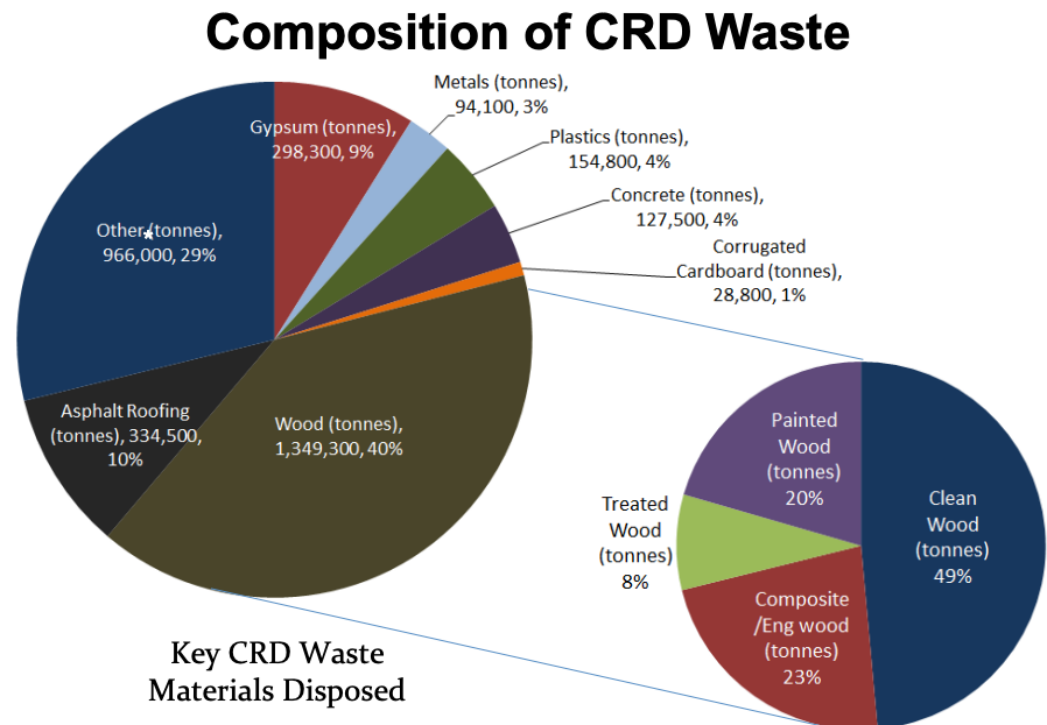
Definitions (2021)

- **Deconstruction:** is the systematic dismantling of the built environment specifically for reuse, recycling, and responsible waste management (LightHouse, 2021)
- **Green Demolition:** “fast and cost-effective method of tearing down buildings with a focus on increasing recycling” (Corneil, 2020)
- **Circular Economy:** A closed-loop system that promotes waste reduction by incorporating product reuse, recycling, repair, or returned to the environment in its natural state (CCME, 2019; Giroux, 2014)

Deconstruction of single-family dwellings: “It’s not waste, it’s just wasted” (Adam Corneil)

Considering Construction, Renovation, and Demolition (CRD) Waste...

- Waste reduction and diversion in North America has largely been focused on individual and household waste production (single-use items, source separated waste collection, “zero-waste” movement, etc.).
- Canada ranks among the top waste producers per capita in the world (Government of Canada, 2020; OECD, 2021).
- In Canada, it is estimated that on average 27% of municipal solid waste (MSW), or 4 million tonnes annually (some estimates are as high as 9 million tonnes), comes from the CRD sector, and 61% of that comes from the residential sector (Canada, 2021; Environment and Climate Change Canada, 2014; Service & Kelleher, 2020; Yeheyis et al., 2013).
- Approximately 42% (1.67 million tonnes) and 47% (1.87 million tonnes) of all CRD waste in Canada is from renovations and demolitions, respectively (CCME, 2019).
- A report published by the CCME found that up to 95% of CRD waste can be salvaged, reused, or recycled (2019).
- Approximately 1.3 million of the 4 million tonnes of CRD waste is wood waste (see image on composition of CRD waste) (Canada, 2021b; Service & Kelleher, 2020).
- Canada annually recycles less than 22% of the 1.3 million tonnes, with the remainder being landfilled (Yeheyis et al., 2013).
- As of 2006, Alberta produced an estimated 677,395 tonnes of CRD waste with an estimated 643,590 tonnes going straight to landfill (Sonnevera International Corporation, 2006). This is the most recent data available.
- In North America, studies have shown that the construction sector is responsible for nearly 40% of raw material consumption (CCME, 2019).
- In 2014 Canadian municipalities spent approximately \$3.3 billion on waste management (StatisticsCanada, 2017).
- Studies show that nearly 95% of CRD waste has the potential to be recycled or reused (CCME, 2019).



Deconstruction of single-family dwellings: Benefits and Barriers

ENVIRONMENTAL BENEFITS

- Reduces waste entering landfills and GHG emissions as a result of landfilling
- Retains embodied carbon in the materials and reduces embodied carbon emissions associated with new materials
- Conserves natural resources required to make new materials
- Reduces emissions in the construction sector

ECONOMIC BENEFITS

- Creates green jobs in deconstruction and the reuse market
- Strengthens supply of salvaged materials, which are often higher-quality, and reduces cost of new materials
- Lower taxes through incentives for deconstruction materials
- Lowers costs of maintaining landfills
- Contributes to the local materials economy

SOCIAL BENEFITS

- 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
- Equity through affordable building materials

CULTURAL BENEFITS

- 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

DECONSTRUCTION SPECIFIC BARRIERS

- **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 credits that will be offered at the end of the year in Canada, it will be cheaper.
- **Education:** Education for how to deconstruct properly, the benefits, the challenges, and how to handle the material are all important challenges.

DECONSTRUCTION POLICY BARRIERS

- **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.

Current Municipal Actors in Deconstruction

Deconstruction/Salvage Requirement (often lumber salvage)

- Portland (required to use certified deconstruction contractors)
- Victoria (3.7 kg per sq. ft. of above-ground floor space)
- District of North Vancouver (3.5 kg or 2.6 board ft per sq. ft. of finished floor space)
- San Antonio, USA (required to use certified deconstruction contractors)
- Palo Alto, USA (certified itemized salvage survey with weights and proof of salvage from certified companies)
- Pittsburgh (city piloted deconstruction on city-owned properties, exploring policy options)

Recycling Requirement

- Vancouver
- Coquitlam
- New Westminster
- Port Moody
- Richmond
- Surrey
- District of West Vancouver
- Cook County, USA
- Orange County, USA
- Foster City, USA

Salvage Incentive

- Seattle

Other

- Baltimore (Proposed Rebuild Act in 2022, \$4 million annually for deconstruction efforts of pre-1970 homes, focus on abandoned buildings)
- Toronto (exploring)
- Cleveland (various projects)

Deconstruction of single-family dwellings: “It’s not waste, it’s just wasted” (Adam Corneil)

Appendix IV: Definitions

Circular Economy: a closed-loop system that promotes waste reduction by incorporating product reuse, recycling, repair, or returned to the environment in its natural state (CCME, 2019; Giroux Environmental Consulting, 2014)

Deconstruction: “is the systematic dismantling of a structure and building components, specifically for reuse, recycling, and responsible waste management” (LightHouse, 2021)

Demolition: “fast and cost-effective method of tearing down buildings” (Corneil, 2020)

Destruction: “Certain buildings are destroyed with the intent of erasing the (collective) memory or identity related to these buildings (or what they stand for)” (Thomsen et al., 2011)

Green Demolition: “fast and cost-effective method of tearing down buildings with a focus on increasing recycling” (Corneil, 2020)

Recycle: to break down and convert waste into new materials

Reduce: to minimize and lessen the amount of material entering the waste stream

Repair: to fix an item or material so that it can be used again for the same or different purpose

Reuse: to use a material or item again for the same or different purpose, preventing it from entering the waste stream

Salvaged: materials from buildings that are recycled, repaired and/or reused, thus preventing them from entering the waste stream