Guide for Selecting Policies to Reduce and Divert Construction, Renovation and Demolition Waste

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Submitted by
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PREFACE

Construction, renovation and demolition (CRD) wastes are one of the largest solid waste streams in Canada. This document is designed to guide policy makers seeking to reduce CRD waste through a process to identify and select the most effective mix of policies to:

- Reduce the amount of waste generated by CRD activities,
- Decrease the amount of CRD waste disposed, and
- Lessen the environmental impacts of the CRD waste that requires disposal.

Based on considerable secondary research and literature review, and industry stakeholder interviews, this guide presents a three-phase process that could be used for selecting CRD waste management policies:

1. **Assess**: The starting point is to assess the regional context to determine the current state of the CRD waste management and identify the materials and systems with the greatest potential for reduction and/or diversion.

2. **Prioritize**: The second step is to establish a set of goals and select a shortlist of strategies and policy measures that are best aligned with the regional priorities, needs and context. This may include setting diversion targets and identifying priority materials, construction life cycle stages and/or actors for action.

3. **Evaluate**: The final step is to assess the potential benefits and impacts of each policy and decide on a path forward.

This policy selection process is supported by an overview of CRD waste management in Canada, a description of fourteen policy options for reducing CRD waste and a focussed discussion on how to deal with the most prevalent CRD waste materials (wood, asphalt roofing and drywall). Throughout the guide there are numerous Canadian and international examples and case studies, as well as specific considerations for dealing with CRD waste in remote regions.

The guide is written primarily for federal, provincial, territorial and municipal government policymakers with responsibilities for managing and reducing solid waste (e.g. environment ministries and departments). However, it may also be of interest to businesses, design professionals, non-governmental organizations and other stakeholders who are involved in the production, diversion and management of CRD waste.
<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>FULL FORM</th>
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<tbody>
<tr>
<td>ASHRAE</td>
<td>American Society of Heating and Refrigeration and Air-Conditioning Engineers</td>
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<tr>
<td>BOMA</td>
<td>Building Owners and Managers Association</td>
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<tr>
<td>CCA</td>
<td>Copper Chrome Arsenate</td>
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<tr>
<td>CRD</td>
<td>Construction, Renovation &amp; Demolition (waste)</td>
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<tr>
<td>CARE</td>
<td>Carpet America Recovery Effort</td>
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<td>CCME</td>
<td>Canadian Council of Ministers of the Environment</td>
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<tr>
<td>CEN</td>
<td>European Committee for Standardization</td>
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<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
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<td>MBI</td>
<td>Market Based Instrument</td>
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<td>MMC</td>
<td>Modern Methods of Construction</td>
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<td>MRF</td>
<td>Material Recovery Facility</td>
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<td>NGO</td>
<td>Non-Government Organization</td>
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<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<td>OCP</td>
<td>Official Community Plan</td>
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<td>OSB</td>
<td>Oriented Strand Board</td>
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<tr>
<td>PAS</td>
<td>Publicly Available Specification</td>
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<td>PCR</td>
<td>Product Category Rules</td>
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<td>PED</td>
<td>Primary Energy Demand</td>
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<td>PEF</td>
<td>Process Engineered Fuel</td>
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<td>PRN</td>
<td>Packaging Recovery Note</td>
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<tr>
<td>PET</td>
<td>Polyethylene terephthalate</td>
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<tr>
<td>PRO</td>
<td>Producer Responsibility Organization</td>
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<tr>
<td>PP</td>
<td>Polypropylene</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
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<tr>
<td>QA/QC</td>
<td>Quality Assurance and Quality Control</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>SME</td>
<td>Small or Medium-sized Enterprise</td>
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<tr>
<td>WtE</td>
<td>Waste to Energy</td>
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</table>
GLOSSARY

Building deconstruction describes the selective dismantling or removal of materials from buildings prior to (or instead of) conventional demolition. It is an approach to building removal that can convert this waste stream into highest-value resources in a manner that retains their original functionality as much as possible for re-use in future buildings.

Circular Economy refers to a closed loop model of an economy where waste is eliminated and product are sold, consumed, collected and then reused, remade into new products, returned as nutrients to the environment or incorporated into global energy flows. 1

Cradle to Cradle design (also referred to as Cradle to Cradle, C2C, cradle 2 cradle, or regenerative design) is a biomimetic approach to the design of products and systems. It models human industry on nature’s processes viewing materials as nutrients circulating in healthy, safe metabolisms.

Design for disassembly describes how a building is “designed with the end in mind” so that it can be cost-effectively and rapidly taken apart at the end of life and components can be reused and/or recycled. The design team creates a Disassembly Plan that sets out the method of disassembly of major systems during renovations and end-of-life, and the properties of major materials and components.

Design for durability considers the implications of the functions and loads on a building on a life cycle basis. The intention of standards such as CSA S478-95 “Guideline on Durability in Buildings” is to protect against premature failure of components and systems, to minimize the impacts of renovation and repair. However, design for durability also contemplates the adaptability of a building as a means to extend its service life and its potential for re-purposing and re-use in lieu of demolition.

Design for the environment (DfE, D4E) is a design approach to reduce the overall human health and environmental impact of a product, process or service, where impacts are considered across its life cycle.

Diversion (waste diversion, landfill diversion) is the process of diverting waste from landfills or incinerators through various means such as reuse, recycling, composting or gas production through anaerobic digestion. Waste diversion is a key component of effective and sustainable waste management. 2

End waste is the waste that results after residual materials have been sorted, processed, and reclaimed and cannot be processed any further under existing technical and economic conditions to extract reclaimable content or reduce its polluting or hazardous character.

Extended Producer Responsibility (EPR) is “a policy approach in which a producer’s responsibility (physical and/or financial) for a product is extended to the post-consumer stage of a product’s life cycle. EPR shifts responsibility upstream in the product life cycle to the producer and away from municipalities. As a policy approach it intends to provide incentives to producers to incorporate environmental considerations in the design of their products. EPR also shifts the historical public sector tax-supported responsibility for some waste to the individual brand owner, manufacturer or first importer.” 3

Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high-temperature waste treatment systems are described as “thermal treatment”.

Incineration of waste materials converts the waste into ash, flue gas, and heat.
Life cycle analysis is a comprehensive method for assessing a range of environmental impacts across the full life cycle of a product system, from materials acquisition to manufacturing, use, and final disposition. Linear Economy is a consumption model of an economy where a product is sold, consumed and discarded (take-make-waste).

Sustainable consumption and production: As defined by the Oslo Symposium in 1994, sustainable consumption and production (SCP) is about "the use of services and related products, which respond to basic needs and bring a better quality of life while minimizing the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of further generations". Sustainable Materials Management (SMM) is an approach to promote sustainable materials use, integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity.

Virgin materials are resources extracted from nature in their raw form, such as gravel, timber or metal ore and have not been previously used or consumed, or subjected to processing other than for its original production.

Waste-to-energy (WtE) or energy-from-waste (EfW) is the process of generating energy in the form of electricity and/or heat from the primary treatment of waste. WtE is a form of energy recovery. Most WtE processes produce electricity and/or heat directly through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels.

Zero Waste is a policy concept that goes beyond recycling to focus first on reducing waste and reusing products and then recycling and composting/digesting the rest, with the ultimate goal of eliminating all waste and achieving zero waste to landfill. Achieving zero waste requires new business and economic models. At the level of the economy, it involves a transition from the prevalent "Linear Economy" to a "Circular Economy" closed loop model where a product is sold, consumed, collected and then reused, remade into a new product, returned as a nutrient to the environment or incorporated into global energy flows.
INTRODUCTION

Construction, renovation and demolition (CRD) wastes are one of the largest solid waste streams in Canada. It is estimated that as much as 40 per cent of the raw materials consumed in North America – wood, metals, minerals, and so on – are used in construction. When building stock turns over, most of these materials become waste. CRD waste from residential and non-residential buildings accounts for a significant amount of Canada’s annual waste production.

This waste comes at a significant cost to governments, businesses and the environment. It is expensive to manage – for example, municipalities alone spent more than $2.9 billion on waste management in 2010 – and it represents a missed opportunity to recover value from materials in the waste stream. The production and disposal of waste also negatively impacts human health and the environment through habitat loss, soil and water contamination and the release of air emissions such as greenhouse gases.

Consequently, there is a strong social, economic and ecological imperative to both reduce the rate of CRD waste generation and increase the quantities diverted from disposal. The good news is that almost all waste materials from construction are reusable or recyclable. Numerous projects across the country have shown that it is possible to divert as much as 95 per cent of all CRD waste materials through reuse and recycling. These diversion efforts also generate significant economic benefits. It is estimated that there are over 4,800 green jobs associated with CRD waste and recycling in Canada. Another study concluded that seven jobs are created for every 1,000 tonnes of waste diverted with an economic benefit 4 times greater than the net cost.

Reducing the amount of CRD waste heading to landfill is a complicated task that requires a sophisticated policy approach. There is no single policy or strategy that can address this issue on its own: successful jurisdictions – such as the Netherlands, the State of Massachusetts and the province of Nova Scotia – have been able to achieve high CRD waste reduction and diversion rates using a combination of policies that were tailored to their unique political, economic and market conditions.

Purpose

This document is designed to guide policymakers seeking to reduce CRD waste through a process to understand, identify and select the most effective mix of policies to:

- Reduce the amount of waste generated by CRD activities,
- Decrease the amount of CRD waste disposed, and
- Lessen the environmental impacts of the CRD waste that requires disposal.

Target audience

This guide is written primarily for federal, provincial, territorial and municipal government policymakers with responsibilities for managing and reducing solid waste (e.g. environment ministries and departments). However, it may also be of interest to businesses, design professionals, non-governmental organizations and other stakeholders who are involved in the production, diversion and management of CRD waste.
**Assumptions, scope and limitations of this guide**

This guide presents decision-makers with high-level guidance for identifying, evaluating and selecting the best policies for influencing CRD waste management. It assumes that the reader has a basic understanding of the CRD waste management context, concepts and approaches. For those that are new to the field, a brief overview is provided in Section 2.

This guide does not delve into the process and best practices for developing environmental policies generally. It assumes that the reader is familiar with the policy development process in their jurisdiction and instead focuses on identifying the unique considerations and questions for developing effective CRD waste policies.

There are many different policies that can be used to encourage the reduction and diversion of CRD waste materials. This guide presents an overview of some of the most common and effective policy tools for managing CRD waste in Canada. A more comprehensive list of policies that may apply to CRD waste management is provided in Appendix A.

**How to use this guide**

This guide is organized into four sections that provide guidance in developing CRD waste policy supported by an overview of CRD waste management, descriptions of fourteen policy options for reducing CRD waste and a focused discussion on how to deal with the most prevalent CRD waste materials (wood, asphalt roofing and drywall).

Throughout the guide there are numerous Canadian and international examples and case studies, as well as specific considerations for dealing with CRD waste in remote regions.
CRD waste management snapshot

To navigate this guide, it is important for the reader to be familiar with the key terms, concepts and frameworks that form the context for CRD policy making. (Additional details are provided in the sections below).

Sources of CRD waste

Although Construction, Renovation and Demolition (CRD) wastes may consist of similar materials, they emerge from very different processes with significant implications for waste management. The three waste streams can be described as follows:

- **Construction waste** refers to wastes that are derived from the process of building new structures.
- **Renovation waste** is generally a hybrid of construction waste and demolition waste and is derived from undertaking improvements and repairs to existing structures.
- **Demolition waste** refers to wastes and material debris that are derived from the process of demolishing existing structures. Demolition activities tend to produce mixed waste that is challenging to separate into different materials for reuse or recycling.

More details are provided in Section 2.

CRD waste materials

CRD waste is comprised of many different types of materials and products. The most prevalent materials by weight are wood (clean, engineered, treated and painted), asphalt roofing and drywall and these have been highlighted for particular attention in this guide. Other materials include metals, plastics, concrete, asphalt paving, bricks, glass, cardboard, and a host of other materials are found in relatively small quantities such as ceiling tiles, equipment, furniture, paint, etc. More information about CRD waste materials are provided in Section 2. Policies for dealing with the most prevalent materials are discussed in Section 4.

Waste management and diversion

Waste diversion is the process of diverting waste from landfills or incinerators through various means such as reuse, recycling, composting or gas production through anaerobic digestion. From a diversion perspective, this guide (in Section 2) classifies CRD waste materials in one of four categories:

- **High value**: Materials for which well-established reuse or recycling technologies and markets exist that are economically viable in most regions (e.g. metals),
- **Simple to divert**: Materials for which established, proven diversion technologies and processes are available but in most regions some level of support is required to make them economically viable. (e.g. clean wood, concrete, brick),
- **Complex to divert**: Materials for which technological options for diversion exist but they are complex, under development and/or not economically viable without significant support (e.g. plastics, carpet, asphalt shingles), and
- **Limited options**: Materials for which no technological options for diversion are currently available (e.g. treated wood).
CRD waste management goals

In 2010, the average Canadian CRD waste diversion rate was quite low at approximately 16 per cent. Several jurisdictions have demonstrated that achieving diversion rates of up at least 50 per cent and up to 95 per cent are possible with existing technologies. At the highest level, policy makers can set CRD waste goals in three areas:

- Reducing the amount of waste generated by CRD activities,
- Increasing the amount of CRD waste diverted from landfills and incineration, and
- Reducing the environmental impacts of the waste that requires disposal.

CRD waste management strategies and policies

In Section 3, this guide identifies six broad strategies and fourteen policies for achieving these goals:

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Associated CRD waste management policies</th>
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<tbody>
<tr>
<td>A. Create accountability for waste diversion</td>
<td>Make specific actors (e.g. producers, builders, facilities) more accountable for reducing and diverting CRD waste. Featured policies:</td>
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<tr>
<td></td>
<td>1. Extended Producer Responsibility (EPR)</td>
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<td></td>
<td>2. Waste management plans for facilities and projects</td>
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<td>B. Limit disposal options</td>
<td>Limit where, how or what materials can be disposed, such as through waste disposal bans or transportation restrictions. Featured policies:</td>
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<tr>
<td></td>
<td>3. Waste disposal bans</td>
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<td></td>
<td>4. Transportation requirements</td>
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<tr>
<td>C. Align financial incentives</td>
<td>Use fees and charges to encourage waste reduction and diversion, such as through differential tipping fees or virgin material levies. Featured policies:</td>
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<td></td>
<td>5. Differential tipping fees</td>
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<td>6. Virgin material levies</td>
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<tr>
<td>D. Improve CRD processes</td>
<td>Increase the resource efficiency of CRD activities, such as through building certification and deconstruction standards. Featured policies:</td>
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<td>7. Building codes</td>
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<td>8. Green building design certification</td>
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<td>9. Environmental product labelling and standards</td>
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<td></td>
<td>10. Deconstruction standards</td>
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<tr>
<td>E. Strengthen diversion markets and infrastructure</td>
<td>Increase the supply and demand of diverted materials, such as through public procurement and investment. Featured policies:</td>
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<tr>
<td></td>
<td>11. Invest in infrastructure, research and development</td>
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<td>12. Public procurement</td>
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<tr>
<td>F. Build knowledge and skills</td>
<td>Increase the capacity and knowledge of the sector, such as through education programs and data collection. Featured policies:</td>
</tr>
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<td></td>
<td>13. Industry outreach, education and resources</td>
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<td>14. Benchmark and track data</td>
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1. KEY STEPS IN CRD WASTE POLICY DEVELOPMENT

Reducing the amount of CRD waste heading to landfill is a complicated task and there is no single policy that can address the issue on its own. CRD waste reduction and diversion requires a comprehensive approach. Successful jurisdictions use a combination of policies that are tailored to their unique regional political, economic and market conditions. These policies are usually developed after extensive consultation with industry and other key stakeholders. This guide presents a simple three-phase process for selecting CRD waste management policies (summarized in Figure 1):

4. Assess: The starting point is to assess the regional context to determine the current state of the CRD waste management and identify the materials and systems with the greatest potential for reduction and/or diversion.

5. Prioritize: The second step is to establish a set of goals and select a shortlist of strategies and policy measures that are best aligned with the regional priorities, needs and context. This may include setting diversion targets and identifying priority materials, construction life cycle stages and/or actors for action.

6. Evaluate: The final step is to assess the potential benefits and impacts of each policy and decide on a path forward.

This section provides a high level overview of each of these areas and highlights the key questions and considerations that are specific to the CRD waste management context. Subsequent sections in this guide then provide additional information that policymakers can use to help them answer these questions as they move through the policy selection process.

Figure 1 The policy selection process
1.1. Assess

There are three key steps in the assessment process (Figure 2).

Each province, territory and region has its own unique context that influences which policies are most effective for managing CRD waste. Consequently, it is important to collect as much information as possible about the CRD waste streams, infrastructure and markets before setting a goal and selecting a set of policies. Ideally, this information should be validated with industry and other key stakeholders.

Figure 2 Assess the market and policy context

1. Assess waste markets and infrastructure

- What are the current disposal and diversion rates (overall and by material)?
- What is the state of the current CRD waste management system (actors, infrastructure, services, markets)?

2. Assess policy environment

- What is the current policy framework for waste reduction and diversion? For CRD waste in particular?
- What are the drivers and what is the degree of urgency for addressing the issue?

3. Identify gaps, opportunities and challenges

- What are the gaps or barriers that can be addressed through strategic policy intervention?
- Where are there opportunities to significantly move the bar on waste management?

1. Assess waste markets and infrastructure

An assessment of CRD waste markets and infrastructure involves looking at the current CRD waste stream and the infrastructure and markets that can support diversion. The options for diversion may vary depending on the type and relative volumes of material (e.g. wood, drywall, asphalt etc.), its source (e.g. residential, non-residential) and the activities it is derived from (e.g. construction, renovation or demolition).
The cost and viability of collecting, processing and diverting materials depend upon the accessibility of regional public and private infrastructure and the state of the markets for re-used and recycled materials and feed stocks.

**CRD waste markets and infrastructure**

Questions to consider:

- What is the composition of materials in the CRD waste stream?
- What are the current disposal and diversion rates (overall and by material)?
- What is the state of the current CRD waste management system?
  - What public and/or private facilities, services and actors exist for receiving, handling and processing CRD waste materials in the region?
  - What is the estimated remaining capacity and lifespan of key facilities?
- What is the state of diversion and disposal markets?
  - What are the options for using diverted materials?
  - What end-users and markets exist for buying and selling these materials?
  - What is the cost or price of different diversion and disposal options?
- Which materials are particularly easy or challenging to divert?
  - What are the gaps in coverage?

As part of this assessment, it can be useful to categorize materials based on the ease with which they can be diverted from landfill. Ease of diversion of particular CRD waste materials varies from region to region based on the accessibility and efficiency of infrastructure and markets. This guide suggests four broad categories:

- **High value**: Materials for which well-established reuse or recycling technologies and markets exist that are economically viable in most regions (e.g. metals),
- **Simple to divert**: Materials for which established, proven diversion technologies and processes are available but in most regions some level of support may be required to make them economically viable. (e.g. clean wood, concrete, brick),
- **Complex to divert**: Materials for which technological options for diversion exist but they are complex, under development and/or not economically viable in all regions without significant support (e.g. plastics, carpet, drywall, asphalt shingles), and
- **Limited options**: Materials for which no technological options for diversion are currently available (e.g. painted or treated wood).

Sections 2.2 to 2.4 provide additional information on CRD waste materials, the CRD waste management system, key actors, the building lifecycle and diversion options. Appendix B provides additional details on the diversion options for the 20 most common CRD waste materials.
2. Assess the policy environment

CRD waste management occurs within a broader solid waste management context and regulatory environment. The options available to policymakers depend on their level of government (e.g. municipal, regional, provincial, territorial, federal), departmental mandate and existing related policies and regulations.

### Policy Environment

Questions to consider:

- What is the overall policy framework for waste reduction and diversion?
  - What goals, measures and tools are in place to support diversion of solid waste in general?
    - For CRD waste in particular?
  - What is the current funding model for CRD waste management activities?
    - What support exists for research and infrastructure development?
- What are the experiences of other jurisdictions?
  - What are the relevant leading practices and lessons learned?
- What level of political, public and industry support is there for acting on CRD waste?
  - What is driving their interest in the issue, and what is the degree of urgency?
  - Why is action needed now?

Section 2.5 provides additional information on CRD waste management policy trends. Examples of how different jurisdictions are approaching CRD waste management are integrated throughout this guide.

3. Identify gaps, challenges and opportunities

Policymakers can then use the market, infrastructure and policy context assessments to identify the specific gaps, opportunities and challenges for CRD waste management in their region. This includes identifying the general and material-specific barriers that can best be addressed through a strategic policy intervention. Some of the common challenges that governments may seek to address through CRD waste policies include:

- CRD waste diversion activities can be time-consuming and expensive, particularly given market forces that result in labour and land being expensive, and materials being inexpensive (and therefore disposable).
- Lack of established markets and market capacity to effectively serve consumers of secondary materials with the right product in the right place at the right time.
- Lack of accessible infrastructure for supporting diversion into reuse and recycling.
- CRD waste materials are often combined in such a way that they are difficult to separate.
- The complex life-cycle of building products and materials and the diverse number of actors involved.
- Organizational culture impediments, such as customer/client preferences for new materials, a general lack of awareness of deconstruction options, and the firm entrenchment of status-quo construction practices.

Section 2.7 provides additional information on the opportunities and barriers for CRD waste management.
1.2. Prioritize

There are two steps in the policy prioritization phase (Figure 3).

Construction is a slow moving industry and it responds best to long-range market signals that give businesses the confidence to invest in new products, processes and training. All levels of government can set the stage by establishing long term plans for CRD waste that include clear goals, targets and strategies.

This phase involves establishing a set of goals and selecting a shortlist of strategies and policy measures that are best aligned with the regional priorities, needs and context. This may include setting diversion targets and identifying priority materials, construction life cycle stages and/or actors for action.

Figure 3 Prioritize goals and strategies

1. Establish goals and scope

- What are the goals and targets for CRD waste management as a whole? For specific materials?

2. Short-list strategies and policies

- Which policies are best aligned with the regional goals, priorities needs and context?

1. Establish policy goals and scope

At the highest level, governments can establish goals in three areas:

- Reducing the amount of waste generated by CRD activities (e.g. through improved efficiency in design and construction),

- Increasing the amount of CRD waste that is diverted from landfills and incineration (e.g. through improved reuse, recycling and composting systems and markets), and

- Reducing the environmental impacts of the waste requiring disposal (e.g. through safe disposal and the use of less toxic materials).

CRD waste goals can vary considerably in their specificity, targets and ambition. They may be targeted to specific materials (e.g. wood waste), building types (e.g. homes) or be applied to the CRD waste stream as a whole. They may include concrete, time-bound reduction targets or simply establish a general direction (e.g. reducing waste) without specifying a target or timeline.
Drivers of CRD waste diversion are normally time-based whereby specified amounts of waste (or percentage of a total waste stream) are to be diverted by a certain date. As a result, policy mechanisms such as waste disposal ban dates can be powerful motivators for CRD waste diversion policies.

The level and timeframe of goals and targets depend on the degree of political ambition. They may be intended to foster small, incremental changes and improvements or a significant overhaul and transformation of the waste management system as a whole. Similarly, some decision-makers will set targets based on a rigorous analysis of what is achievable within their current market context whereas others will choose to set aspirational targets (to “plant a flag in the sand”) and offer an incentive for innovation. For example, the city of Whitehorse has set a goal of achieving zero waste by 204016 and the province of Ontario has developed a long-term vision for zero waste and zero greenhouse gas emissions from the waste sector.17

Many aspirational waste diversion targets have their roots in emerging waste management approaches and movements (e.g. Zero Waste, Design for Environment, Cradle-to-Cradle, Circular Economy, Sustainable Materials Management: see Section 2.5 for descriptions of these terms). These approaches advocate for the elimination of waste to landfill entirely through the design of durable, reusable and recyclable products and materials. These concepts are gaining increasing traction in Canada through the effort of organizations such as regional recycling councils and the National Zero Waste Council.18

In sum, there is not a set process or standard for establishing CRD waste policy goals. Each jurisdiction and leadership team uses an approach that fits their unique circumstances. See Section 2.5 for additional information on policy trends and Section 2.6 for examples of goals from different jurisdictions.

2. Short-list strategies and policies

As summarized in Figure 4, this guide presents six distinct strategies and fourteen associated policies for achieving CRD waste goals. Each strategy uses different policy tools to influence CRD actors, markets and systems at various stages in the building lifecycle. These are discussed in detail in Section 3, which provides a description of each of policy is provided which includes:

- Overview of what it is and how it works,
- Applicability to CRD waste,
- Advantages and disadvantages,
- Considerations when developing the policy,
- Government insolvent in developing and implementing the policy, and
- Examples.

There is also a brief summary of the potential impact of the policy in terms of its potential to reduce CRD waste, divert materials from landfill and/or support the development of markets for the recovered materials.
Figure 4: Strategies for reducing and diverting CRD waste

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Associated CRD waste management policies</th>
</tr>
</thead>
</table>
| A. Create accountability for waste diversion | Make specific actors (e.g. producers, builders, facilities) more accountable for reducing and diverting CRD waste. Featured policies:  
  1. Extended Producer Responsibility (EPR)  
  2. Waste management plans for facilities and projects                                                                                                         |
| B. Limit disposal options                     | Limit where, how or what materials can be disposed, such as through waste disposal bans or transportation restrictions. Featured policies:  
  3. Waste disposal bans  
  4. Transportation requirements                                                                                                                                       |
| C. Align financial incentives                 | Use fees and charges to encourage waste reduction and diversion, such as through differential tipping fees or virgin material levies. Featured policies:  
  5. Differential tipping fees  
  6. Virgin material levies                                                                                                                                                |
| D. Improve CRD processes                      | Increase the resource efficiency of CRD activities, such as through building certification and deconstruction standards. Featured policies:  
  7. Building codes  
  8. Green building design certification  
  9. Environmental product labelling and standards  
  10. Deconstruction standards                                                                                                                                            |
| E. Strengthen diversion markets and infrastructure | Increase the supply and demand of diverted materials, such as through public procurement and investment. Featured policies:  
  11. Invest in infrastructure, research and development  
  12. Public procurement                                                                                                                                                    |
| F. Build knowledge and skills                 | Increase the capacity and knowledge of the sector, such as through education programs and data collection: Featured policies:  
  13. Industry outreach, education and resources  
  14. Benchmark and track data                                                                                                                                              |

In general, governments with an ambitious agenda will need to use a combination of strategies to achieve their goals. This is because the effectiveness of each strategy depends in large part on the accessibility of diversion options and markets and these vary significantly across different materials and regions.
At this step in the process, the purpose is to identify a short list of strategies and policies that have the best high-level fit with the region’s circumstances. Rural and remote communities may have particularly challenging conditions for CRD waste diversion that are discussed in Section 3.7. In developing their short-list, decision-makers can consider how policies align with:

- **Overall goals.** Some strategies are better suited to reducing the production of waste (e.g. Strategy A: Create accountability and Strategy D: Improve CRD processes) whereas others have more of an impact on increasing diversion rates (e.g. Strategy E: Strengthen diversion markets).

- **Market conditions.** Some policies can be implemented in almost any market (e.g. Differential tipping fees, Public procurement) whereas others are best suited to markets and materials with established diversion options (e.g. waste disposal bans).

- **Desired impact.** Some policies have the potential to significantly shift CRD waste diversion rates (e.g. Extended producer responsibility, Waste disposal bans) while other policies are more effective at sending a market signal (e.g. Public procurement) and stimulating innovation at a project level (e.g. Green building certification).

- **Appetite for risk and innovation.** Some policies have a long track record of successful implementation in Canada (e.g. Differential tipping fees) whereas others represent more emerging practices for CRD waste (e.g. Extended producer responsibility and Virgin material levies).

- **Government level and mandate.** Some policies can only be implemented by federal, provincial or territorial governments (e.g. Building codes) while others are better suited to local government (e.g. Differential tipping fees).

Another consideration is the preferred intervention approach of the government. The US Environmental Protection Agency describes three broad intervention approaches:

1. Voluntary approaches (such as education),
2. Prescriptive regulations (such as building codes), and
3. Market-based (or economic) instruments (such as fees and grants).

Some governments lean towards using a single approach for waste management, while other jurisdictions prefer to use a combination of approaches. Similarly, some of the policies can only be implemented using a specific approach (e.g. building codes are prescriptive regulations and differential tipping fees are economic instruments) whereas other policies can be implemented in different ways (e.g. extended producer responsibility programs may be voluntary or required).

Section 3 provides a detailed description of each of the strategies and policies and their applicability to CRD waste, advantages and disadvantages and applicability to different levels government.
1.3. Evaluate

There are two steps in the policy evaluation phase (Figure 5).

Having identified a short-list of policies, the final phase is to conduct a detailed evaluation of each policy and then finalize the approach. These should ideally be validated and refined through consultation with industry and other key stakeholders, as well as engagement with other jurisdictions that have experience with these policy approaches.

Each jurisdiction will have its own evaluation process based on their priorities, consultation mechanisms and information sources. This section provides some high-level questions to consider as part of the evaluation.

Figure 5 Evaluate preferred policies

1. Conduct detailed evaluation

- Are short-listed policies socially, economically and ecologically viable in the market and policy context?

2. Finalize approach

- Select final suite of policies and develop detailed policy approach.

1. Conduct a detailed evaluation

The detailed evaluation takes a deeper look at each of the shortlisted policies to ensure that they are i) viable in the regional market and policy context, ii) will be effective at achieving the desired outcomes and iii) will align with the environmental, economic and social priorities of the government, industry and general public.

This process can also be used to tailor the policies to best suit the issues and challenges faced by the government. For example, one of the most important considerations is how the implementation and administration of each policy will be funded. Some of the common options are:

- Using revenue from general or waste-specific taxes, fees and charges such as via differential tipping fees (Section 3.3.1) and virgin materials levies (Section 3.3.2). For example, the Québec government charges a levy on solid waste that is used to fund the development and implementation of regional governments’ Residual Materials Management Plans (RMMPs). Funding levels are tied to waste diversion performance. Another example is the UK’s Aggregates Levy Sustainability Fund (ALSF) that charges a fee on virgin aggregate and uses...
the fees to fund environmental programs and research to stimulate the market for recycled and secondary materials.  

- **Distributing waste management costs among generators and recyclers.** This is commonly done through extended producer responsibility and product stewardship approaches (Section 3.1.1). For example, BC’s Recycling Regulation shifts responsibility for end-of-life management of packaging and printed paper from governments and their taxpayers to the businesses that produce these materials: Industry Stewards pay annual fees to fund the program. In contrast, under the California Carpet Stewardship Bill (AB 2398) customers are charged a fee for all new carpet purchased: the revenues fund post-consumer carpet recycling measures.

- **Using deposit-refund schemes** to both incentivize compliance and generate revenue. For example, the City of Vancouver Green Demolition Bylaw imposes a $15,000 refundable fee paid with the demolition permit of a detached house. If the deconstruction, reuse and recycling targets are achieved, then $14,650 is refunded with the remainder being used to offset administrative costs. Similarly, the province of Nova Scotia charges a deposit on beverage containers and provides a 50 per cent refund when the containers are returned for recycling; the balance is used to fund recycling programs throughout the province.

To help inform this process, **Section 4** provides a deeper look at the policy options for the most common CRD waste materials: i) Wood (clean, engineered, painted and treated), ii) Drywall and iii) Asphalt roofing.

There are many questions to ask when undertaking an evaluation of prioritized CRD waste policies. They fall in four broad categories: Policy viability and effectiveness, Economic and funding considerations, Environmental considerations and Social considerations.

**Policy viability and effectiveness**

Questions to consider:

- Based on regional circumstances, will the proposed suite of policies be effective at diverting waste?
  - Will they offer the right degree of certainty and deliver the desired results within the available timeframe?
- How easy will the policy(ies) be to implement and enforce?
  - What are the potential costs (for administration, monitoring, other costs)?
- Is (are) the proposed policy(ies) compatible with other jurisdictions?
- How flexible and/or costly will the proposed policy(ies) be for target audience(s)?
  - What is the likely level of public and industry acceptance and capacity?
- Is it important for the proposed policy(ies) to be easily adaptable over time?
- Is(Are) the proposed policy(ies) technical viable?
  - Are there available markets & infrastructure and how functional are they?
- Is(Are) the proposed policy(ies) fair and equitable in terms of the distribution of costs and benefits, and creating a level playing field?
Economic and Funding Considerations

Questions to consider:

- How will the policy(ies) be funded?
  - Is it financially sustainable?
- What are the associated direct economic benefits (revenues from taxes, fees, deposits, etc.)?
- What are the associated ancillary economic benefits?
- Are there any costs to government, producers, recyclers, taxpayers and consumers?
  - If so, how significant are they?
- What are the implications for trade, investment and competitiveness?
  - Does(Do) the proposed policy(ies) cause any market distortions,
    - If so, how significant are they?
- To what extent does(do) the proposed policy(ies) foster innovation and investments in R&D?

Environmental Considerations

Questions to consider:

- What are the associated direct environmental benefits (GHG reductions, resource efficiency, etc.)
- What are the associated ancillary environmental benefits?
- Are there any environmental costs and risks? If so, how significant are they?

Social Considerations

Questions to consider:

- What are the associated direct social benefits (e.g. jobs, health)?
- What are the associated ancillary social benefits?
- Are there any social costs and risks (e.g. health)?
- What are the current levels of awareness about CRD waste management, and
  - How much effort and resources will be needed to ensure that all actors accept and can achieve CRD waste goals?
- What degree of behavioural change will be necessary to achieve the desired policy goals?
2. Finalize approach

The last step is to finalize the suite of policy options and move into the detailed policy development process. Unfortunately, there is not a great deal of practical data on which policy works best given a certain set of specific circumstances and market characteristics. For example, for some regions it has been very important to have recycling infrastructure in place prior to implementing waste disposal bans so that the market can adjust to the ban quickly. Yet, when the province of Nova Scotia imposed a ban on compostable organic material in 1997 there were very few existing composting facilities or established markets. In fact, the ban created the conditions for the private sector and municipalities to react and create the facilities and markets. More were built after the ban was announced.

Therefore, an important part of the final stage of the policy development process is to engage with other jurisdictions that have experience with these policy approaches. As a starting point, numerous case studies and examples are provided throughout this guide.

To illustrate how policy making for CRD waste diversion is not a linear process, there are two detailed case studies of leading jurisdictions (the State of Massachusetts and the Netherlands) that have implemented a large number of coordinated CRD policies and achieved significant reductions in CRD waste to landfill (in Appendix D). These case studies demonstrate international best practices in CRD waste management. They show how it may be necessary to assemble a large number of decision-making criteria in order to develop a portfolio of policy tools and levers that will best meet the needs of the region’s specific circumstances.
2. OVERVIEW OF CRD WASTE IN CANADA

2.1. Defining CRD waste

CRD waste is the waste stream derived from construction, renovation and demolition activities. It is composed of many different types of materials such as wood, asphalt roofing products, drywall, plastic, metals and aggregates.

CRD waste can come from residential sources (e.g. house renovations) or from non-residential sources (e.g. construction or demolition of office buildings). Although construction, renovation and demolition wastes may consist of similar materials, they emerge from very different processes. For example, while it is relatively straightforward to separate and divert waste materials from new construction projects from landfill, it is much more challenging with demolition and renovation projects because they involve:

- Much larger quantities of waste (often the entire building),
- Less certainty about the composition of materials being removed. For example, older buildings may be contaminated with hazardous materials (e.g. asbestos),
- Automated demolition equipment like cranes and grapples, which don’t lend themselves to the separation of one material from another, and
- Tight and inflexible schedules and economics. The highest project value is in new construction, while demolition is perceived simply as a cost, with the goal to finish as quickly and cheaply as possible.

CRD waste from residential and non-residential buildings accounts for a significant amount of Canada’s annual waste production. Statistics Canada estimates that about 4 million tonnes of CRD waste was generated in Canada in 2010 (excluding large civil and public infrastructure projects, marine pilings, telephone, rail, landclearing, etc.), and this figure could be possibly much more depending on how CRD waste is tracked. According to a 2015 study commissioned for Environment Canada, only about 16 per cent was reused or recycled (653,000 tonnes) while the remaining 84 per cent was disposed (3,353,000 tonnes), mostly in landfills (Table 1).

### Table 1 Sources of CRD Waste

<table>
<thead>
<tr>
<th>Building Stage</th>
<th>Residential</th>
<th>Non-Residential</th>
<th>Total CRD Waste (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>15%</td>
<td>5%</td>
<td>444,700 tonnes (11%)</td>
</tr>
<tr>
<td>Renovation</td>
<td>57%</td>
<td>32%</td>
<td>1,873,200 tonnes (47%)</td>
</tr>
<tr>
<td>Demolition</td>
<td>28%</td>
<td>63%</td>
<td>1,668,900 tonnes (42%)</td>
</tr>
</tbody>
</table>

**Construction waste** refers to wastes that are derived from the process of building new structures.

**Renovation waste** is generally a hybrid of construction waste and demolition waste and is derived from undertaking improvements and repairs to existing structures.

**Demolition waste** refers to wastes and material debris that are derived from the process of demolishing existing structures.

*Source: Characterization and Management of Construction, Renovation and Demolition (CRD) Waste in Canada*
CRD waste comprises many different types of materials and products. Figure 6 illustrates that the most prevalent wastes by weight are wood (clean, engineered, treated and painted), asphalt roofing and drywall and these have been highlighted for particular attention in the guide (Section 4). Other materials include metals (3 per cent of the total by weight), plastics (4 per cent), concrete (4 per cent), cardboard (1 per cent), and a host of other materials that, individually, are found in relatively small quantities such as glass, asphalt paving, bricks, ceiling tiles, equipment, furniture, paint, etc.

Figure 6: Most prevalent CRD waste streams (percentage by weight) in Canada in 2010

Source: Characterization and Management of Construction, Renovation and Demolition (CRD) Waste in Canada

2.2. Common waste materials and considerations for reduction and diversion

From a waste management perspective, it can be helpful to categorize CRD waste materials into the following groups:

- **High value**: Materials for which well-established reuse or recycling technologies and markets exist that are economically viable in most regions (e.g. metals).

- **Simple to divert**: Materials for which established, proven diversion technologies and processes are available but in most regions some level of support is required to make them economically viable. These materials are mostly environmentally benign but generally require some processing and command less market value (e.g. clean wood, concrete, brick).

- **Complex to divert**: Materials for which technological options for diversion exist but they are complex, under development and/or not economically viable without significant support. These more complex materials are comprised of numerous raw materials that require extensive processing infrastructure (equipment, on site space, etc.) so markets may need to be incentivized to accept them (e.g. plastics, carpet, asphalt shingles).

- **Limited options**: Materials for which no technological options for diversion are currently available. This includes materials containing hazardous and/or toxic substances specified under applicable federal, provincial, territorial...
and municipal legal requirements, which may pose risks to human health and the environment if improperly managed.

Figure 7 (following page) presents a snapshot of the state of CRD waste management for common materials.

Given that the largest volumes of waste materials from construction and demolition projects are inert materials (clean wood, concrete, etc.), numerous projects across Canada have demonstrated that high diversion rates are possible. Leadership in Energy and Environmental Design (LEED) offers credits for construction waste management in excess of 50 per cent (1 credit) and 75 per cent (2 credits), which is considered easily achievable, particularly in urban centres (and especially when concrete and rubble are included). Indeed, the new Toronto Airport terminal project included demolition specifications for the old Terminal One building included the requirement to divert a minimum 90 per cent of materials from landfill. Overall, 95 per cent of demolition wastes were diverted, while an estimated $1,845,000 was saved by recycling concrete on site.

Markets for recycled materials are growing, albeit slowly and in selective areas, and motivations to build green are improving levels of awareness and familiarity with the CRD waste management process. Twenty of the most common CRD waste materials, the potential markets and the opportunities for diversion are illustrated in Appendix B.

The materials are discussed in the context of clean, un-contaminated waste streams. However, a great deal of CRD waste comprises materials that are not technically or economically feasible to separate and must be disposed of safely (for example wood waste contaminated with drywall, hardware, plastic laminate, etc.). Currently, most processing facilities can only accept a small amount of contamination (less than 10 per cent, at the most). Waste stream contamination is discussed as a barrier to CRD waste diversion in Section 1.5.

### Waste to energy

Waste-to-energy (WtE) or energy-from-waste (EfW) is the process of generating energy in the form of electricity and/or heat from the primary treatment of waste. WtE is a form of energy recovery. Most WtE processes produce electricity and/or heat directly through combustion (i.e. incineration), or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels.

In Canada, the majority of the nation’s WtE facilities are owned by local governments that have invested in these facilities to achieve long-term solid waste management solutions. More or less any hydrocarbon-based material (plastics, wood, etc.) can be used as a fuel source for WtE. For example, small scrap, painted and damaged wood is often used as fuel source for WtE. For example, small scrap, painted and damaged wood is often used as fuel source for power generation plants and cement kilns.

CRD wood waste derived fuel can play a role in replacing high-carbon fuels for industrial processes which can contribute to an industrial GHG reduction strategy. It can also deal with hard to divert materials. For example, the Enerkem facility in Edmonton is able to treat wood (www.enerkem.com).

However, energy recovery is the lowest level solution on the waste management hierarchy (see Section 2.1) and should be considered a “last resort” for CRD waste that might otherwise command a higher value as a feedstock for industrial, agricultural or other markets. Policies that promote WtE as an end-market to drive CRD wood waste diversion may inadvertently capture materials being recycled for beneficial use and undermine the waste hierarchy. Ideally, Waste to Energy is used in regions that have deployed all other efforts to reduce, reuse and recycle and have achieved high rates of diversion (greater than 50 per cent).
Figure 7 Categories of CRD waste with associated management and recycling opportunities

**High value**
- Ferrous and non-ferrous metals
- Architectural salvage, some furniture & functioning equipment
- Large steel or wood structural members
- Metals

**Simple to divert**
- Clean wood
- Most engineered wood
- Drywall (some regions)
- Asphalt roofing (some regions)
- Asphalt paving
- Cardboard
- Concrete
- Brick
- Rock, gravel and aggregates
- Most equipment, appliances & “white goods”

**Complex to divert**
- Some painted wood
- Creosote-treated wood (some regions)
- Some contaminated wood (with hardware, roofing materials, laminate, drywall, etc. attached)
- Drywall (some regions)
- Asphalt roofing (most regions)
- Plastics
- Ceiling tiles
- Mixed glass
- Carpet
- Fiberglass
- Paint

**Limited options**
- Combinations of materials that cannot be separated
- Most painted and treated wood
- Some non-functioning equipment, furnishings & furniture

Well-established reuse or recycling technologies and markets that are economically viable in most regions

Established, proven diversion technologies and processes available but in most regions some level of support is required to make them economically viable

Technological options for diversion exist but they are complex, under development and/or not economically viable without significant support.

No technological options for diversion currently available. Need to be disposed of safely
2.3. CRD waste management system and actors

The management of CRD waste involves many different organizations, processes and activities and a waste stream comprised of thousands of different types of products and materials. Policy makers may consider the presence (and absence) of actors, service providers, infrastructure, facilities and markets when developing CRD diversion policies.
Figure 8 (following page) provides a simplified view of the generic CRD waste management ecosystem and its complex web of inter-relationships. Table 2 presents the key actors involved in the production and management of CRD waste.

### Table 2: Actors involved in the production and management of CRD waste

<table>
<thead>
<tr>
<th><strong>CRD waste generators</strong></th>
<th><strong>Facilities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies that generate waste and therefore have a role in reducing volumes created.</td>
<td>Companies and agencies responsible for receiving, sorting and processing CRD waste</td>
</tr>
<tr>
<td>- Home owners</td>
<td>- CRD waste processors, also known as Material Recovery Facilities (MRFs)</td>
</tr>
<tr>
<td>- Designers (architects, engineers, etc.)</td>
<td>- Transfer stations</td>
</tr>
<tr>
<td>- Building owners and developers</td>
<td>- Waste/ material haulers &amp; equipment rentals</td>
</tr>
<tr>
<td>- Builders (general contractors, trades)</td>
<td>- Landfill operators</td>
</tr>
<tr>
<td>- Demolition contractors, salvagers</td>
<td></td>
</tr>
</tbody>
</table>

**Transporters**

Companies that move waste from the point of generation to the facilities and end users

- Hauling companies

**Regulators**

Governments, agencies and standards organizations responsible for controlling CRD waste management

- National, provincial and municipal governments
- Standards organizations

**End users and markets**

Organizations involved in the sale and re-use of CRD materials

- Public procurement agencies
- Product manufacturers and suppliers
- Wholesalers, retailers (with / without deconstruction &/or installation services)
- Materials exchanges

**Other stakeholders**

Organizations with interests in CRD waste management

- Industry associations & councils (e.g. trade associations and product councils)
- Producer Responsibility Organizations (PROs)
- Non-Government Organizations (NGOs)
- R&D centres
Figure 8: Simplified CRD waste management system

- Generators
  - Construction
  - Renovation
  - Demolition

CRD waste management options
- Garbage
- Recycling
- Deconstruction

CRD waste materials processing
- Transfer & sorting
- Materials processing and recovery

Salvage markets
- On-site sale of high value structural and non-structural materials
- Online wholesalers
- Re-use centres

Commodity materials

End user

Waste to energy
- Landfill
2.4. Building lifecycle and policy intervention points

To develop effective policies aimed at encouraging strategies to minimize the creation of CRD waste and maximize diversion from landfill, it is important to understand who makes decisions about the deployment of materials and processes, and when those decisions take place in order to determine the best opportunity to intervene to influence behaviour.

For example, it is said that 90 per cent of the decisions made related to the configuration, composition, process and schedule for a building project are made during the first 10 per cent of the project process. This suggests that the most effective opportunity to inform CRD waste reduction strategies (such as design for disassembly, selection of sustainable materials, etc.) is as early as possible in the building lifecycle (Figure 9).

The building industry is highly regulated offering many opportunities for policymakers to interact with industry actors at the various regulatory milestones in the building life cycle, although some of these policy “touch points” are typically outside the jurisdiction of provincial or territorial governments. These milestones are typically:

- Enactment of legislation, e.g.:
  - Provincial legislation
  - Local government plans and by laws
  - Land use and zoning by laws
  - Building preservation by laws

- Issuance and administration of permits and licenses, e.g.:
  - Development permit
  - Building permit (new construction & renovations)
  - Trade permits and periodic inspections
  - Occupancy permit
  - Demolition permit
  - Hauler & facility licenses

- Point of payment, e.g.:
  - Fees at the processing facility or landfill gate
  - Product point of sale

![Figure 9 Typical building life cycle](image)
Other policy tools can be directed towards the manufacturers and sellers of building products and materials, haulers of CRD waste and the facilities that manage, sort and process the materials. These policies interact with actors at the product point of sale, at the processing or sorting facility or at the landfill gate.

2.5. Concepts and emerging approaches in CRD waste management

At the heart of all solid waste management policy making is a combination of strategies known as the **Waste Hierarchy** or the “5Rs”: 1) Reduce, 2) Reuse, 3) Recycle, 4) Recover for energy, and 5) Residuals management (waste to landfill). The aim of the waste hierarchy is to extract the maximum practical benefits from materials and to generate the minimum amount of waste. Figure 10 illustrates how the 5R’s hierarchy helps to establish policy priorities because the higher levels of the hierarchy (e.g. Reduce) are preferred over lower levels (e.g. Dispose). Policies and market mechanisms are needed to drive recycled materials back up the 5R’s hierarchy via the highest value markets.

The CRD waste management industry is evolving and policy makers are increasingly looking for new opportunities to move up the waste hierarchy and eliminate waste to landfill. Emerging waste management approaches and movements – such as Zero Waste, Design for Environment, Cradle-to-Cradle, Circular Economy and Sustainable Materials Management – advocate for the elimination of waste to landfill entirely through the design of durable, reusable and recyclable products and materials. An overview of many of these key concepts is provided below.
Design for the Environment (DfE)

Design for the environment (DfE) is a design approach to reduce the overall human health and environmental impact of a product, process or service, where impacts are considered across its life cycle. Carpentry is an example of a product category that has embraced DfE principles. Some carpet companies have shifted their marketing philosophy away from the manufacture of a product to the provision of a “service”. How the product is made is defined by its requirement to perform the service required (durable, comfortable, sound absorbent, non-toxic, easy to maintain flooring), be easy to remove and be completely recyclable. DfE is an important mechanism in reducing waste to landfill.

Sustainable Materials Management (SMM)

DfE is underpinned by sustainable materials management (SMM), in which the emphasis is a holistic approach to keeping materials out of the waste stream, influencing upstream behaviours of the various actors in the construction supply chain to reduce waste, and informing the design and manufacture of products and buildings in a way that reduces carbon footprint. SMM involves integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity.33 SMM policy development is underpinned by the following principles or “framework conditions”:

- Preserve natural capital.
- Design and manage materials, products and processes for safety and sustainability from a life-cycle perspective.
- Use the full diversity of policy instruments to stimulate and reinforce sustainable economic, environmental and social outcomes.
- Engage all parts of society to take active, ethically-based responsibility for achieving sustainable outcomes.

The Dutch chain-oriented waste policy (see Appendix D) is an example of SMM applied to policy making.

Circular Economy

DfE and SMM are important pillars in making the shift to a “circular economy” whereby waste is eliminated and product are sold, consumed, collected and then reused, remade into new products, returned as nutrients to the environment or incorporated into global energy flows (Figure 11). Circular economy principles are a part of Ontario’s recently approved Waste-Free Ontario legislation.34 Also the Construction Resource Initiatives Council (CRIC) – a national NGO focussed on addressing waste in Canada’s construction sector – has set a “Mission 2030” goal of zero waste.35

From the policymaking perspective, the objective of a circular economy is to keep materials out of the waste stream by influencing upstream behaviours of the various actors in the construction supply chain to reduce waste, and influencing the design and manufacture of products and buildings in a way that reduces carbon footprint.

Promoting sustainable materials use to achieve a circular economy ultimately implies an integrated approach that reaches beyond the construction industry – taking actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity.36

Zero Waste

Zero Waste is also a commonly used term that supports similar goals to the circular economy (and the terms can sometimes be used interchangeably). It has been defined and deployed in various ways. For example, Zero Waste a defined by Zero Waste Canada as, “A goal that is ethical, economical, efficient and
visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use.\textsuperscript{27} This definition may be understood to limit energy recovery, which may be an end market solution for CRD waste for some regions. By comparison, Zero Waste Scotland lays out a softer approach whereby “resource use is minimised, valuable resources are not disposed of in landfills, and most waste is sorted into separate streams for reprocessing, leaving only limited amounts of waste to go to residual waste treatment, including energy from waste facilities”.\textsuperscript{38} Several regions in Canada have adopted policies that establish zero waste goals and/or are designed to support zero waste (see \textbf{Section 2.6}).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure11}
\caption{The transition from a linear to a circular economy}
\end{figure}

\textbf{2.6. CRD waste diversion goals and targets}

At the highest level, governments can establish goals in three areas:

- \textbf{Reducing the amount of waste generated by CRD activities} (e.g. through improved efficiency in design and construction),
- \textbf{Increasing the amount of CRD waste that is diverted} from landfills and incineration (e.g. through improved reuse, recycling and composting systems and markets), and
- \textbf{Reducing the environmental impacts of the waste requiring disposal} (e.g. through safe disposal and the use of less toxic materials).

CRD waste goals vary considerably in their specificity, targets and ambition. They may be targeted to specific materials (e.g. wood waste) or to the waste stream as a whole. They may include concrete, time-bound reduction targets or simply establish a general direction (e.g. reducing waste) without specifying a target or timeline.
Many jurisdictions have set ambitious goals for reducing and diverting CRD waste that are in line with emerging waste management approaches and movements (e.g. Zero Waste, Design for Environment, Cradle-to-Cradle, Circular Economy, Sustainable Materials Management) that advocate for the elimination of waste to landfill entirely through the design of durable, reusable and recyclable products and materials. Examples of a range of goals and targets in effect across Canada and around the world are provided below.

| Nova Scotia | Nova Scotia’s Environment Act and the Environmental Goals and Sustainable Prosperity Act (EGSPA) established the goal of maintaining 50 per cent waste diversion and reaching a target for waste disposal of no more than 300 kilograms per person per year (kg/per/yr) by the year 2015.  
|———|———|
| Halifax Regional Municipality, Nova Scotia | The Halifax Regional Municipality requires the operators of licenses CRD waste sites to meet recycling targets of 75 per cent diversion.  
|———|———|
| Québec | Québec’s residual materials management policy sets the following goals for the end of 2015:  
- Reduce the quantity of disposed residual materials to 700 kg per capita (110 kg less than in 2008),  
- Recycle 70 per cent of paper, cardboard, plastic, glass, and metal waste,  
- Process 60 per cent of organic putrescible waste,  
- Recycle or reclaim 80 per cent of concrete, brick, and asphalt waste, and  
- Sort at source or send to a sorting centre 70 per cent of CRD waste from the building sector.  
|———|———|
| Metro Vancouver, BC | Metro Vancouver’s 2010 Integrated Solid Waste and Resource Management Plan set four broad goals:  
- Goals: Minimize waste generation  
- Goal 2: Maximize reuse, recycling and material recovery  
- Goal 3: Recover energy from the waste stream after material recycling  
- Goal 4: Dispose of all remaining waste in landfill, after material recycling and energy recovery  
It also established several associated targets:  
- To reduce the quantity of waste generated per capita within the region to 90 per cent or less of 2010 volumes by 2020.  
- To increase the regional diversion rate from an average of 55 per cent to a minimum of 70 per cent by 2015 and an aspirational target of achieving 80 per cent by 2020. This includes an 80 per cent diversion target for demolition, land clearing and construction waste by 2015.  
<p>|———|———|</p>
<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
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</table>
| **Whitehorse, Yukon**            | The City of Whitehorse’s 2013 Solid Waste Action Plan establishes the goal of achieving 50 per cent solid waste diversion by 2015 and zero waste by 2040.  
41                                                                                                                                               |
| **Ontario**                      | The province of Ontario has developed a long-term vision for zero waste and zero greenhouse gas emissions from the waste sector.  
42                                                                                                                                               |
| **York, Ontario**                | The city of York has established the goal of achieving more than 90 per cent diversion from landfill by 2016 and eliminating the disposal of unprocessed waste in landfill by 2020.  
43                                                                                                                                               |
| **Regional District of Nanaimo, BC** | The RDN is a regional government located on Vancouver Island serving a population of about 146,000. In 2006, the RDN set a target of diverting 75 per cent of the region’s waste from the landfill by 2010. At that time, about 11,000 tonnes of CRD waste was landfilled including about 8,000 tonnes of wood waste and 3,000 tonnes of asphalt shingles.  
Guided by its Construction/Demolition Waste Strategy,  
44  the majority of CRD waste is now recycled  
45, including:   
• Wood waste is chipped and used as hog fuel at pulp mills on Vancouver Island and Washington State,   
• Drywall (gypsum) is recycled,   
• Metal is recycled,   
• Concrete and asphalt are recycled,   
• Asphalt shingles are recycled on a limited basis,  
There is also significant reuse of building materials and fixtures through salvage operations and retail stores. |
| **Massachusetts, USA**           | The State of Massachusetts Solid Waste Master Plan established a state-wide goal of 88 per cent reduction in CRD waste by 2010.  
46  (See Appendix D for a detailed case study).                                                                                                                                                  |
| **The Netherlands**              | The Netherlands has achieved recycling and recovery rates for CRD waste of 95 per cent.  
47  (See Appendix D for a detailed case study).                                                                                                                                                  |
2.7. Opportunities and barriers to CRD waste diversion

CRD waste diversion offers many substantial economic and environmental benefits, such as:

- **Increasing CRD waste diversion also presents a multi-billion dollar opportunity.** Canada is projected to generate close to a billion tonnes of municipal solid waste between 2008 and 2033, including approximately $25 billion in recyclable materials (about $1 billion per year). Bringing the annual average of waste disposed down to 500 kg per capita would inject about $10 billion into the Canadian economy and generate more than 50,000 jobs, as an estimated seven jobs are created for every 1,000 tonnes of waste diverted. This is highly achievable: for example, the province of Nova Scotia has already achieved 50 per cent overall diversion and lowered its rate of per capita solid waste disposal to less than 400 kg per year on route to its target of 300 kg/year.

- **CRD waste recycling reduces environmental impacts.** On a lifecycle basis, recycling produces usable materials at much lower environmental cost than materials from primary sources. That is, in addition to conserving raw materials, recycling conserves energy and water, and reduces the production of greenhouse emissions and other pollutants. On and off the job site, recycling is one of the most significant commitments that the construction industry can make to sustainability.

- **CRD waste recycling creates jobs.** In providing materials to local vendors and processors, job site diversion creates employment and economic activity that help to sustain local economies. For example, implementation of Nova Scotia’s Solid Waste – Resource Management Strategy in 1995 was expected to create over 600 jobs through the expansion of diversion programs, industry stewardship initiatives and the manufacturing of value-added goods from recovered materials.

In order to capture these opportunities, there are a number of barriers and challenges to CRD waste diversion that governments must address. These include:

- **Presence of easily accessible, low-cost disposal options.** Most communities provide easy access to landfills and landfill fees are low compared to the cost of diversion.

- **There are many actors** involved in the decision to divert CRD waste from landfill and sometimes they have different, even potentially conflicting, priorities. For example, deconstruction and disassembly usually takes longer than conventional demolition. This may impact subsequent construction schedules, which, in turn, may add more cost to the project than might be saved from CRD waste recycling.

- **Market forces that result in labour and land being expensive, and materials being inexpensive.** High labour costs create a disincentive to utilize used building materials at the design, restoration, re-grading, and installation stages. Expensive land makes it difficult for used building material stores to hold significant inventory.

- **Disaggregation of supply such that each supplier of used building materials has a small inventory,** a good deal of CRD waste is sold informally, and there is no way to capture the entire offering. It can be difficult for architects to easily find what is available.

- **Lack of established markets** and market capacity to effectively serve consumers of secondary materials with the right product in the right place at the right time. For example, there are very few (if any) used building material stores that are able to support large projects. There is also a lack of markets for materials to be recycled back into new products.
• Currently, most producers are not responsible for their building materials once they reach the end of their useful life and so lifecycle costs are not factored into pricing, and processes for managing products at end of life are not well established.

• Disconnection between each step in the construction process (design, construction, renovation, deconstruction, diversion) that isolates decision-making and precludes the coordination that would allow additional use of used building materials.

• CRD waste diversion can be time consuming and expensive. It is often cheaper to demolish a structure and dispose than to de-construct and/or separate waste materials for recycling. Funding / financial support may be necessary for the various actors (contractors, facilities, etc.) to undertake deconstruction, disassembly, sorting, cleaning sufficient to generate materials of a quality that is accepted by the market.

• Lack of infrastructure for supporting diversion into reuse and recycling includes too few drop-off locations, lack of facilities for some materials and pricing structures that do not support small and medium-scale recycling.

• CRD waste materials are often combined in such a way that they are difficult to separate. The end uses for CRD waste materials are sometimes limited because they are contaminated with other wastes (e.g. roofing attached to plywood, ceramic tile adhered to drywall. etc.). Contamination makes it difficult to divert CRD wastes because CRD waste materials can also potentially include with hazardous materials (such as asbestos).

• Lack of information or knowledge about alternatives to disposal. Canada’s building industry is characterized by the large proportion of SMEs, which have little capacity to stay up to date with trends in CRD waste management. They are also unlikely to be members of industry associations or unions and are therefore difficult to reach other than through the regulatory process (e.g. information at permit counters or provided by municipal staff).

• The complex life-cycle of building products and materials, and the structures themselves means that different materials need to be replaced at different times (Figure 12), and some materials are easier to remove and replace than others.

• Cultural impediments, including customer/client preferences for new materials, a general lack of awareness of deconstruction options, and the firm entrenchment of status-quo construction practices.

Figure 12: Typical life cycles of buildings and their components\(^{53}\)
3. POLICY OPTIONS FOR CRD WASTE REDUCTION AND DIVERSION

This section presents six strategies and fourteen policy approaches that can be used to implement key CRD waste management strategies (see Table 3). They work best in combination: it is very difficult for a single policy to be designed to deliver meaningful CRD waste reduction and diversion on a stand-alone basis.

Table 3 Key CRD waste management strategies, associated policies and areas of greatest impact

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Associated CRD waste management policies</th>
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<tbody>
<tr>
<td>A. Create accountability for waste diversion</td>
<td>Make specific actors (e.g. producers, builders, facilities) more accountable for reducing and diverting CRD waste. Featured policies:</td>
</tr>
<tr>
<td></td>
<td>1. Extended Producer Responsibility (EPR)</td>
</tr>
<tr>
<td></td>
<td>2. Waste management plans for facilities and projects</td>
</tr>
<tr>
<td>B. Limit disposal options</td>
<td>Limit where, how or what materials can be disposed, such as through waste disposal bans or transportation restrictions. Featured policies:</td>
</tr>
<tr>
<td></td>
<td>3. Waste disposal bans</td>
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<td></td>
<td>4. Transportation requirements</td>
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<tr>
<td>C. Align financial incentives</td>
<td>Use fees and charges to encourage waste reduction and diversion, such as through differential tipping fees or virgin material levies. Featured policies:</td>
</tr>
<tr>
<td></td>
<td>5. Differential tipping fees</td>
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<td></td>
<td>6. Virgin material levies</td>
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<tr>
<td>D. Improve CRD processes</td>
<td>Increase the resource efficiency of CRD activities, such as through building certification and deconstruction standards. Featured policies:</td>
</tr>
<tr>
<td></td>
<td>7. Building codes</td>
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<td></td>
<td>8. Green building design certification</td>
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<td></td>
<td>9. Environmental product labelling and standards</td>
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<td>10. Deconstruction standards</td>
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<tr>
<td>E. Strengthen diversion markets and infrastructure</td>
<td>Increase the supply and demand of diverted materials, such as through public procurement and investment. Featured policies:</td>
</tr>
<tr>
<td></td>
<td>11. Invest in infrastructure, research and development</td>
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<td></td>
<td>12. Public procurement</td>
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<tr>
<td>F. Build knowledge and skills</td>
<td>Increase the capacity and knowledge of the sector, such as through education programs and data collection: Featured policies:</td>
</tr>
<tr>
<td></td>
<td>13. Industry outreach, education and resources</td>
</tr>
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<td></td>
<td>14. Benchmark and track data</td>
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3.1. Create accountability for waste diversion

This strategy focuses on making specific actors (e.g. producers, builders, facilities) more accountable for reducing and diverting CRD waste.

3.1.1. Extended producer responsibility (EPR)

EPR programs are “upstream” approaches that shift the responsibility for end of life to an earlier stage in the product lifecycle. Also referred to as “product take back” schemes, Extended producer responsibility (EPR), shared responsibility and product stewardship are related policy approaches that connect production and consumption activities with the post-consumer stage of a product’s life cycle. For many governments, the most important benefit of EPR is its ability to engage industry in the development and funding of markets for used materials. EPR is also linked with broader philosophies such as design for the environment that are aimed at reducing the overall human health and environmental impact of a product, process or service, where impacts are considered across its life cycle.

The three programs can look similar but they vary in governance structure and in the level of responsibility they place on producers for dealing with product waste as follows:

- **EPR**: There are two main approaches to EPR:
  - **Legislated EPR**: Programs or requirements in which manufacturers, brand owners and/or first importers are directly responsible for both the funding and the operation of the programs, as required via legislation or regulations, either directly or through producer responsibility organizations (PROs).
  - **Voluntary EPR**: Industry-led programs where manufacturers, brand owners and/or first importers have come together to provide a provincial, territorial or Canada-wide collection and recycling program for specific products that have reached their end-of-life. Governments have not regulated or otherwise mandated these EPR programs and are not involved with their operations.

- **Shared Responsibility**: Programs operated by governments (e.g., municipalities or other public agencies) but with varying degrees of producer responsibility, control and/or funding. These are commonly found in the areas of packaging and printed paper, where municipalities provide collection and sorting/processing services with substantial funding provided by producers, notably through a producer responsibility organization or an industry funding organization.

- **Product Stewardship**: programs in which manufacturers, brand owners and/or importers are neither directly responsible for program funding, nor for program operations. These are waste diversion initiatives funded by consumers or general taxpayers and are operated by public agencies or delegated administrative organizations. These programs may be mandated through legislation and regulations or may be voluntary. Producers may play an advisory role.

All of these approaches to EPR involve setting up waste management systems for targeted products (e.g. paint), product categories (e.g. electronic products) or waste streams (e.g. packaging). They all also associated financial mechanisms to cover the costs of collection, processing and diversion. These can be in the form industry stewardship fees, consumer eco-fees, deposit-refund systems or some combination of income sources. For example, Nova Scotia’s deposit-refund Product Stewardship program for beverage containers generates net-revenue which funds a network of Enviro-Depots, recycling programs and regional waste management systems.
EPR programs will generally include the following elements:

- Clear definitions of the products, product categories and/or waste streams covered by the policy and their associated responsible (or designated) producers.
- Clear description of producer roles and responsibilities for the financing and operation of the program and ability to raise and spend funds to meet the program objectives.
- A stewardship plan that outlines how producers will meet their obligations
- Requirements for performance, documentation, reporting, communication and auditing.
- The consequences of non-compliance, such as financial, administrative, legal or other penalties.
- Compliance with trade agreements and competition requirements

Applicability to CRD waste materials

EPR programs are in operation across Canadian jurisdictions, covering a wide range of products. For example, British Columbia (BC), Manitoba and Prince Edward Island (PEI) have some of the most comprehensive programs. Ontario passed new legislation in 2016 (the Waste Free Ontario Act) that will overhaul the existing system and significantly expand the role of EPR in the province.56 Local governments are also exploring opportunities to develop EPR polices that specifically address construction and demolition materials. For example, the regional municipality of Halifax has also been working to establish and/or grow EPR programs for a range of materials (e.g. for packaging).57

There are a few programs related to several CRD waste products in Canada, which include thermostats, fluorescent lamps, paint products, solvents and flammable liquids, but the application of EPR to CRD materials is expected to expand. CRD materials are identified under CCME’s Canada-wide Action Plan for Extended Producer Responsibility58 for incorporation into operational EPR programs. Looking forward, there are several CRD waste products that may lend themselves well to EPR policies in Canada. For example, major manufacturers of both commercial carpet and ceiling tiles already operate voluntary “take-back” and EPR programs in the US (see example below). EPR programs are also being considered by some provinces for other CRD materials such as flooring, drywall (wallboard), window glass, brick, asphalt shingles, engineered wood and treated wood (such as creosote timbers).

Policy advantages

- EPR can be very effective at diverting CRD waste, encouraging waste material recovery and recycling, supporting recycling infrastructure growth.
- EPR can stimulate innovation in product design (design for the environment) and supports the transition to a circular economy.
- EPR can be a powerful tool for financing the creation and growth of new markets and driving demand for recovered materials.
- EPR programs can be designed to be revenue-neutral for governments or even revenue generating to fund waste diversion.

Policy disadvantages

- Producers may pass on their costs for diversion programs to consumers.
- There is the potential for “eco-fees” to be applied to products by producers (visible fees).
- EPR requires comprehensive and sustained industry education to ensure that responsibilities of all parties are clearly understood.
- For construction and demolition projects, many different materials pass through many hands making it difficult to pinpoint the responsible parties.
- EPR programs run by industry may be difficult to track to ensure compliance.
Considerations when developing the policy

- EPR programs for CRD waste are in early stages of development, but the situation is likely to change soon. Several provinces are targeting CRD waste as a potential EPR program in response to commitments made by jurisdictions under CCME’s Canada-wide Action Plan for EPR\(^{59}\).

- Detailed background information is necessary in order to design the program and ensure proper oversight and enforcement. Knowledge of what markets already exist, what other regulations may already apply, what competing interests exist, and how its EPR policy will help to achieve objectives is also important.\(^{60}\)

- The design of EPR programs should consider the cost of conforming with the EPR program relative to the size of the regulated market, the price and lifecycle cost of the product and/or the cost or technical viability of reusing or recycling the product.

- Consultation with industry is critical prior to and during the development of any EPR program. When a form of product stewardship program was being contemplated for composite wood, wallboard and asphalt shingles in Nova Scotia\(^{61}\), the province undertook a comprehensive engagement process with producers to explore the viability of creating a plan for the province’s approval that would outline how the producers will assist existing CRD stakeholders divert more of their end-of-life materials from disposal. The idea was to have the plan include how producers would fund R&D projects to increase the local options to divert CRD materials from disposal, inform processors of any chemicals of concern in their products and bring their knowledge of diversion of their products from disposal (from other parts of the world) to local stakeholders.

- Lessons from electronics EPR programs point to the advantages of pre-approving facilities to be allowed to process materials because it helps the facilities maintain input flow of waste materials for processing (and therefore improve business). Facilities that are not pre-approved can still accept EPR materials but they may not get the volumes to be financially viable.

- There is a lack of consistency in key definitions, reporting criteria and enforcement across Canada. This can make it challenging for compliance and reporting across jurisdictions.

- Future EPR schemes can incorporate tradable Producer Responsibility Notes, which are gaining traction in Europe. These are a form of credit that producers can trade in markets to reduce the cost of compliance.\(^{62}\)

Government involvement in policy development and implementation

EPR regulations are mostly developed at the provincial and territorial government level. Recognizing that EPR for CRD waste in early stages of development and EPR can be implemented in different ways, the regulations that do exist generally make producers (i.e. manufacturers, first importers and first sellers) responsible for the financing and end-of-life management of designated products.

EPR programs are generally developed at the provincial and territorial government level. However, their design and implementation requires extensive collaboration with local governments, producers and producer responsibility organizations.
Examples

Multi-Material BC\textsuperscript{63}

BC’s Recycling Regulation shifts responsibility for end-of-life management of packaging and printed paper from governments and their taxpayers to the businesses that produce these materials. Multi-Material BC (MMBC) is the non-profit organization formed to develop and implement the stewardship plan for residential packaging and printed paper. Businesses that supply printed paper and packaging materials are considered Industry Stewards and pay annual fees to fund the program. Collection is handled by local governments, First Nations, private companies and non-profits that have partnered with MMBC.

Divert Nova Scotia\textsuperscript{64}

Divert Nova Scotia is a not-for-profit organization that operates two core programs – the Beverage Container Deposit-Refund Program and the Used Tire Recycling Program – and manages a network of Enviro-Depots throughout the province. The organization is completely self-sustaining through the environmental fees collected from the sale of new tires, deposits collected on the sale of beverage containers and the sale of recyclable materials.

The California Carpet Stewardship Bill (AB 2398)\textsuperscript{65}

This state ordinance requires carpet retailers to help divert used carpet from landfills. Retailers are now required to create and implement a carpet-recycling plan to increase the percentage of post-consumer carpet diverted from the landfill. Customers are charged a fee for all new carpet purchased. The revenues fund post-consumer carpet recycling measures.

EPR in combination with green building certification

Version 4 of the LEED green building certification system provides credit for the use of products managed under EPR schemes if they total at least 25 per cent of the value of installed products\textsuperscript{66} (See Section 3.4.2).
3.1.2. CRD waste management plans for facilities and projects

Policies can be implemented that require CRD waste generators and facilities to prepare and implement a waste management plan. These policies may be enacted in a variety of ways, including i) municipal waste management bylaws tied to the building regulatory process (e.g. as a condition of a demolition or building permit), ii) Facility operating licences, iii) building codes (Section 3.4.1), iv) procurement requirements for publicly funded projects (Section 3.5.2), and v) green building certification schemes (Section 3.4.2).

When done effectively, this can be a very effective way to increase waste diversion by requiring these actors to meet certain standards or targets. These policies may require proponents to:

- **Develop a waste management or diversion plan** that outlines the types of materials to be diverted and how they will be separated and processed for reuse and recycling. They may also address managing hazardous materials, deconstruction, salvaging and onsite reuse.

- **Set targets** for the percentage of waste diverted from landfill (e.g. total waste, by material).

- **Track and report on activities**, such as the location, material type, volume/weight, facility, etc.

- **Send waste to specific facilities** that have been approved for processing CRD waste.

- **Pay a deposit** that is refunded when the requirements are met (e.g. submitting the waste management plan, achieving diversion target etc.).

The policy should be developed by an authority that has the mandate to impose compliance via financial, legal or administrative penalties, such as warnings or notices, consent orders, unilateral orders, license restrictions, fines or fees. This may be challenging for some local governments that are responsible for issuing construction permits but may not be able to force builders to go beyond what is required through the building code. In these cases, governments may rely on financial incentives (e.g. rebates on development cost charges or deposit-refund schemes), moral suasion and negotiation (e.g. during rezoning processes).

**Applicability to CRD waste materials**

Waste management plans can apply to all CRD waste. However, they are most effective at increasing diversion rates for readily recyclable materials with established regional infrastructure and markets (e.g. clean wood, concrete, metals etc.). They can be used to encourage waste reduction (e.g. through efficient processes) as well as reuse and recycling. They are also flexible and can be applied at any stage of the lifecycle, from design to construction, renovation and demolition.
Policy advantages

- Waste diversion plans can be very effective at stimulating diversion, particularly through hard diversion targets and tied to permit approvals.
- Waste diversion goals can be applied at any stage in the building lifecycle but when addressed early in the design stage, they can inform how buildings are built, thereby reducing the volumes of waste generated.
- Waste diversion goals offer flexibility to stakeholders to develop a plan that suits their businesses.
- Waste management plan requirements are usually simple to manage and administer.

Policy disadvantages

- Some jurisdictions may only have the authority to require reporting and not performance (e.g. building permits). If so, they should provide sufficient incentive to encourage compliance.
- Affordable alternative facilities should be in place to prevent illegal dumping.
- Regulated diversion goals require strong and continuous enforcement, which may add cost.
- By imposing a requirement for facilities to be licensed may have unintended consequence of materials being transported out of the region to cheaper unlicensed facilities elsewhere (see Section 3.2.2).

Considerations when developing the policy

- Requirements for waste management plans are most effective when they include enforceable targets or outcomes. Plans without targets generally result in low levels of compliance.67
- Establishing diversion targets for processing facilities is administratively simple and can be an effective way to stimulate a market response: it provides facilities with the incentive to charge higher fees for non-recyclable materials, invest in equipment that facilitates processing and find innovative new end-uses for materials.
- When supported by disposal bans (Section 3.2.1) and differential tipping fees (Section 3.3.1), CRD waste management plans can be valuable where wide-ranging changes in behaviour are needed across a large number of production and consumption activities.
- To be effective, these policies should establish sufficient financial or non-financial incentives for compliance. These can be supported by an effective enforcement regime (e.g. inspections, document review) to ensure the plans are implemented and materials end up in the right facility.
- Web-based tools (accessible by the regulator, the project team and the processing facilities) are available to assist with the considerable measurement and tracking is required to determine if goals are met, and to take corrective action if they are not (see Appendix C).

Government involvement in policy development and implementation

Waste plan requirements may be implemented by any level of government (federal, provincial/territorial, municipal/ regional) with jurisdiction over the target actor.
Examples

City of Vancouver Green Demolition Bylaw

Operating under the Vancouver Charter, the City of Vancouver has imposed a $15,000 refundable fee paid with the demolition permit. If the following deconstruction, reuse and recycling targets are achieved, then $14,650 is refunded.

- **Houses built before 1940**: 75 per cent of materials by weight, excluding hazardous waste
- **Houses built before 1940 and deemed character houses by the City**: 90 per cent of materials by weight, excluding hazardous materials.

Halifax licensed facility diversion targets

The Halifax Regional Municipality (HRM) has established licenced sites to receive CRD materials and requires the operators of those sites to meet recycling targets of 75 per cent diversion. Generators should separate CRD materials (wood, insulation, vinyl siding, asphalt shingles, drywall / plaster, vapour barrier, metals, roofing materials, doors and windows, rugs / carpeting / vinyl flooring, countertops / cupboards, tiles), which can only be brought to licence CRD facilities.

City of York, Ontario waste management targets and requirements for CRD waste management plans

The City of York (population 134,000) has established the goal of surpassing Ontario’s waste management regulatory requirements by achieving over 90 per cent diversion from landfill by 2016 and eliminating the disposal of unprocessed waste in landfill by 2020. To implement these goals the City requires project owners to undertake the following:

- A construction waste management plan is submitted and implemented to demonstrate diversion of approximately 50 per cent or more of construction, demolition and land clearing waste from landfill.
- At least one recycling or reuse station is provided during construction, dedicated to separation, collection and storage of materials for recycling (at a minimum, wood, drywall, paper, corrugated cardboard, glass, plastics and metals).
- At least 75 per cent of non-hazardous construction & demolition debris is recycled.

An optional goal is to submit and implement a construction waste management plan required demonstrates diversion of at least 75 per cent of construction, demolition and land clearing waste from landfill.
3.2. Limit disposal options

This strategy focuses on limiting where, how or what materials can be disposed, such as through waste disposal bans or transportation restrictions.

3.2.1. CRD waste disposal bans, limits and surcharges

A disposal (or landfill) ban prevents or restricts the disposal, transfer for disposal and/or contracting for disposal of target (or designated) wastes, hazardous items and recyclable materials. Disposal bans encourage the reuse and/or recycling of materials, conserve disposal capacity, and reduces adverse environmental impacts.

Disposal bans are an important mechanism in the implementation of a waste diversion plan and targets. When supported by differential tipping fees (Section 3.3.1) and waste diversion targets (Section 3.1.2), they can be valuable where wide-ranging changes in behaviour are needed across a large number of production and consumption activities.

Bans can be implemented in various ways:

- **Outright exclusions** - zero tolerance for the disposal of some materials in the landfill (e.g. hazardous materials, batteries) Loads that contain banned materials may be rejected by the facility, resulting in increased costs to separate the materials and/or transport them to another facility. The non-compliant organization may be subject to warnings or notices, consent orders, unilateral orders, administrative penalties, license restrictions, fines or other penalties.

- **Disposal limits** – establish maximum permissible amounts of waste materials that may be disposed in the landfill. Higher thresholds or more flexible requirements may be allowed for small loads and / or facilities in remote or rural locations. Disposal of some materials (e.g. clean wood) may be acceptable up to a certain amount. Other considerations may include the quality or physical condition of the banned material, the ease with which it can be separated from the waste stream, and the worker safety.

- **Disposal surcharges** - a “banned” material may be allowed in a landfill but there are requirements for pre-sorting or pre-treatment and a surcharge is imposed – usually at the gate. For example, Metro Vancouver imposes a $50 minimum surcharge, plus the potential cost of removal, clean-up or remediation on loads containing banned hazardous and operational impact materials or product stewardship materials. A surcharge of 50 per cent of the tipping fee on the entire load is applied to loads containing banned recyclable materials (e.g. clean wood and drywall).

The elements of an effective disposal ban include:

- **Knowledge of jurisdiction’s unique market context** (e.g. waste management policies, available technologies and capacities, diversion rates, etc.) based upon good data collection, tracking and monitoring of the CRD waste stream (Section 3.6.2).

- **Measures in place that will mitigate the potential for unintended consequences** such as illegal dumping, transportation of waste to another (less stringent) jurisdiction, and the contamination of recyclable waste streams. Pilot programs, industry engagement and best practice research can help to alleviate these issues.

- **Sufficient penalties to incentivize diversion** and strong enforcement to ensure compliance.
• **Setting clear requirements** for documenting and reporting the transportation and handling of designated materials is essential (**Section 3.2.2**).

Disposal bans may be imposed on generators, haulers and/or facility operators. Expectations of these actors may take the form of:

• **Generators** – may need to develop a waste management plan, separate wastes at source to remove and recycle any banned materials, and ensure they do not contract for the disposal of banned items.

• **Haulers** – may be responsible for inspecting loads before transporting them, refusing to transport designated materials and/or delivering banned materials only to authorized facilities.

• **Facility operators** – may be required to implement measures (waste management plan, inspections) to ensure that unallowable quantities of banned materials are not disposed or transferred for disposal from their facilities. This would prevent the operator from accepting banned materials.

### Applicability to CRD waste materials

Disposal of cardboard, clean wood, drywall and many hazardous materials is banned in several jurisdictions in Canada. For example, the Capital region in BC has banned the following CRD materials: aggregate, asphalt, clean soil, concrete, corrugated cardboard, drywall, rubble and scrap metal. Large loads of inert materials – such as soil, sod, gravel, concrete and asphalt – may also be banned as they can readily be re-used or recycled.

#### Policy advantages

- Disposal bans can send a clear signal to the market that designated materials must be diverted from landfill through reduction, reuse or recycling.
- Bans can generate revenue via fees and fines that can be used to process banned materials and stimulate the development of reuse and recycling businesses and markets.
- Bans can increase economic activity including jobs, business development and innovation and can help stimulate the development of lower cost products (e.g. animal bedding in Nova Scotia).

#### Policy disadvantages

- Bans can be “blunt instruments” that can be costly to implement and enforce.
- Bans focus on “end of life” solutions that do not necessarily affect the volumes of waste being generated (i.e. inform upstream decisions that may have an impact on how much waste is produced).
- Bans are not generally effective on their own. They work well in combination with secondary policies such as differential tipping fees (**Section 3.3.1**) and established infrastructure (**Section 3.5.1**) and markets.
- Bans may require significant lead time (at least 1 year) to ensure adequate alternatives are in place, allow for communication, education and training, and to set up enforcement mechanisms.
- Detecting banned materials in mixed waste can be challenging, and removal may not be feasible due to technical, financial or safety reasons.
Considerations when developing the policy

- CCME is preparing a guidance document covering policy, general legislative and regulatory considerations, best practices and key considerations for material disposal bans. Bans are generally most appropriate if there are established, regional facilities and markets to collect, process and use the reused, recycled or recovered materials. If this is not the case, policy makers may wish to provide advance notice of the ban to allow time for these markets to develop.

- Bans should establish sufficient financial or non-financial penalties to incentivize compliance. They can be supported by an effective enforcement regime to ensure that the banned materials end up in the right facility and not dumped illegally.

- To be effective, bans rely on comprehensive and sustained outreach and education (Section 3.6.1) in combination with detailed documentation, tracking and reporting (Section 3.6.2).

- Sufficient resources may be needed for oversight, education and enforcement. Financial and staff support may also be required to establish / scale up markets and alternatives for banned materials.

Government involvement in policy development and implementation

Disposal bans may be implemented at the provincial, regional or municipal level. Bans that are developed at the provincial or territorial level are generally managed and enforced at the local level, adding a layer of administrative complexity.

Example

**Nova Scotia disposal ban for compostable organic material**

Nova Scotia imposed a ban on compostable organic material in 1997 with very few existing composting facilities or established markets. The ban created the conditions for the private sector and municipalities to react and create the facilities and markets. Nova Scotia’s experience shows that it is not essential to have established facilities and markets in place before instituting a ban, as long as sufficient advanced notice is provided.

Nova Scotia reports that the net benefits of the ban (e.g. diversion, jobs, innovation, etc.) outweigh the costs of compliance and enforcement. Nova Scotia has banned almost 20 materials/end-of-life products from disposal and now has a disposal rate almost 50 per cent lower than the Canadian average.

**Massachusetts Waste Ban**

Massachusetts has employed landfill bans for specific CRD waste materials in order to reduce the total amount of waste landfilled in the state. The Massachusetts Department of Environmental Protection (DEP) banned the disposal of asphalt pavement, metal, brick, concrete and wood in 2006 and clean gypsum board in 2011. Through a Solid Waste Master Plan entitled “Beyond 2000” (updated in 2006), the Massachusetts DEP committed the state to an 88 per cent reduction in landfilled non-municipal solid waste by 2010 and the waste bans were designed to assist this process. See case study in Appendix D.
3.2.2. Transportation requirements

Hauler licenses and other regulations (e.g. municipal bylaws) can ensure materials are taken to the appropriate facility, and are handled and processed correctly. Many regions operate some form of licensing scheme for haulers however the standards and forms of compliance vary.

Establishing a requirement for hauler companies to secure a licence to operate places the onus on the license applicant to understand fully the types of waste being handled and ensure that the materials are taken to the correct facility. They can also be used in combination with municipal bylaws to direct waste to the appropriate facility within a geographic region, complementing with any material disposal bans and prohibitions (Section 3.2.1) and considering implications with current or future EPR programs (Section 3.1.1).

License schemes enable strong data collection processes to track and report on CRD waste materials. Understanding the waste will determine which other regulations apply to the waste; for example, whether the waste or commodities fall under the Environmental Protection Act or the Transportation of Dangerous Goods (TDG) Act and their relation to either Federal or Provincial regulators.

Usually, the entire hauler company is certified (as opposed to a specific vehicle) and loads are subject to inspection at regional facilities to track program effectiveness. In some programs, a hauler may be eligible for incentives (or may avoid a disincentive) for having a portion of their customers meet certain waste diversion criteria (Section 3.2.1). Other programs restrict where haulers can take waste (i.e. to an appropriate facility that can process and/or dispose of CRD materials).

Municipal bylaws may discourage or prohibit generators from contracting with unlicensed haulers for the disposal of CRD waste. Non-compliance with licensing schemes usually results in fines. In some cases, a government may have the power to suspend business’s activities or close a business altogether.

Applicability to CRD waste materials

Transportation requirements can apply to all CRD waste materials or to a sub-set of target materials.

<table>
<thead>
<tr>
<th>Policy advantages</th>
<th>Policy disadvantages</th>
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<tbody>
<tr>
<td>• The costs of compliance with licensing requirements are borne by the market.</td>
<td>• Hauler licenses may not be administered by the government department responsible for solid waste, which may add a layer of complexity to the process.</td>
</tr>
<tr>
<td>• Licensing haulers helps to reduce illegal activity (e.g. materials by-passing disposal bans, etc.)</td>
<td>• Cost to governments for administering, monitoring and enforcing the licensing program.</td>
</tr>
<tr>
<td>• Applied early in the design process, they can help to reduce the volumes of waste generated.</td>
<td>• There is a lack of consistency in how CRD waste is regulated across different jurisdictions, which may make it difficult for hauler licenses to be successful.</td>
</tr>
<tr>
<td>• Policy tools directed towards the haulers helps to prevent valuable materials from leaving the market ensuring CRD wastes end up at appropriate facilities supports local markets (e.g. supply of diverted materials).</td>
<td>• Licensing may reduce competition by creating virtual monopolies for authorized operators, particularly if there are few options available.</td>
</tr>
<tr>
<td></td>
<td>• Licensing requirements may increase disposal costs</td>
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</table>
for local generators.

- Potential for conflict with current or future EPR programs.

<table>
<thead>
<tr>
<th>Considerations when developing the policy</th>
</tr>
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<tbody>
<tr>
<td>- To be effective, transportation requirements should be enforced through regular inspections and the application of appropriate legal, administrative and financial penalties.</td>
</tr>
<tr>
<td>- Strong data collection and enforcement is essential to ensure compliance (e.g. avoid illegal export or dumping).</td>
</tr>
<tr>
<td>- It is important to understand the CRD waste management market to determine the relative costs and benefits to businesses of complying with the licensing scheme compared to shipping to cheaper facilities. Often local processing facilities rely on hauler licensing and other mechanisms to ensure they receive adequate flow of waste materials to be economically viable.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Government involvement in policy development and implementation</th>
</tr>
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<tbody>
<tr>
<td>The government department responsible for solid waste usually operates CRD waste facility licensing and some are also responsible for CRD hauler licenses. In some cases ministries of transportation or highways administer hauler licenses. Consistent regulations across boundaries, such as disposal restrictions, may remove the motivation to ship CRD waste to inappropriate facilities. Other incentives, such as variable tipping fees, may also encourage waste to be directed to appropriate facilities.</td>
</tr>
</tbody>
</table>
3.3. Align financial incentives

This strategy focuses on using fees and charges to encourage waste reduction and diversion, such as through differential tipping fees or virgin material levies.

3.3.1. Differential tipping fees

Differential tipping fees provide incentives for waste generators and haulers to increase their diversion rates. A tipping fee is the charge levied on a given quantity of waste received (usually based on weight) at the gate of a transfer station, sorting facility or landfill. Fees are also charged at the gate of waste processing facilities. They can be set-up as positive incentives (e.g. discounted fees for source-separated loads of recyclable materials), negative disincentives (e.g. surcharges for unsorted mixed loads) or a combination of both. They may also be used to encourage waste generators and haulers to bring their materials to specialized facilities (e.g. offering lower rates at CRD waste facilities than at landfills).

Historically, landfill fees have been designed to address the full cost of managing waste, including site development, permitting, labour, equipment, and materials, and other items such as capital expenditures, accruals, and depreciation. However, to encourage diversion, differential tipping fees (i.e. fee reductions or surcharges) can be set so that the economics of diversion become more favourable than of disposal. Ideally, the full suite of fees (transporting, handling, recycling, landfill, etc.) should reflect the full cost of management and recovery.

When supported by disposal bans (Section 3.2.1) and waste diversion plans and targets (Section 3.2.1), differential tipping fees can have considerable environmental and economic impact in ensuring that CRD waste management decisions take account of the environmental consequences of different disposal options (landfill, incineration, recycling, etc.) and encouraging substitution by producers and consumers towards products that involve less waste, and more efficient recycling.

Applicability to CRD waste materials

Differential tipping fees can apply to the entire CRD waste stream.

**Policy advantages**

- Differential tipping fees can discourage disposal by making it more expensive and can be used to selectively target specific materials.
- Differential tipping fees can be structured to cover the full cost or recovery and generate funding for infrastructure investment (Section 3.5.1) or education programs to encourage diversion (Section 3.6.1).

**Policy disadvantages**

- Tipping fees are “end-of-life” solutions and do not address the volumes of waste generated. They simply seek to divert materials from landfill.
- High tipping fees may generate unintended consequences, such as illegal dumping or transporting waste to lower cost jurisdictions.
- Generators may simply pass costs on to customers, instead of adopting changes in behaviour.
Considerations when developing the policy

- To be effective, differential tipping fees should be applied comprehensively (i.e. to all landfills, private and government owned/operated), as is done by the Columbia Shuswap Regional District in BC.77
- The fees collected should be dedicated to investment in alternative management options or there is a risk that they may be diverted to general revenues.
- Tipping fees are very susceptible to price sensitivity. If the fee is set too low, there is little incentive to divert waste, and the costs will simply be passed on to customers. If the fee is set too high, it promotes trans-shipment of waste out of the jurisdiction or other avoidance behaviours such as illegal dumping.
- Tipping fees increase the cost of a product or service (such as landfill) and can be particularly valuable where wide-ranging changes in behaviour are needed across a large number of production and consumption activities. Fees are generally used to fund waste management activities and are not material specific. Frequently, tipping fees are used to fund improved infrastructure and programs.

Government involvement in policy development and implementation

Provincial, territorial and regional governments that own, operate and/or license landfills, sorting and waste processing facilities are able to impose tipping fees.

Examples

**Bow Valley Waste Management Commission Alberta**

The Francis Cooke regional dry landfill in Canmore (population 12,000) reduces landfill rates by 43 per cent for acceptable dry and inert material that is tipped with recyclable materials removed. It also offers a 55 to 84 per cent reduction in tipping fee for construction and demolition recyclable materials (e.g., clean wood, clean asphalt, broken concrete). There is also a minimum $100 fine for illegal material.

**Regional municipality of Waterloo, Ontario:**

Waterloo (population about 500,000) applies differential tipping fees at their landfill and transfer stations whereby segregated loads of brick, concrete, rubble and yard waste receive a 43 per cent reduction per tonne when compared to general refuse rates. There is no charge for the first 50 kg on all loads under 500 kg.
3.3.2. Virgin material levies

Virgin material levies are taxes that are imposed on the extraction and use of raw (or virgin) natural resources. They are intended to encourage the use of recycled materials in construction projects by increasing the relative cost of virgin materials. These levies can reduce the rate of resource depletion and associated environmental externalities, reduce the production of CRD waste and encourage the substitution of secondary and recycled materials for virgin materials. This can also provide indirect benefits as the opening of new quarries can be challenging politically and financially.

Virgin material levies are generally applied at the extraction phase on a fee per tonne basis. The fee applied varies by jurisdiction and is typically between 5 per cent and 20 per cent of the base price of the material. Where subsidies to encourage the extraction of virgin materials exist, these should be lowered or removed to help encourage the use of secondary materials before a virgin material fee is put in place.

Virgin materials taxes have been imposed in several countries, including Sweden, Denmark and the UK, for aggregates – specifically gravel, rock, stone, etc. They work hand in hand with EPR programs (Section 3.1.1). The levy may be applied on raw materials that are commercially extracted and consumed within the government’s jurisdiction as well as materials that are commercially imported and those that are exported. Some levies include exemptions for specific activities, such as the use of raw materials for industrial processes.

Applicability to CRD waste materials

These levies are most applicable to low cost materials where large volumes of commensurate quality recycled alternatives exist, such as gravel, rock, stone, topsoil, sand, sawdust and gypsum.

Policy advantages

• Virgin materials levies can reduce the rate of resource depletion and associated environmental externalities, reduce the production of CRD waste and encourage the substitution of secondary and recycled materials for virgin materials.
• Virgin materials levies are easy for stakeholders to understand.
• Virgin materials levies can generate revenue to fund environmental programs.

Policy disadvantages

• Virgin materials levies may only have a modest impact as a stand-alone measure but can be very effective as part of a suite of complementary policies such as disposal bans (Section 3.2.1).
• Virgin materials levies may be less effective when the revenues generated are incorporated into a general budget and not allocated to environmental programs.
• To date, there have been no virgin materials levies implemented in Canada.

Considerations when developing the policy

• Research suggests that a 15 per cent virgin material tax on plastic, wood pulp, cardboard and paper virgin materials would produce an 11 per cent reduction in waste while providing a source of sustained funding for environmental programs.
• When considering a virgin material levy, policy makers should:
  o Clearly identify the relevant market failure that the tax is intended to address,
  o Assess the impacts of the tax on environmental quality and economic efficiency, and
  o Compare these impacts with those resulting from the use of other regulatory approaches.

• The design and use of virgin material levies includes:
  o Monitoring: These types of levies tend to be applicable to situations where monitoring of environmental
  impacts (such as non-point source emissions) or property rights regimes are hard to implement.
  o Market conditions: For such systems to work, there needs to be sufficient price elasticity for the market
  to favour use of products containing recycled materials over virgin materials. Relative to overall
  construction costs, the cost of aggregate materials is quite low. So, even significant levies (e.g. 10-20 per
  cent) may only have a modest impact on the market.
  o Recycling incentives: A virgin materials tax does not provide any incentive for waste generators to
  increase sorting and processing activities. Consequently, additional policies may be needed to increase
  the supply, quality and accessibility of recycled materials.

Government involvement in policy development and implementation

Virgin materials levies can be applied by federal or provincial/territorial government. The most well-known examples of
virgin material taxes come from the UK, Sweden and Denmark but have not yet been deployed in Canada.

Examples

UK Aggregate Levy

Effective 2002, the Aggregate Levy\(^{81}\) has been charged on all extraction and imports to the UK of sand, gravel and crushed
rock used for construction purposes (except for recycled aggregates) and excludes exports. Companies pay a levy of about
$4/tonne, which corresponds to about 20 per cent of the total price. With roughly 200 million tonnes of virgin aggregate
extracted each year the levy brings in more than $700 million in annual revenue. Most of the revenue is returned to
companies through a reduction in employer taxes, while a portion is directed to the Aggregates Levy Sustainability Fund
(ALSF). The ALSF funds environmental programs and research and helps to stimulate the market for recycled and
secondary materials. The levy – along with a suite of complementary measures such as a landfill tax – has been successful
at delinking aggregates production and construction output, significantly increasing the use of recycled aggregate (to
about 25 per cent of the market), and reducing virgin aggregates production.

Swedish tax on natural gravel

Introduced in 1996, the intention was to set the tax rate at a level high enough to close the price gap between gravel and
its closest substitute, crushed rock. The Swedish government initially set the tax level at SEK 5 (US$ 0.7) per ton, which
corresponded roughly to a 10 per cent price increase on natural gravel. By 2006 the tax had risen to SEK 13 (US$ 1.7) per
ton. All of the revenues from the tax are incorporated into the central state budget. In 1984 the natural gravel share out of
total aggregates production in Sweden was 82 percent but in 2008 it had fallen to only 19 per cent, while the share of
-crushed rock and other materials experienced a corresponding increase. This implies that the 30/70-goal set up by the
government has been fulfilled.\(^{82}\)
3.4. Improve CRD processes

This strategy focuses on increasing the resource efficiency of CRD activities, such as through building certification and deconstruction standards.

3.4.1. Building codes

Building codes and regulations establish technical standards and provisions that govern the design and construction of new structures as well as the alteration, change of use and demolition of existing ones. They provide specific powers for inspectors and rules for the inspection of buildings, and may allow municipalities to establish by-laws related to the use, function and performance of buildings.

The transition to objective- and performance-based building regulations that is happening in Canada is allowing for a wider selection of compliance options. These “functional-based” policies encourage advances in building technology by allowing flexibility of design approach and can lead to innovative, efficient solutions using sustainable materials. For example, there are several examples in the US where building codes include requirements for construction waste diversion, prohibit the use of certain materials, and establish minimum environmental performance criteria. In Canada, the 2014 City of Vancouver By Law 10908 requires that for all work of a value of $50,000 or more, “All waste material on a construction site shall be sorted, diverted and disposed of in a manner satisfactory to the Chief Building Official”.

Other ways in which building codes can support CRD waste reduction, reuse and recycling include:

- **Alternative solutions**: Progressive policy approaches include allowing design teams to create ‘Alternative Solutions’ with supporting test data that meet or exceed standard requirements.
- **Mandatory standards**: may be established for CRD waste diversion or for the use or prohibition of certain materials.
- **Mandatory upgrades**: to ensure that the existing building stock complies with certain regulatory criteria. For example, the City of Vancouver operates an “existing building upgrade mechanism model” (Part 10 of the Vancouver Building By Law) that establishes certain additional energy efficiency measures to be undertaken based on the scope of the proposed amendment to an existing building. Such a mechanism could be extended to establish CRD waste diversion targets, durability standards or the use or restriction of certain materials.

The regulation of facilities ensures that services are provided legitimately and safely. They limit the potential for illegal activity and the compliance process can also be leveraged to capture data and monitor CRD waste flows.

Building codes should not be confused with building standards. Building standards establish specific “pass-fail” performance criteria (e.g. for energy efficiency, indoor air quality) and may be voluntary in nature. Sometimes, standards are imposed by governments in the form of a “stretch code” as a condition of development (thereby becoming mandatory). Governments and building owners can create their own standards. For example, the American Collaborative for High Performance Schools established a deconstruction standard for school buildings (see Section 3.4.4) and the University of BC created the REAP standard for residential buildings that included measures for CRD waste diversion. Green building rating systems (LEED, BuiltGreen, etc.) are also a form of building standard that include performance criteria for building re-use, sustainable building materials and CRD waste diversion. They are discussed in Section 3.4.2.
Environmental product standards also exist that similarly demonstrate certain performance achievements (EnergyStar for energy efficient appliances, FSC for sustainable wood products, etc.). See Section 3.4.3.

Applicability to CRD waste materials

Building codes address the performance of a structure as a whole and can be used to address the entire CRD waste stream. They can also be oriented towards the use (or prohibition) of specific materials such as hazardous materials.

Building codes across Canada have recently been updated to allow for mid-rise wood frame construction (up to 6 storeys), which will, in the long run, reduce the amount of concrete and steel entering the waste stream.

Some local governments have established regulations for moving entire buildings, which is an excellent way to retain the value of the construction materials and reduce CRD waste. For example, the Saskatchewan government has a useful policy for moving buildings that does not set any limits on the length of the building but rather imposes a weight limit. With the increasing uptake of prefabricated and modular construction, more and more volumetric building components will need to be shipped by road and by rail.

Policy advantages

- Prescriptive regulations create a “level playing field” and enforce compliance.
- The costs of compliance with the code are borne by the market.
- Building codes are very effective at limiting illegal activity.
- Applied early in the design process, building codes that include CRD waste management criteria can help to reduce the volumes of CRD waste generated.

Policy disadvantages

- Building codes may be developed provincially, but they are managed and enforced locally, adding a layer of administrative complexity.
- There may be a cost to stakeholders of compliance with the code, which may adversely affect important markets. There may also be costs to the regulator in the form of administration and enforcement.
- Codes establish minimum levels of permissible performance. It is difficult to use codes to encourage exemplary behaviour.

Considerations when developing the policy

- While building codes may offer many opportunities to encourage the use of recycled materials and establish CRD waste diversion goals, they can also present barriers to creating a truly circular economy. For example, increasingly stringent energy efficiency codes can make it difficult to re-use old windows, doors, heating and cooling equipment. To address this challenge, a science-based analysis of the costs and benefits of using old materials and equipment should be made on a life-cycle basis. For example, life-cycle assessment (LCA) tools can help designers and policy makers understand whether the operating energy savings foregone by using an old product are greater or less than the costs and environmental impacts of disposing of the old product, making a new one, transporting to the site and disposing it and the end of its life.
- The following context is necessary for building codes to function effectively:
  - A well-functioning market with knowledgeable and accountable 'professionals' (designers, builders,
manufacturers, contractors, etc.) who understand building and stand behind their product, and knowledgeable consumers who know their obligations and have access to the information they require to make informed decisions and choices.

- **A legal framework for the conduct of business** so that all parties can be held accountable for their actions.
- **Reliable standards, testing and design guides** so that ‘professionals’ and owners can have confidence in the materials used in construction, and that these will be installed properly.
- **Warranties and insurance** to provide a measure of assurance to building owners that any practical, technical or performance defects in the ultimate product or process will be rectified.
- **Education and training** to enhance the skills of those involved in the building process. Sustained and comprehensive consultation, outreach and education for all CRD waste management stakeholders are important for success (Section 3.6.1).

**Government involvement in policy development and implementation**

Building codes are enacted by provinces / territories and administered primarily by local municipalities. The National Building Code applies to property under federal jurisdiction. Provinces and territories can also adopt or amend the Code for their own jurisdiction. Some governments adopt the national code and adjust to suite local conditions. Others develop their own codes, keeping a close eye on federal directives. A few (e.g. Vancouver), municipalities have the right to enact their own building codes and by laws. Transportation and/or highways departments usually handle regulations related to moving entire buildings.

**Examples**

**Metro Vancouver model bylaw**

Metro Vancouver has developed a model bylaw for municipalities that requires generators to develop and report on a Waste Disposal and Recycling Services Plan as part of the construction and demolition permit process. Generators pay a fee and receive a refund after submitting their final report. For example, the City of Port Moody (one of Metro Vancouver’s 22 member municipalities) has implemented a version of the bylaw and established a target of 70 per cent diversion (see example in Section 3.6.2).

**International Green Construction Code (IgCC)**

The IgCC acts as an overlay to an existing set of “opt-in” international building codes and incorporates the American ASHRAE Standard 189.1 as an alternate path to compliance. The IgCC includes measures to conserve materials including requirements for at least 55 per cent of materials to contain recycled content, be recyclable, bio-based or indigenous and to divert at least 50 per cent of CRD waste from landfill. It has been adopted as a mandatory regulation by five US states (and being reviewed by ten more).

**California Green Building Code (CalGreen)**

Under CalGreen, the State of California requires a minimum of 50 per cent of the nonhazardous construction waste to be recycled and/or salvaged for reuse.
3.4.2. Green building certification

Green building rating systems evaluate, verify and certify the environmental performance of the design, construction, operation, and maintenance of buildings. Programs usually benchmark performance against a set of requirements or optional criteria and several include measures for CRD waste diversion. Systems to certify both new construction and existing buildings, including fit-up, operations and renovations have been in operation in Canada for about 20 years. They are usually voluntary and administered by 3rd party NGOs as leadership-level aspirational goals. However, some (such as the American Collaborative for High Performance Schools deconstruction standard (see Section 3.4.4) and the UBC REAP program98) have been developed by institutional owners and/or governments as enforceable standards for specific building types and / or priorities, functioning more like a building code (See also Section 3.4.1).

The most common systems that reference CRD waste management are: BOMA BEST, BuiltGreen™ and LEED. Most certification systems have the following common elements:

- **Categories**: Common performance categories are energy, water, materials & resources, indoor environmental quality and site selection.

- **Criteria**: Most systems have a combination of mandatory (pass-fail) and points-based criteria in each performance category.

- **Certification levels**: Most systems have multiple levels (e.g. Bronze, Silver, Gold) based on the building’s total score across all categories.

- **Assessment**: Most systems are certified by an independent third-party.

CRD waste management credits typically require the submission of a CRD waste management plan that demonstrates how the proposed diversion rate will be achieved. Compliance with the credits is achieved by tracking waste diversion via weigh bills and other documentation (photos, receipts, etc.) and submitting a final total once the project is complete.

Green building rating systems are important mechanisms for introducing new approaches and “stretch” goals for progressive builders to adopt on a voluntary basis. As the industry becomes familiar with the techniques, policymakers can expand the application of the policies to a broader range of building types and, eventually, incorporate elements of the rating system into legislation.

**Applicability to CRD waste materials**

Rating systems address the entire CRD waste stream via the following strategies.

- Re-use of existing structures (whole or in part) and components
- Incorporation of salvaged and reclaimed products
- Sourcing sustainable, reusable and recyclable materials
- Using materials with recycled content
- Implementing a comprehensive waste management plan with minimum diversion targets
- Building durability plan
Policy advantages

- Rating systems offer the potential for very high rates of diversion. Numerous projects have achieved diversion rates greater than 90 per cent.
- Rating systems offer clear green targets and flexibility to designers for how they are achieved.
- There are consistent approaches to documentation that are transferable from project to project and across different jurisdictions.
- Industry is familiar with how rating systems work.
- The costs of many green products are competitive with traditional alternatives.
- There are excellent opportunities to educate industry on the principles of green building.
- 3rd party validation processes tend to fit well with government priorities.

Policy disadvantages

- Many rating systems only include CRD waste management as optional credits as opposed to mandatory requirements.
- Rating systems normally only apply to “top 25 per cent” of leadership-level buildings. So CRD diversion from LEED projects represents less than 1 per cent of annual CRD waste generated in Canada.91
- Generally, rating systems do not address demolition.
- Certification is not issued until after project completion making it difficult to enforce.
- Rating systems may not adequately consider the local characteristics of a particular project.
- The checklist approach means it is not always possible to be sure that a project has scored well in CRD waste management.

Considerations when developing the policy

- Green building rating systems are effective at driving improvements in environmental design that lead to generally improved performance including reducing construction waste, increasing durability and facilitating deconstruction. Since 2005, LEED projects in Canada have recycled over 3 million tonnes of CRD waste.92
- Rating systems are useful tools for building owners to use when procuring building projects. Indeed many governments reference LEED performance for their capital projects (see Section 3.5.2).
- In most rating systems, activities related to CRD waste management only comprise a small portion of the overall score. In LEED Canada 2009, CRD waste management comprises up to 2 optional credits out of a total of 110 points and materials credits comprise only 13 per cent of the total.
- Most green building rating systems are administered by industry associations or other not-for-profit organizations and may not have the legal authority to hold builders accountable.
- Although numerous municipal governments leverage certification systems during rezoning negotiations with developers, it is difficult to mandate builders to exceed the standards outlined in the provincial building code. Some municipalities use incentives (e.g. a rebate on development cost charges) to encourage higher performance.

Government involvement in policy development and implementation

Governments of all levels can demonstrate leadership in advancing CRD waste diversion by adopting green building rating systems in their public procurement policies (Section 3.5.2).93

Green building rating systems offer governments an opportunity to create or expand the market for a particular product (e.g. requiring the use of wood waste chips used in public landscaping projects).
Examples

CAGBC LEED project database
There are over 5,000 LEED certified buildings in Canada (representing a market penetration rate of about 10 per cent in 2014). The Canada Green Building Council operates an online database that is searchable by region (city, province, etc.).

Toronto Green Standard
The City of Toronto has developed its own certification scheme – the Toronto Green Standard – that is inspired by LEED. It has two levels: Tier 1 (mandatory) and Tier 2 (voluntary). Tier 2 includes a requirement to recycle at least 75 per cent of construction and demolition waste. As an incentive, developers who achieve Tier 2 may be eligible for a partial development charge refund.

The Living Building Challenge
The Living Building Challenge is a US based system that stipulates that builders achieve “net positive waste”. Proponents are expected to create a Material Conservation Management Plan that covers design, construction, operation and end-of-life. During construction, the project team should divert more than 90 per cent of materials. It also includes requirements for the use of salvaged materials and the adaptive reuse of existing structures. There are three projects that have been certified in Canada – all in BC. They include a house in Victoria, the SFU UniverCity childcare centre in Burnaby and the Van Dusen visitors’ centre in Vancouver.
3.4.3. Environmental product standards and labels

Environmental product standards and labels are documents that provide “requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.” They communicate verifiable and accurate information on the environmental aspects of a product from manufacture through to recycling and disposal in order to:

- Ensure that products and services are safe, reliable and of good quality,
- Provide comparable, standardized information to assist consumers with making informed choices, and
- Stimulate the demand for and supply of environmentally friendly products and services.

There is a very large number of product standards and labelling schemes in operation, and some are much better organized and more rigorous than others. Ideally, they should define the technical and environmental requirements that materials should fulfil and describe the means of evaluation and compliance.

For materials recovered from CRD waste to be accepted and adopted by the end users, information is needed to describe the method to use, functionality and performance (including quality, variability, contamination levels, etc.). Further, the requirements to comply with standards and labels can influence the generation, reuse and recycling of CRD waste by providing information on the product at different stages of the product lifecycle. This includes:

- **Product content**, such as amount of recycled versus virgin material, biodegradability, etc.
- **Production process**, such as the amount of energy used and waste generated and emissions to air, soil and water.
- **Product performance and durability**, such as expected lifespan, tolerances, efficiency (e.g. energy, water), emissions and engineering specifications.
- **Product reusability and recyclability**, such as design for disassembly, percentage of the product that can be recycled, etc.

**Applicability to CRD waste materials**

Environmental product labels can apply to all materials and products. Common multi-attribute certification and labelling schemes related to construction include ECOLOGO, GreenSeal and Cradle-to-Cradle. Common product or material-specific schemes include Forest Stewardship Council (forestry products) and Greenguard (chemicals). Industry-led product-category specific certifications include U.S. Carpet and Rug Institute’s GreenLabel Plus program.
Policy advantages

• Product labelling provides important support to the markets for secondary materials recovered through waste diversion programs by providing consistent definitions and performance information.
• Product standards support regulations that mandate how much secondary material should be used in products via “recycled content” labels.
• Product standards can help governments to determine the economic value of processed materials along the value chain.

Policy disadvantages

• Not all product standards and labels comply with ISO standards\(^1\) (some are “self-regulated” by the industries they represent), which can make it difficult for governments to determine whether the label or standard has value.
• There are no standard definitions of waste and secondary materials in common use in Canada.
• Producers and users of secondary materials processed from CRD waste tend to restrict themselves to local markets to avoid administrative and judicial costs or risks of an unclear waste status of materials.
• End of Waste criteria (defined in the examples below) are not in common use or consistent across regional and national boundaries - requires comprehensive investment by government and stakeholders to define and verify CRD wastes as secondary materials.

Considerations when developing the policy

• Product labelling will not reduce CRD waste directly, rather it will provide the information necessary to establish markets for products made from secondary materials and are an important element when working towards a circular economy.
• End of waste criteria are starting to be integrated into standards and labels. However, with CRD waste, it is often challenging to determine when a waste ceases to be a waste and becomes a recovered material that can be freely traded in the market. This is a significant issue as once a material is classified as waste there are restrictions on how it can be used and transported, particularly across jurisdictions (Section 3.2.2).
• A growing number of manufacturers and scientists are developing a relatively new type of label called an Environmental Product Declaration (EPD) or life-cycle declaration. The purpose of an EPD is to provide standardised, quantified information on a product’s environmental performance in order to enable objective comparisons between products fulfilling the same function. EPDs are produced following specific ISO-compliant rules, requirements, and guidelines for calculating and reporting environmental impacts across the full life cycle of a product. A qualified third party verifies both the parameters and process. EPDs are one of the only internationally recognized tools that enable this type of accurate comparison, and are starting to be integrated into green building certification programs. While they are referenced in green building rating systems such as LEED Version 4 (Section 3.4.2), they are not part of the Canadian policy context yet.
Government involvement in policy development and implementation

Product certifications and labels are typically administered by industry associations, not-for-profit organizations or national government agencies. There are many labelling schemes currently in operation. There is no necessity for governments to develop their own.

Examples

ECOLOGO

Almost 7,000 different products, services and packaging are ECOLOGO Certified for reduced environmental impact, including 79 building construction materials. ECOLOGO certifications are voluntary, lifecycle based environmental certifications that indicate a product has undergone rigorous scientific testing, exhaustive auditing, or both, to prove its compliance with stringent, third-party, environmental performance standards. ECOLOGO Certification is classified as an ISO Type 1 Ecolabel.

European Commission Waste Framework Directive End of Waste Criteria:

The EC Waste Framework Directive sets out how certain specified waste ceases to be “waste” when it has undergone a recovery operation and complies with specific criteria developed in accordance with the following conditions:

- The substance or object is commonly used for specific purposes
- A market or demand exists for such a substance or object
- The substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products
- The use of the substance or object will not lead to adverse environmental or human health impacts
- Limiting values for pollutants where necessary and shall take into account any possible adverse environmental effects of the substance or object

Consistent definitions of secondary products create legal certainty for waste management decisions and for the different actors dealing with specific waste streams, including producers and users of the recycled material. Investment decisions on new treatment capacities for the management of waste require legal certainty. Definitions would also improve compatibility of regulatory frameworks for the recovery and reuse of secondary materials.

In the EU, criteria have, so far, been laid down for iron, steel and aluminum scrap. The next waste streams to be addressed include copper scrap, recovered paper, glass cullet, plastics and biodegradable waste / compost. Technical proposals have been submitted for the end-of-waste criteria on copper scrap metal, recovered paper, glass cullet and is conducting further studies biodegradable waste/compost and plastic. Once established, these criteria will provide a reference for Canada.
3.4.4. Deconstruction standards

Deconstruction standards describe the selective dismantling or removal of materials from buildings prior to or instead of conventional demolition. Deconstruction is an approach to building removal that can convert the CRD waste stream from demolition into highest-value resources in a manner that retains their original functionality as much as possible for re-use in future buildings. Demolition waste accounts to over 40 per cent of the CRD waste stream in Canada (see Table 1 in Section 2.1) and the removal of waste materials from buildings also comprises a large part of renovation waste as well.

Building deconstruction can be handled in several ways:

- **Manual building deconstruction** is the systematic disassembly of a structure (whole or in part) to maximize reuse and recycling.
- **Hybrid deconstruction** describes the use of people and machines to efficiently deconstruct buildings, with the goal of maximizing reuse and recycling. It refers to the hybrid of demolition and manual deconstruction.
- **Partial deconstruction** is the removal of part of a structure without harming the remaining section(s) while still focusing on maximizing reuse and recycling.
- **Building kits** are collections of materials that have been labelled, diagrammed, and then carefully disassembled in order to be reassembled at another job site.

The extent to which buildings are designed for deconstruction using recyclable materials is an important indicator of the potential for future economic feasibility of achieving a “zero-waste” building sector.

### Applicability to CRD waste materials

Deconstruction can reduce the use of a wide range of new materials, extend the life of existing materials, reduce the amount of materials entering recycling/reprocessing centres, and minimize/eliminate the amount of all materials entering the CRD waste stream. Characteristics of buildings that are likely to be good deconstruction candidates include:

- Wood-framed with heavy-timbers and beams, or with unique or “old growth” woods,
- Large proportion of pre-fabricated components where documentation exists that illustrates the location of fixings (such as bolts, plates, brackets, ties, etc.),
- Constructed with high-value specialty materials such as hardwood flooring, multi-paned windows, architectural moulding, and unique doors or plumbing/electrical fixtures,
- Constructed with high-quality brick laid with low-quality mortar (for easy break-up and cleaning), and / or structurally sound (i.e., generally weather-tight to minimize rotted and decayed materials).
- Buildings constructed mainly of concrete and/or steel may be good candidates for partial deconstruction, or the “stripping” of salvageable materials. Stripping out these materials may make it easier to recycle the concrete and steel as well.
Policy advantages

- Deconstruction promotes the principle of “closed loop” construction whereby materials can be re-used many times with minimal re-processing.
- Deconstruction can cost less than demolition overall because of the value of the salvaged materials and the avoided disposal costs.
- Deconstruction results in significantly greater protection to the local site (e.g. soil and vegetation).
- Deconstruction can divert up to 90 per cent of a building into reuse or recycling while creating much less dust and noise than conventional demolition.
- Manual disassembly of buildings offers excellent job creation opportunities.

Policy disadvantages

- There is a potential for safety hazards when manually taking down large elements and some materials may contain toxins such as lead and asbestos.
- It is usually quicker (and therefore less expensive) to landfill a building than it is to deconstruct it.
- The skills required to deconstruct a building may not be readily available.
- Depending on the type of building and the size of the crew, deconstruction can take two to ten times longer than conventional demolition because most existing buildings have not been designed with disassembly in mind so are not easy to deconstruct.
- Deconstruction requires extensive and easily accessible processing infrastructure to support it.
- There is a lack of sufficiently detailed standards for recovered materials so they can be accepted by secondary markets (Section 3.4.3).

Considerations when developing the policy

- Deconstruction requires a fundamental re-think of the entire design and construction process to maximize opportunities for building deconstruction in the future. Not only should construction solutions allow for easy non-invasive maintenance and repair but also spatial reorganization, adaptability and even re-use of the whole building.
- Deconstruction adds about 25 per cent to the cost of the average demolition. For example, typical demolition for a house in Vancouver costs $16,000, so there is an added cost for deconstruction is $4,000. However, revenues from the recovered materials and the savings from tipping fees may reduce or eliminate this cost differential. The challenge is ensuring the costs and benefits are allocated among the stakeholders fairly.
- Effective deconstruction policies commonly include the following elements:
  - Guidelines for deconstruction process, including management of hazardous materials,
  - Requirements for designers to develop a comprehensive Disassembly Plan that incorporates design for disassembly, durability, and adaptability principles,
  - The availability of clear deconstruction standards and a qualified workforce that can implement deconstruction safely and efficiently. This includes clear regulations related to the management and disposal of hazardous materials.
  - Training / certification for workforce. The availability of clear deconstruction standards and a qualified workforce that can implement deconstruction safely and efficiently.
  - Requirement / incentive for deconstruction (regulation, economic incentive, etc.), and/or
  - Design guidelines and standards to enable deconstruction.
• Assistance may need to be provided to builders contemplating a deconstruction project in the form of training, information resources and toolkits.

**Government involvement in policy development and implementation**

Regulating deconstruction standards is currently occurring at the regional or local level. Currently, few jurisdictions have established policies promoting building deconstruction and design for disassembly although there are numerous programmes in development and pilot projects.

**Examples**

**King County Deconstruction Guide**

King County in the State of Washington (which includes the City of Seattle) provides a free design guide for building disassembly, a free downloadable Master Specifications for Construction Waste Management and Building Deconstruction and Salvage. Deconstruction is also encouraged by their disposal ban on readily recyclable construction materials, including clean wood, cardboard, metal, gypsum scrap, asphalt paving, bricks, and concrete.

**American Collaborative for High Performance Schools (CHPS) Destruction Standard**

The CHPS is one of the few rating systems in operation that includes for building disassembly or deconstruction. Although it only addresses educational facilities, the intent of CHPS credit “LE3.2: Design for Adaptability, Durability and Disassembly” is to:

- Reduce building material waste and promote local building material reuse during construction, renovation, repurposing of space, and disassembly.
- Provide spaces that are adaptable, durable, and flexible.
- Drive innovation in designing schools to support disassembly and reuse.

CHPS describes how the design team should provide the owner, builder and records management systems with a Disassembly Plan that sets out the method of disassembly of major systems during renovations and end-of-life, and the properties of major materials and components. The designer is also encouraged to design major systems with differing functions and lifespans to promote disentanglement. For example:

- Separation of envelope from structure.
- Dedicated service voids (chases, raceways).
- Separation of interior spatial plan from structure.
- Separation of finishes from substrate associated with spatial plan, structure or weather envelope.
- For major systems such as roof or HVAC, etc. provide access to and types of connections that allow disassembly:
  - Visible and/or ergonomic connections
  - Human scale components and use of industry standard connectors and tools that are trade-friendly.
  - Minimize number and different types of connectors over whole building.
  - Use of reversible connections (screws, bolts, nails, clips).
3.5. Strengthen diversion markets and infrastructure

This strategy focuses on increasing the supply and demand of diverted materials, such as through public procurement and investment.

3.5.1. Investment in infrastructure

Technologies, education and capital help to create and grow the infrastructure required to manage and process CRD waste materials. For example, convenient materials exchanges, re-use centres and retailers are required to purchase, process, refurbish and sell the materials. Also, improving the efficiency with which facilities can process CRD wastes will reduce the costs and improve the quality of the recovered and processed materials.

Governments can deliver this support in several different ways:

- Facilitate private, public or some form of partnership funding for new facilities and capital upgrades,
- Provide grants and funding for pilot projects, studies and other research and development activities,
- Provide direct investment, subsidies or service agreements in infrastructure for sorting, transportation and processing, and/or
- Enable innovative approaches through a supportive policy environment (e.g. zoning/community planning to remove barriers to and encourage private sector investment).

Sustained investment in innovation is essential for industry competitiveness, survival and growth. A healthy innovation ecosystem is critical to the uptake of new technologies and solutions such as those necessary to introduce and adopt sustainable construction materials. Therefore grants and funding for research and pilot projects are critical for exploring new opportunities for CRD waste diversion, testing new technologies or equipment and for addressing the many economic, educational or technical barriers to CRD waste management.

Applicable CRD waste materials

Public investment in CRD waste management infrastructure is applicable to all CRD waste materials. However, while it is difficult to attribute direct impacts on specific CRD waste material streams, all of these types of investment have an important role to play in advancing a more sustainable system of waste diversion and recycling in all regions.
Policy advantages
• Investment in infrastructure fills an important market gap for processing CRD materials and providing them to the market for re-use.
• Investment in upgrades can help to improve the efficiency of processing facilities, which will help to bring down the cost and improve the quality of the processed materials.
• Investment opportunities in the growing waste diversion market may present a compelling economic opportunity for local NGOs and/or businesses.

Policy disadvantages
• Investment in infrastructure is unlikely to be successful in isolation. To ensure economic viability of new facilities and to generate a return on investment in infrastructure requires the presence of strong disincentives to landfill target materials.
• Materials re-use and re-sale centres require significant and sustained (multi-year) investment and a supportive policy environment to get started.

Considerations when developing the policy
• Funding for investment can be sourced from landfill and recycling fees (Section 3.3.1), virgin materials levies (Section 3.3.2) and/or deposit fees (see example in Section 3.1.2).
• There is a high level of industry fragmentation and limited collaboration in the construction industry generally, and within the CRD waste management sector specifically. Further, the levels of investment in R&D and innovation in Canada is low compared to other developed countries both in terms of private sector funding and government spending.112
• Other potential barriers to innovation to advance CRD waste management efficiency and effectiveness, close market gaps and find new uses for secondary materials include:
  o Procurement impacting on the level of collaboration,
  o Sub-optimal knowledge transfer and lost sector-wide learning opportunities,
  o Issues around market uptake and awareness of benefits from innovation,
  o Lack of access to finance, and
  o A risk-averse attitude to innovation.

Government involvement in policy development and implementation
All levels of government can invest in CRD waste management infrastructure either directly, in partnership with industry or NGOs or focus on facilitating private sector investment.
Government and/or corporate investment in sector-specific R&D can extend beyond facilitating access to capital to include the provision of testing facilities and expertise, gathering and sharing information on markets and R&D activities, creation of demonstration projects and connecting researchers to the industry applications.
Clear performance metrics against which to monitor innovation vitality should be developed that reflect the unique characteristics of the building industry.
Examples

Edmonton Waste Management Centre\textsuperscript{113}

The City of Edmonton, Alberta owns and operates the Edmonton Waste Management Centre (EWMC), a unique collection of advanced waste processing and research facilities. The EWMC includes:

- **Construction and Demolition (C&D) Facility.** The C&D Facility accepts both mixed and segregated loads of CRD waste at a lower tipping fee than the landfill (\$0-\$70/tonne depending on the material). This advanced facility diverts more than 90 per cent of segregated loads (wood, drywall, asphalt shingles, concrete, metals, bush/trees) and between about 40 and 60 per cent of mixed loads.

- **Waste to Biofuels and Chemicals Facility.** The City of Edmonton has entered into a service agreement with Enerkem to increase its residential waste diversion from 50 per cent to 90 per cent\textsuperscript{114}. Municipal waste will be used as the feedstock for producing biofuels at the facility (Note: See Waste to Energy in Section 2.2).

Redistribution to municipalities of charges paid for the disposal of residual materials, Québec

The Québec residual materials management policy, (part of the Environment Quality Act) provides financial support to regional municipalities to develop residual materials management plans (RMMPs) that should include all residual materials, including household, industrial, commercial, institutional, and other types of waste\textsuperscript{115}. Further, approximately 85 per cent of the revenue from landfill fees (\$29.93 per tonne) is redistributed to municipalities based on:

- Their population, and
- Their waste management performance (including CRD waste).

This is an incentive to improve performance and competition against other municipalities. To date, each municipality has received an average subsidy of \$2.58 for each dollar spent on the management of its residential residual materials.

DivertNS\textsuperscript{116}

DivertNS is a Nova Scotia-based NGO that administers several waste diversion programs and a network of Enviro-Depots. Its programs generate surplus revenue, which is used to support waste diversion. It provides:

- **Funding support** for companies to conduct research into new and more efficient ways to divert CRD and other solid waste from disposal. Research projects can be related to i) materials or products that incorporate solid waste resources, ii) technologies that will facilitate the separation and recovery of solid waste resources, and iii) market opportunities for solid waste resources and/or recycled materials.

- **Interest free loans** to ENVIRO-DEPOT™ owners to make improvements to operations and facilities that are used for RRFB Nova Scotia programs and activities.

- **Annual funding for Solid Waste Management Regions** Each year, RRFB Nova Scotia disperses almost 70 per cent of its net revenues to its municipal partners to help fund waste diversion programs, municipal approved programs, education and awareness contracts, and other waste disposal programs. Credits are based on the amount waste diverted from landfill.
3.5.2. Public procurement

Sustainable public procurement and purchasing policies not only take into account the economic value (price, quality, availability and functionality) but also the related environmental and social impacts of goods and services.

Governments can harness their sizeable purchasing power to reduce consumption of materials, resources and energy (see Toronto Airport example of 90 per cent waste diversion in Section 2.2). They can demonstrate that green procurement requirements are achievable, which can encourage potential vendors to alter their business practices in order to compete in an advantageous way for government business. Sustainable procurement and purchasing can therefore have substantial “trickle-down” effects on the construction materials supply chain.

A sustainable procurement/purchasing policy or programme focused on reducing the impacts of construction materials can include a range of objectives such as waste prevention and reduction, resource reduction, pollution and toxin reduction, reduction of greenhouse gas (GHG) emissions, etc. When buildings are tendered for construction, the bid documents can be designed to reflect “triple bottom line” goals, which encompass, environmental, social and economic criteria. Green building certification (Section 3.4.2), and environmental product labeling programs (Section 3.4.3) can provide standards that are simple to incorporate into procurement policies or requirements.

“Social procurement” is also starting to make its way into government procurement policies, which is an innovative market-based opportunity to create social impact through existing purchasing. The Town of Cumberland on Vancouver Island, BC (population 3,400) has established a social procurement policy framework that evaluates projects based on quality, price, environmental impact and social value.117

Applicability to CRD waste materials

Green public procurement can address the environmental performance of a structure as a whole and can be used to influence upstream impacts of materials as well as the entire CRD waste stream via the adoption of tools such as green building rating systems.

Purchasing requirements can also be oriented towards the use (or prohibition) of specific materials (e.g. BC's Wood First Act which promotes wood as a “first choice” material for public projects).118
**Policy advantages**

- Governments can use public procurement as an effective instrument for forcing behaviour change by demonstrating that desired practices are achievable.
- Public procurement can be a powerful tool to drive market innovation.
- Procurement policies can hold the builder financially liable if the performance criteria (such as CRD waste diversion goals) are not met.
- Green building rating systems and environmental product standards have been in effect for a long time and can be easily referenced in public procurement policies as a means to establishing desired performance.
- Public procurement can help to build industry capacity and acceptance of new business practices.

**Policy disadvantages**

- Public procurement processes may have to be modernized for the benefits of novel products, processes or solutions to be fully realized.
- Many public procurement policies favour the lowest bid (ignoring the life cycle impacts or non-financial benefits such as environmental or social impact). This approach can hinder innovation, especially in construction projects.
- There may be a lack of awareness and lack of resources available to purchasing officers for translating desired environmental / social goals into “best value” solutions for construction projects.
- Applying too many criteria to the public procurement process may disadvantage small businesses in the bidding process.

**Considerations when developing the policy**

- Governments can “seed the market” by requiring public projects to meet certain CRD waste diversion goals, or guaranteeing to supply and/or purchase certain quantities or types of sustainable materials, or reclaimed / re-processed products.
- By favouring the purchase of products with better environmental performance, green procurement strategies can reinforce similar signals given through policies (e.g. EPR programs).
- Some public organizations have developed their own green procurement specifications, while others refer to green building certification ([Section 3.4.2](#)).
- Procurement of innovative or unfamiliar construction products and processes require early engagement with the project team and flexible, performance based agreements.
- Quality-based proponent selection is critical to ensuring a project is developed with its entire life-cycle impacts in mind. Frequently, public procurement is driven by first cost resulting in a building that requires higher levels of maintenance and/or premature repair / replacement.
- Governments can develop demonstration projects that demonstrate outstanding performance in the area of building design and waste reduction.
- Feedback loops are essential to ensure that lessons learnt are transferred from project to project and back into the organization as a whole.
Government involvement in policy development and implementation

All levels of government, crown agencies and public sector organizations have a great opportunity to lead by example and inject environmental measures into their procurement decisions.

Examples

The Federal Government of Canada green building assessment initiative

The Federal Government has set a target of assessing 80 per cent of existing buildings to identify environmental opportunities. Consequently, all new construction, build to lease projects and major renovation projects should achieve an industry-recognized level of high environmental performance. Similarly, existing Crown buildings and new lease or lease renewal projects over 1,000m² should be assessed for environmental performance using an industry-recognized assessment tool.\(^\text{119}\)

British Research Establishment (BRE) Global framework standard for the Responsible Sourcing of Construction Products (BES6001)

BES6001\(^\text{120}\) is a model standard that provides a holistic approach to managing a product from the point at which component materials are mined or harvested, through manufacture and processing. It is demonstrated through an ethos of supply chain management and product stewardship and encompasses social, economic and environmental dimensions. It has been adopted by large public infrastructure in the UK such as the £15 billion trans-London Crossrail project.\(^\text{121}\)
3.6. Build knowledge and skills

This strategy focuses on increasing the capacity and knowledge of the sector, such as through education programs and data collection.

3.6.1. Industry outreach, education & resources

An educated market may be more likely to be receptive to changes in the way business gets done. Consultation, supported by easily accessible, practical information will aid the adoption of CRD policies and should take place after fact-finding and data collection and prior to policy development and implementation.

There are many methods of providing information to market actors, the key considerations being how best to deliver the right information, to the right decision-maker at the right time. Given the large number of stakeholders involved in CRD waste management and all the different ways they prefer to receive information, a multi-tier approach to developing and disseminating information, outreach and education can build awareness, stimulate demand and document improvement over time (Figure 13).

Figure 13 A typical multi-tier education model

<table>
<thead>
<tr>
<th>Market level</th>
</tr>
</thead>
<tbody>
<tr>
<td>• High level general outreach and engagement</td>
</tr>
<tr>
<td>• Multi-media</td>
</tr>
<tr>
<td>• Example</td>
</tr>
<tr>
<td>• Moral suasion diversion campaigns (e.g. Zero Waste)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company level</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Industry-specific education</td>
</tr>
<tr>
<td>• May be office-based or at policy intervention points</td>
</tr>
<tr>
<td>• Examples</td>
</tr>
<tr>
<td>• Promote alternate models (e.g. Cradle to cradle, Closed-loop construction, circular economy, dematerialization, modern methods of construction, durability)</td>
</tr>
<tr>
<td>• Promote and provide databases of lifecycle assessment of materials, assemblies and structures</td>
</tr>
<tr>
<td>• Competition and awards</td>
</tr>
<tr>
<td>• Education programs (lifecycle assessment, technology assessment, green building, etc.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project level</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Tactical information and technical support for workers</td>
</tr>
<tr>
<td>• May be in the office or in the field</td>
</tr>
<tr>
<td>• Examples</td>
</tr>
<tr>
<td>• Deconstruction &amp; salvage guidelines and case studies</td>
</tr>
<tr>
<td>• Waste management tools (CWM plan templates, online tracking and reporting systems, etc.)</td>
</tr>
<tr>
<td>• Building design tools (catalogues of product and assemblies, directories, master specifications and templates)</td>
</tr>
<tr>
<td>• Job site training and recycling programs, deconstruction</td>
</tr>
</tbody>
</table>
Hands-on technical assistance programs can be provided as free or as discounted services to designers, contractors and trades to help them set up their CRD waste management plans, establish diversion goals, find haulers and recyclers, and then document progress. Other technical support services may include training, mentorship, research or other advice. For example, master specifications can be developed to assist designers and builders to accurately describe desired processes and outcomes such as the use of reclaimed or salvaged materials and technical experts can be made available to come into the office or onto the construction site to provide “hands-on” advice.

Education and training programs can be developed, delivered and/or administered by local governments, training institutions, trade associations, solid waste management companies and NGOs. Adequate and sustained funding may be necessary given the length of construction processes and the long time frames between projects.

Examples

Metro Vancouver multi-tier education

Since the early 2000’s, Metro Vancouver has been creating and implementing an integrated outreach and education program designed to support market transformation to a “diversion first” mindset. A range of multi-media programming (including the Sustainable Region TV show) aim to raise market awareness of the benefits of CRD waste diversion. A range of industry specific guides for designers, builders and trades included the “Guide for Builders” and the DLC Waste Management Toolkit which includes a directory of haulers and facilities.

While the industry was ramping up with CRD waste diversion, Metro Vancouver’s BuildSmart program offered a free field-based technical training service to help contractors set up waste management plans, source haulers and materials recovery facilities, and document the CRD waste being diverted.
3.6.2. Benchmarking and tracking CRD waste data

CRD waste management strategies, targets and goals work best when they are based upon accurate data.

A robust understanding of the CRD waste materials that are being generated helps policymakers to pinpoint gaps and challenges, report on progress and monitor performance. CRD waste management metrics can include diversion as a proportion of total waste generated, or (better) weight per capita (in kg). As methodologies such as Life Cycle Assessment (LCA) become mainstream, a far greater quantity and quality of data will become available such as embodied energy, GHG emissions, as well as industrial energy efficiency in order to keep track of construction material manufacture and production. Also, as environmental performance criteria are incorporated into building codes, the need to establish benchmarks and targets will become increasingly important. Benchmarks and targets are already in place for “in-use” energy and GHG emissions performance in many European countries and were recently adopted by the City of Vancouver as part of its Zero Energy Building plan.125

Provincial / territorial governments may establish the requirement for benchmarking and tracking of CRD waste management performance. However, it is primarily local governments, waste management and processing facilities that will be responsible for gathering data, evaluating the information and tracking progress. Other tracking that may be useful for informing CRD waste management polices include an inventory of locally available materials and what they contain, and building stock characteristics (such as condition and pace of likely replacement, number of historical buildings that may be worth preserving).

Governments can use various performance measurements to monitor, measure and report key solid waste management information, both internal and external, for use in decision-making and communications. CRD waste management performance measures may include:

- Waste composition studies,
- Recycling participation rates,
- Waste and recycling tonnages, and/or
- Diversion rates and costs.

Broader environmental, economic, social indicators can also be developed that complement other regional priorities (such as economic development key performance indicators, GHG emissions, job creation, etc.). Emerging methods for CRD waste tracking and reporting are discussed in Appendix C.

As governments start to consider broader impacts, the metrics become more complex. Environmental impact is measured on a life-cycle basis (tonnes of end-of-life waste, volume of CO₂ emissions, pollution and land use). LCA analysis is necessary to determine if (and to what extent) the policy is having a positive effect in one area (e.g. designing products that can be recycled more easily) may have a negative effect in another (e.g. products being made from materials with more energy-intensive extraction methods). This approach raises questions about how and where trade-offs are to be made. Working within a lifecycle based policy environment is challenging. It requires large amounts of data and specialists to manipulate it correctly. Although LCA is starting to appear in green building rating systems, for most regions, this approach to policy making is still some years away.
Example

Tracking and reporting on performance in Port Moody, BC

Port Moody is a sub-urban municipality within Metro Vancouver (population about 35,000). Port Moody’s Waste Management By Law requires that a Waste Management Plan be part of Building Permit and Demolition Permit applications. The by law requires permit holders to submit proof that 70 per cent of recyclable CRD waste material has been diverted to licensed processing facilities prior to project completion.

According to a BC government case study, city staff found that with the by law in place, almost 100 per cent of the potentially recyclable materials are being diverted. On the strength of this finding, the City may now consider amending the by law to require 100 per cent diversion of recyclable CRD waste materials.
3.7. Considerations for rural and remote communities

While CRD waste management solutions are becoming increasingly common in urban areas, remote regions encounter many additional challenges over and above those described in Section 2.7. For example, there is limited (sometimes no) road access and recycling facilities are far away. There are also high costs of reverse logistics and limited local markets. As a result, many rural and remote communities have low diversion rates and very few options for recycling conventional waste streams, let alone CRD waste. Consequently while materials such as clean wood waste and aggregates may be relatively easy to divert in large urban centres, small, rural and remote communities may be forced to landfill these materials because the scale of demolition and construction activity is comparatively low, the economics of investment in materials recovery facilities are also difficult to justify. These challenges can be especially acute in the north where climate can further limit access and transportation options. Examples in this section therefore focus on accomplishments by northern communities, but these experiences may be relevant to many rural and remote locations.

To date, CRD waste has not been singled out for specific attention in most rural and remote communities, in large part because of other priorities in the waste stream. This situation is changing however, as more communities invest in engineered disposal facilities and turn their attention to waste management policies. For example, the City of Whitehorse has set an initial target of 50 per cent overall waste diversion by 2015 (include CRD waste) and a goal of zero waste by 2040. In addition the city hosted the first pan-northern “Zero Waste” conference in March 2016.

There is a good deal of resourcefulness in many small communities. Where there is no processor within a hauling distance that is economically feasible, waste generators might benefit from some “networking” to learn if combining recyclable materials from multiple sources of CRD waste to accommodate larger-volume shipments would make it feasible for an outside processor to haul away the materials for material recovery and recycling. CalRecycle suggests another more ambitious option is for generators to research possible end markets for CRD waste products they could make themselves. This might require some capital investment, such as purchase of a mobile processor or grinder.

Table 4 provides a selection of examples of policies and programs in effect using northern communities as examples.

Table 4 CRD waste management policies that may apply to rural and remote communities

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Associated CRD waste management policies</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Create accountability for waste diversion</td>
<td>Extended Producer Responsibility (EPR)</td>
<td>The Northwest Territories (NWT) Electronics Recycling Program is an EPR program that requires companies that supply new electronics to register with the NWT program, collect environmental handling fees on designated electronics sold/distributed and then report and remit fees, where applicable.</td>
</tr>
<tr>
<td></td>
<td>Waste management plans for facilities and projects</td>
<td>The MacKenzie Valley Land and Water Board (MVLWB) in the North West Territories has developed a waste management planning guide describing how project proponents requiring land use permits and/or water licences should prepare waste management plan. The guide provides a template for proponents to write a plan and a benchmark for reviewers to evaluate a proponent’s plan, thus ensuring that waste management plans are submitted and reviewed in a consistent way. Also see the Yukon Waste Management Cost Recovery Bylaw below.</td>
</tr>
</tbody>
</table>
### Strategy | Associated CRD waste management policies | Examples
--- | --- | ---
B. **Limit disposal options** | Transportation requirements | The Yukon Waste Management Cost Recovery Bylaw dictates that all waste management activity costs are fully recovered via tipping fees and utility charges and waste transfer bins are in effect in all communities across the territory. Also, the Yukon government provides a direct subsidy to haulers and processors based on the volumes they process. Up to $573,000 is expected to be committed to local recycling processors, based on the type and tonnage of recyclable material they process in 2015/16. This is 2.5 times more than what was provided the previous year. Another $68,000 will be given to the processors to ship 400 tonnes of stockpiled mixed plastics out of the territory for recycling. Much of this additional cost will come from an increase in recycling deposits on refundable beverage containers and the establishment of environmental fees on items such as electronics.
C. **Align financial incentives** | Differential tipping fees | The Whitehorse landfill operates differential tipping fees. It accepts recyclables such as beverage containers, bottle glass, plastics, aluminum and paper without a tipping fee.  
D. **Improve CRD processes** | Green building design certification | There are four LEED certified buildings in the Yukon. The LEED Silver Whitehorse Hospital staff residence (complete in 2013) achieved over 50 per cent CRD waste diversion.
E. **Strengthen diversion markets and infrastructure** | Invest in infrastructure, research and development | Habitat for Humanity opened a ReStore in Yellowknife, NWT in June 2016. ReStores are non-profit home improvement stores and donation centres that sell new and gently used furniture, home accessories, building materials, and appliances to the public at a fraction of the retail price.
--- | --- | ---
F. **Build knowledge and skills** | Industry outreach, education and resources | Individual and organizational “heroes” are regularly celebrated by Zero Waste Yukon.
--- | --- | ---
--- | Benchmark and track data | The City of Whitehorse has been tracking its solid waste for many years. With a combination of programs, the City has seen overall waste diversion increase. In 2012, the business community landfilled 81 per cent of the total waste generated. In 2015, that number dropped to 65 per cent.
--- | --- | ---
4. GUIDANCE FOR COMMON CRD WASTE MATERIALS

In most regions, wood (clean, engineered, painted, treated), asphalt roofing and drywall are generated in particularly large volumes. This section focuses on policies that are best suited to reducing and diverting these materials. Each of the materials is described in Appendix B and summarized in Figure 14.

Figure 14 Common CRD waste materials and the respective ease of diversion in most regions

Most of the CRD waste management policies described in Section 3 can be applied to almost any target material - or to all CRD waste at once. So, it follows that when waste diversion policies are being considered for one specific target CRD waste material, it is likely that others will be affected as well. Therefore, while this section is focused on a few specific materials, it is possible that the approaches described may work for other materials with similar waste management characteristics (ease of diversion, presence of functioning markets, etc.).

For each material, this section provides:

- A description of the waste material and a discussion about available recycling capacity / infrastructure and markets for end products,
- An overview of the policy considerations,
- A description of relevant goals, levers and approaches and, finally,
- Offers a few examples of relevant policies (where possible) as illustrations.
4.1. Policy approaches for clean wood waste

Clean wood (also known as white wood) is not treated with chemicals (e.g. for pressure treatment), paint or other coatings. It includes solid wood, lumber, and pallets that are unpainted, unstained, untreated, and free of glue. CRD waste is mostly comprised of off-cuts, scraps, wood chips and sawdust from new construction and renovation as well as whole and part boards from renovation and demolition. The wood may be pierced with nails or other metal fasteners, such as screws and staples. Some processing facilities delineate between different grades of clean wood waste, for example:

- **Clean wood (#1 Grade)** – Dimensional lumber, pallets, wood panel products in limited quantities and other clean wood.
- **Clean wood (#2 Grade)** – Cedar (new/old), logs, sawdust, medium density panel board, forming wood without adhering concrete or aggregate, new or weathered clean wood, and disassembled cable reels without bolts or plates.
- **Green waste** - Clean land-clearing waste such as brush and small branches.

The value of clean wood waste varies by location, market conditions and the available supply. In most regions, there are markets for:

- Framing wood, and structural members can be recovered for resale,
- Re-milled wood beams can be used in structural and aesthetic applications,
- Chips for panel products (e.g. particle board),
- Landscape mulch and compost amender,
- Erosion control on construction sites,
- Livestock bedding,
- Land-clearing and green waste can be composted.

Although there are many uses for clean wood waste, the challenge can sometimes be in creating functional / economically sustainable markets. The presence and maturity of markets for clean wood waste varies across the country. Most large urban centres are well equipped with a range of market options. In this case, policy approaches should focus on improving the quality, consistency and value of the wood waste stream (for example, establishing higher value markets than for hog fuel). Indeed, the production of low-value products, such as alternative daily landfill cover, is able to consume a large percentage of the wood waste stream, but is energy / GHG intensive, commands a low dollar value and is ecologically only marginally preferable to landfilling. There are also many markets that may need financial support to develop sufficient capacity to process the volumes of waste generated. Small or remote communities may have to first invest in wood waste processing infrastructure and in establishing markets (see Section 3.7).

Given the quantities of CRD wood waste generated, end market opportunities exist in most jurisdictions for wood-derived fuel sources in industrial processes such as cement kilns. This can play a role in replacing high-carbon fuels for industrial processes, which can contribute to an industrial GHG reduction strategy.

However, energy recovery is the lowest level solution on the waste management hierarchy (see Section 2.2) and should be considered a “last resort” for CRD waste that might otherwise command a higher value as a feedstock for industrial, agricultural or other markets. Policymakers should consider this approach carefully because policies that promote WtE as an end-market to drive CRD wood waste diversion may inadvertently capture materials being recycled for beneficial use.
and undermine the waste hierarchy. Ideally, Waste to Energy is used in regions that have deployed all other efforts to reduce, reuse and recycle and have achieved high rates of diversion (greater than 50 per cent).

Currently, large volumes of CRD wood waste cannot be diverted because it are commingled with other materials and contaminants or is in such poor condition that the cost of processing and cleaning limits the economic viability of processing and reusing the material. Policy approaches should focus on improving the quality and consistency of clean wood waste, ensuring that sorting, handling and processing facilities are accessible and adequate. Where markets exist for clean wood waste, the policy approach should concentrate on limiting disposal options and enabling diversion for clean wood waste.

To address the large amounts of clean wood waste that are generated from new construction, renovation and demolition, requires a change in business approach. In the future, waste reduction policies could be considered that align building design requirements to re-use clean wood products more efficiently and use products containing processed clean wood waste (refer to Design for the Environment described in Section 2.5), and encourage designers to scale their projects to suit standard lumber dimensions and/or to prefabricate building elements off-site.

Selected policies for dealing with clean wood waste

1. CRD waste bans and surcharges

Clean wood waste bans are in effect in several Canadian regions and are generally working well. Waste bans send a strong signal to the market that there will be a certain volume of supply for processing and volume of processed material available to end-users, thereby stimulating investment in processing infrastructure.

2. Deconstruction standards

Deconstruction standards can help to improve the quality of the waste stream and reduce the potential for contamination. This improves the marketability of the recovered materials as well as processing efficiency and effectiveness of the recovered materials. For example, although there are many de-nailing technologies available, some facilities currently refuse to accept nails and screws. This can be a major barrier to clean wood end user markets. Financial assistance and/or public investment may be necessary to bridge the gap.

3. Invest in infrastructure

A variety of markets exist for clean wood waste and therefore a multi-pronged approach to market support may be appropriate that includes ensuring adequate processing capacity is available and market support (e.g. the creation of online trading centres and materials exchanges).
**Example: Clean Wood Waste Ban: Regional District of Nanaimo (RDN)**

In January 2008, in accordance with the RDN’s Zero Waste Plan (2004) and the Construction/Demolition Waste Diversion Strategy (2007), the Region introduced a landfill ban on the disposal of clean wood waste. This ban was developed and implemented in collaboration with waste haulers, wood waste generators and licensed private processing facilities. This collaborative approach ensured that all stakeholders had advance notice of this important zero waste initiative.

Enforcement consisted of load inspections and surcharges at disposal facilities by landfill staff as well as on-site education and compliance checks by the RDN staff. The wood waste ban provided a cost-effective way for the Region to divert clean wood waste. As a regulator, the Region did not provide any capital investment for the processing of clean wood waste, as these costs were borne by the private sector.

In 2008, as a result of the ban, landfill disposal of wood waste was reduced by 87 per cent. Licensed facilities in the region also reported receiving and processing 23,500 tonnes of clean wood waste or 161kg per capita. Although this amount was reduced in following years due to the economic slow-down, in 2012, licensed facilities still processed 14,898 tonnes or 98 kg per capita.

**Example: City of Vancouver voluntary advanced deconstruction permit**

About 900 homes are demolished in Vancouver each year. The City estimates that one and two family home demolitions are the single largest source of wood waste generated, and have lower diversion rates than larger buildings. Prior to the establishment of the voluntary advanced deconstruction permit, the Development Permit process for one and two family homes included no incentive for contractors to take the time necessary to remove the home through deconstruction.

Now, a building permit for deconstruction can be obtained prior to issuance of a development permit, providing the applicant demonstrates intent to undertake deconstruction. The applicant must commit to completing a compliance report detailing diversion rates, provide copies of receipts from receiving facilities and apply for a Development Permit.

The City defines deconstruction as: “Systematic disassembly of a building resulting in the reuse, recycling or recovery of not less than 75 per cent of all building materials, excluding materials which are hazardous or banned from landfill.” (July 2011 Environment Policy Report to City Council). Within the first two years of implementing the advanced permit process, 12 Deconstruction Permits were issued, with reported diversion rates ranging from 86 per cent to 91 per cent per deconstruction project.
Example: Building Product Re-Use Centres

There are more than 95 ReStore building supply stores run by Habitat for Humanity affiliates in Canada. ReStores accept and resell quality new and used building materials, such as windows, doors, paint, hardware, lumber, tools, lighting fixtures, furniture and appliances. Some ReStores also offer pick up and deconstruction services for property owners, who may receive a tax receipt for the value of salvaged items. 

The ReBuilding Center was set up in Portland, Oregon (population 600,000) in 1998 to offer deconstruction services, which, on average, salvage 85 per cent of a typical wood frame house. Used building and remodelling materials are sold retail and wholesale. The Center also offers workshops and classes on how to work with used building materials. The Center was founded on government grants, private donations and volunteer support but is now a successful financially self-sustaining social enterprise. 

Success for these stores is highly dependent on location. Research shows that locating material drop-off locations at the entrance to waste disposal, transfer and/or major recycling facilities, drives the drop-off rate dramatically higher. For example, there are two building material reuse stores in Metro Vancouver that generate $1.2 million in annual revenues (or about $600,000 each) and serve a population of almost 2 million people. Neither of their stores is located at a disposal, transfer or recycling centre. By comparison, the small town of Whistler has situated its re-use store right at the recycling depot and that store’s revenues are over $1,000,000 for a population of 10,000 people. The reuse store revenue per capita in Whistler is over 100 times greater than in Vancouver because it is so easy for people to drop off their reusable materials despite the fact that the Whistler reuse store has less than 1/10th of the selling space of the Vancouver ReStores.

4.2. Policy approaches for engineered wood waste

Engineered (composite) wood refers to manufactured plywood, particleboard, medium-density fibreboard (MDF), oriented strand board (OSB), veneers, glu-lam beams, etc., which may include nails, metal plates, glues and other chemicals. Significant quantities are generated from new construction, renovation and demolition.

The markets for engineered wood are mostly similar to clean wood. In most regions, there are markets for:

- Some re-use value through deconstruction.
- Most engineered wood is generally accepted by CRD facilities where it can be de-nailed and processed into chips
- Some markets accept composite wood mixed with clean wood for animal bedding.
- Plywood, particleboard and OSB can be composted.
- Some plastic-wood composites may be recycled.

Because diversion process and end user markets for engineered wood are similar clean wood, the policy goals and priorities are also similar. Therefore the policy approaches and examples provided for clean wood waste in Section 4.1 may also be applied to engineered wood.
4.3. Policy approaches for painted wood waste

Painted wood contains a coating (e.g. paint, varnish, sealer, stain) applied onto or impregnated into clean, engineered or treated wood. It includes trim, doors, cabinets, flooring, some siding, balustrades, baseboards. The largest quantities of painted wood come from demolition and renovation although some off-cuts, ends and scrap are generated from new construction and renovation.

Market options depend on the coating. Some painted wood may contain hazardous or toxic substances and, because it may be difficult to test the type of paint, it is usually not possible to divert from landfill. Painted wood recycling and re-use markets also depend on the wood substrate (i.e. clean, engineered, treated). Nevertheless, some markets may allow a small amount of painted wood to be incorporated into clean wood waste processing (e.g. Waste to Energy facilities, animal bedding). Also, stripping out high value painted wood items (trim, mouldings, etc.) prior to demolition for re-use comprises a very small portion of the waste stream.

With growing awareness of the importance of indoor environmental quality in buildings, more low or non-toxic paint is being used, which may make it easier for facilities to accept painted wood waste over time. Governments can take a leadership approach in the use of new healthy paints and coatings via public procurement policies.

In the future, policies that address building design could also be considered so that wood elements in buildings can be protected without the need for difficult-to-dispose-of paints and coatings.

Because painted wood is so difficult to divert, alternative upstream solutions may be considered to reduce the volumes of waste generated. For example, pre-fabrication (e.g. trusses and panelized walls) and modular construction can greatly reduce waste quantities of all types of wood. If planned for, it can also allow for easy disassembly and re-use of large components, even entire buildings. As codes shift to increasingly energy efficient and airtight buildings, pre-fabrication will become increasingly common. “Lean construction” techniques are also emerging, which focus on construction process efficiency and highlights how waste (materials, labour) eats into the contractor’s profit margin.

Selected policies for dealing with painted wood waste

1. Transportation requirements

In most regions, opportunities for diverting painted wood waste from landfill are extremely limited. The most important policy goal is therefore to ensure that painted wood waste is taken to the appropriate facility and disposed of safely. Many regions operate some form of licensing scheme for haulers however the standards and forms of compliance vary.

2. Invest in infrastructure

There are only a very few markets for painted wood waste. These are primarily focused on high value “architectural salvage” for which functioning markets exist. There are also a few WtE plants that can take a small amount of painted wood waste. Research into new processing technologies and potential markets is also necessary to develop markets for the materials that can be recovered from painted wood waste. At the same time, efforts may need to be applied to finding new ways to reduce the volumes of painted wood waste being generated and encourage the use of alternative environmentally benign paints and coatings.
Example: Halifax Regional Municipality, Nova Scotia transportation restrictions
Described in Section 3.2.2.

Example: DivertNS R&D funding
DivertNS offers R&D funding support for companies to conduct research into new and more efficient ways to divert CRD and other solid waste from disposal. Research projects can be related to materials or products that incorporate solid waste resources; technologies that will facilitate the separation and recovery of solid waste resources; and market opportunities for solid waste resources and/or recycled materials (more details provided in Section 3.5.1).

4.4. Policy approaches for treated wood waste

Treated wood refers to wood that is pressure treated or coated with wood preservatives to protect it against decay, mould, and insects. It includes fencing and wood for exterior applications, marine pilings, railway ties and products that has been treated with stains or preservatives. The largest quantities are generated from demolition and renovation although some off-cuts, ends and scrap may be generated from new construction and renovation.

Wood treated with “safer” modern preservatives or, sometimes, with creosote (in small amounts) may be accepted by recycling facilities. However, some wood preservatives may contain hazardous or toxic substances, such as arsenic and chromium and it is typically not easy distinguish safer types of treated wood from the older types of treated wood that contained toxic chemicals.

In most regions, although the composition of treated wood is different than for painted wood, the policy goals and priorities are similar. Paints, coatings and preservatives can all contain chemicals that may need to be handled carefully and disposed of safely. Therefore, similar to painted wood waste described in Section 4.3, options for diverting treated wood waste from landfill are extremely limited. It is important to build awareness and capacity to deal with treated wood correctly. However, there are a few solutions for a very small amount of the total volume generated. Any recycling facilities that may accept treated wood will require it to be tested for toxic substances prior to acceptance. Depending on quality, some materials may be deemed worthy of removal for sale. Also, a few landfills accept treated wood as daily cover. Treated wood that does not contain CCA or creosote may be accepted (in small amounts) by WtE facilities.

Selected policies for dealing with treated wood waste

1. Extended Producer Responsibility (EPR)

Disposing of painted or treated wood waste can be expensive. The application of eco-fees on the sale of clearly labelled products and/or the implementation of an EPR program for products are difficult to dispose of can help cover the cost of managing them at end of life. A few governments operate EPR for paint products and the application of EPR to CRD materials is expected to expand. CRD materials are identified under CCME’s Canada-wide Action Plan for Extended Producer Responsibility for incorporation into operational EPR programs. Although there appears to be no specific examples, revenues collected from paint EPR programs could be allocated towards the cost of dealing with painted wood waste.
2. Differential tipping fees

Where diversion solutions exist, differential tipping fees could be used to encourage generators to take treated wood waste to the appropriate facility. Note that there are very few facilities that accept treated wood waste in Canada, and those that do, generally only take a very small amount.

Example: New South Wales EPR for treated wood

In New South Wales, Australia, CCA-treated timber is a priority waste on its Extended Producer Responsibility list. A protocol has been developed that describes the assessment, handling, transportation, processing, dealing with processing residues etc. for utility poles and wooden bridges.\(^{145}\)

Example: Enerkem Westbury Waste to Energy plant

Enerkem Westbury is a demonstration plant located in a rural area in Alberta, near a sawmill that recycles used electricity and telephone poles and railway ties. Enerkem converts the non-usable portion of these poles, as well as other waste materials, into clean fuels (syngas, methanol, ethanol) and green chemicals. Annual capacity is 5 million litres per year (methanol).\(^{146}\)

Example: Québec treated wood recycling

Serving Québec, Ontario and Manitoba, Les Industries JPB\(^{147}\) collects waste treated wood products from railways, electric power plants, road transportation, construction and telecommunications installation and processes into posts for framing, electricity pylons and other dimensional products. End products can be used in retaining walls, temporary bridge decks, crash barriers for roads and highways and bearing pads for excavation equipment.

4.5. Policy approaches for asphalt roofing waste

Roofing shingles and asphalt sheeting are made from fiberglass or organic backing, asphalt cement, sand-like aggregate and mineral fillers. Large quantities are generated from demolition and renovation, and, frequently, there is significant scrap from new construction. However, once installed, asphalt shingles cannot be removed from a building and re-used in construction.

Many provinces have an excellent record at reusing asphalt paving in road construction: for example, in Ontario, it is almost 100 per cent reused.\(^{148}\) However, due to processing standards, asphalt from building-related CRD waste typically has a lower recovery rate and is often rejected as unclean because it can be contaminated with other products and some may contain asbestos.\(^{149}\) Nevertheless, technology exists to recycle 100 per cent of asphalt shingles for sale as additive for paving or kiln fuel (Figure 15).
State of the art shingle processing equipment can recycle 100 per cent of residential asphalt shingles, either roof tear-off shingles (TOS) or manufacturer remnants. Nails are removed automatically with a magnetized separator, collected and recycled.

The final products manufactured are then delivered for end uses:

- Manufactured Shingle Additive (MSA) is a homogeneous product comprised of asphalt cement and shingle grit. It is used in paving materials such as hot mix asphalt (HMA), cold patch mix asphalt, aggregate substitute, base course, mineral filler and granular base stabilizer. It can be used to pave roadways, parking lots, bike paths and driveways. Higher quality, more durable and costs less than pavement containing only virgin asphalt cement. However, the use of shingles in hot mix asphalt may be limited due to pavement/engineering standards.

- Shingles are often used in Process Engineered Fuel (PEF), which is a homogeneous, oil saturated fibrous flake for industrial burners such as cement kilns (grit removed). This solution requires less sorting than for HMA.

- Granular grit portion of shingles can be used for landfill site pads and roads, pavement and trails project.

Although processing asphalt shingles is more complex than for some other materials, it can be economically viable. Processing facilities for asphalt roofing exist in most major urban centres, but recycling can be challenging in other parts of the country due to lack of infrastructure. Where markets do exist, they may need support to develop sufficient capacity to process the volumes of waste generated. In small markets without processing facilities, hauling waste materials long distances may be hard to justify economically (see Section 3.7). A survey of the state of asphalt roofing recycling in Canada was completed by the Athena Institute for Natural Resources Canada in 2006.

Given that effective recycling technologies exist, the primary policy goal when dealing with asphalt roofing waste is to limit disposal options (e.g. via transportation requirements, waste disposal bans) and enable diversion (by providing access to processing facilities) and then ensuring that facilities are operating state of the art equipment.

End user markets may need to be established and functional so they can absorb the processed materials. This means that for some regions, the most effective policies may be focussed on the creation of new facilities and infrastructure with...
support from a combination of financial strategies (such as differential tipping fees) to ensure the materials go to the right place, are processed to the quality expected by end user markets and that those markets are economically viable.

To address the large volume of asphalt roofing waste, policies that incentivize waste generators early in the project to consider downstream impacts (e.g. by using alternate products or approaches, incurring an up-front fee, etc.) may be important in combination with policies that could help to develop more processing facilities. So, although there are no Extended Producer Responsibility (EPR) programs or waste disposal bans in operation in Canada for asphalt roofing, both of these policy approaches are being considered by several governments.

Selected policies for dealing with asphalt roofing waste

1. Requirements for waste management plans

Waste management plans can be required of generators that specify target materials to be diverted. Governments can stipulate minimum diversion rates for target materials such as asphalt roofing. Data gathered from the administration of waste management plans can be used for benchmarking, monitoring and reporting.

2. Investment in infrastructure in combination with differential tipping fees

Establishing differential tipping fees and charges in combination with new investments in infrastructure is an important policy approach that can help to drive target materials to the facility and therefore help the facility be economically viable. Revenues from the fees and charges can also contribute to capital investment costs as well as education programs to build market awareness.

Example: City of Port Moody, BC waste management plan requirement

The City of Port Moody requires the completion of a waste management plan that lists all potential materials (including asphalt shingles which are recyclable in the region) as part of both Building Permit Applications and Demolition Permit Applications. Within 90 days of project completion a compliance report should be submitted demonstrating that at least 70 per cent of recyclable material is diverted to licensed processing facilities.

Example: City of Edmonton’s new CRD recycling facility with associated differential fees and charges

The City of Edmonton opened a voluntary CRD recycling facility in 2012 that accepts and segregates wood, drywall, asphalt shingles, flooring material, asphalt and concrete below 80 cm for $60/tonne. Pre-sorted loads of asphalt shingles are charged at the reduced rate of $40/tonne (as are pre-sorted wood and drywall loads).

Example: DivertNS Asphalt Shingles Aggregate Pilot Project

The Nova Scotia Resource Recovery Fund Board (RRFB) – now DivertNS - sponsored the 2006 Asphalt Shingles Aggregate Pilot Project conducted by the District of Lunenburg which investigated the use of a product created from discarded asphalt shingles mixed with aggregate as a potential trail resurfacing material.
4.6. Policy approaches for drywall waste

Also called gypsum, plasterboard, sheetrock, gyproc, and wallboard, drywall waste comprises gypsum (94 per cent), paper backing (6 per cent) and may contain screws, and fasteners (metal content of drywall amounts to less than 1 per cent of the total). Clean waste drywall that is commonly accepted by processing facilities comprises board material, non-hazardous strip-out plasterboard products, plaster blocks and construction off-cuts.

Clean drywall scrap is generated primarily from renovation and new construction. Processing facilities for clean drywall exist in most major urban centres and will usually take for scrap from new installation that is without paint, wallpaper, tape, nails, screws, corner bead, etc. Clean drywall waste can be made into new drywall products easily and most manufacturers have now established systems for re-processing. The gypsum and paper together can also be used as a soil amendment in the agricultural sector to make animal bedding and as an additive at composting facilities. The backing paper can be made into low-grade paper products. In fact, it is possible to recycle 100 per cent of drywall waste into useful products.

Challenges to drywall recycling are primarily related to the potential for contamination. By far, the largest volumes of drywall come from demolition but markets for demolition drywall can be very selective. This is because it may be mixed with (or attached to) other materials. Common contaminants include wood, paint, wallpaper, ceramic tile, presence of electrical outlets and wiring, etc. Also, prior to the 1980’s, the tape and joint compound (“mud”) used to seal the seams and fill gaps between drywall boards sometimes contained asbestos. Drywall from renovation and demolition projects should be tested in accordance with applicable legal requirements prior to determining the appropriate course of action.

Where recycling facilities exist, drywall is a straightforward product to deal with. Modern, efficient facilities exist in most urban locations in Canada (Oakville, Ontario; New Westminster, BC; Calgary, Alberta, etc.). However, drywall recycling can be challenging in many parts of the country due to lack of infrastructure. Where markets do exist, support is often necessary to develop sufficient capacity to process the volumes of waste generated. Although there are no examples of Extended Producer Responsibility (EPR) programs being used for drywall yet, several governments are considering it for the future as it can help to develop more processing facilities. In fact, some recycling facilities have already established agreements with drywall manufacturers in order to secure a strong supply and demand for the gypsum material.

Co-location of recycling facilities with manufacturing plants can significantly boost the business case for recycling. Also, although virgin materials levies are not in use in Canada yet, they may be another financial tool to shift the market into re-using gypsum in new drywall products.

Drywall installation can be a wasteful business because drywall is a very cheap building material compared with the labour required to install it. In the future, policies that encourage modern and efficient methods of construction (e.g. prefabrication) may help to reduce the volume of drywall waste.

Selected policies for dealing with drywall waste

1. Waste disposal bans, surcharges and limits

It is important to keep drywall out of landfills. Landfill disposal of drywall (including use as daily landfill cover) should be avoided because it releases hydrogen sulfide gas under wet anaerobic conditions, which could pose hazards to human health and the environment. Therefore, the primary policy goal for drywall waste is to limit disposal options (e.g. via hauler licenses, waste disposal bans) and enable diversion (by providing access to processing facilities) and then ensuring
that facilities are operating state of the art equipment. This means that for some regions, the most effective policies should be focussed on the creation of new facilities and infrastructure (Section 3.5.1) with support from transportation requirements (Section 3.2.2) to ensure the materials go to the right place.

2. Investment in infrastructure in combination with differential tipping fees

Establishing differential fees and charges in combination with new investments in infrastructure is an important policy approach that can help to drive target materials to the facility and therefore help the facility be economically viable.

Example: Metro Vancouver drywall disposal ban and differential tipping fees

The majority of regional districts in BC have banned drywall from landfills. Metro Vancouver imposes a $50 minimum surcharge, plus the potential cost of removal, clean-up or remediation on loads containing banned hazardous and operational impact materials or product stewardship materials. A surcharge of 50 per cent of the tipping fee on the entire load is applied to loads containing banned recyclable materials (e.g. clean wood and drywall).\textsuperscript{156}
5. APPENDICES
Appendix A: Full list of CRD waste management policy options

In order to develop the shortlist of fourteen policies for this guide (presented in Section 3), a long list of examples was identified that draws on best practices around the world, some of which are in the earliest stage of development. It is a summary of what is possible not what is currently in practice in Canada because many fall outside most governments’ mandates today.

<table>
<thead>
<tr>
<th>POLICY TYPE</th>
<th>POLICY TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations</td>
<td></td>
</tr>
</tbody>
</table>
| 1. Performance-based standards | • Mandatory waste diversion performance (overall or for specific materials) to be demonstrated prior to issuance of building permit for demolition or occupancy permit for new construction.  
• “Zero-waste” goals and policies designed to minimize the volumes of CRD waste generated.  
• Landfill bans for CRD waste (overall or for specific materials with highest diversion potential or where alternatives exist).  
• Onsite disposal (fill) limits.  
• “Outcome-based” building codes with mandatory sustainability & CRD waste diversion standards (e.g. green building certification, durability, climate-appropriate, minimum requirements for the use of materials with reused/recycled content in new projects, minimum CRD waste diversion, etc.).  
• Legislation that promotes renovation and adaptability (e.g. mandatory preservation / renovation of high value/heritage buildings).  
• Land use policy and policies describing desired building form, function and character can encourage certain building types and uses (e.g. to locate an industrial consumer of wood waste close to a MRF) or prohibit certain building types and designs in high-risk locations to minimize premature repair / replacement.  
• Permits and licences for haulers, landfill operators and processing facilities.  
• Limitations on transport (avoid taking to lower cost jurisdiction).  
• Regulations that prohibit, restrict or require the use of certain materials.  
• Mandatory extended producer responsibility (EPR) or product “take back” programs.  |
| 2. Design, process or technology standards | • Mandatory plans / narratives describing strategies for CRD waste management, diversion, deconstruction, zero waste / disassembly.  
• “Prescriptive” building codes (functional-based building codes, form-based codes) that stipulate desired practices and processes.  
• Mandatory recycling and source separation (including the use of specified demolition / deconstruction processes).  |
<table>
<thead>
<tr>
<th>POLICY TYPE</th>
<th>POLICY TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Requirements to use specific facilities and/or service providers.</td>
<td></td>
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<tr>
<td>• Require compliance with durability plans and standards (e.g. CSA S478-95 (R2007) &quot;Guidelines on Durability in Buildings&quot;).</td>
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</tr>
<tr>
<td>• Compliance with technical standards for reused/recycled materials (establishment of “end-of-waste” criteria).</td>
<td></td>
</tr>
</tbody>
</table>

**Market approaches**

| 3. Taxes, fees and charges | • Tipping fees, levies or landfill taxes (can be used to fund programs). |
| • Fines. |
| • Front-end levies or fees (virgin materials, priority CRD materials, eco-fees on materials that are difficult to divert). |

| 4. Subsidies and incentives | • Reduced fee benefits (e.g. building permit fees, development cost charges). |
| • Process / approval benefits (e.g. density bonus, expedited plan review, expedited permitting, demolition prohibited until building permit for new building approved). |
| • Tax credits/ receipts (as deconstruction incentives for donating used materials). |
| • Government-backed insurance. |
| • Grants, subsidies, financing or preferential loans for owners to maintain / upgrade existing buildings (rather than demolition), for companies and facilities providing diversion services (e.g. training, capital cost, R&D), etc. |

| 5. Combinations | • Deposit-refund on building permits (e.g. based on waste reduction or diversion target). |
| • Standard-price combinations (e.g. targets backed by fees or deposits). |

| 6. Direct public sector investment | • Investment in infrastructure and service-provision (e.g. public-private sector processing facility, reuse centres, expanded drop-offs, waste to energy options, right-sized recycling receptacles, pick up services). |
| • Research and development (e.g. Developing new uses for recycled CRD wastes, Lifecycle analysis). |
| • Pilot and demonstration projects. |

| 7. Tradable assets | • Tradable supplier obligations and responsibilities notes. |

<p>| 8. Information disclosure | • Waste diversion performance reports (project, business, landfill, MRF). |
| • Notification and registration of waste transports. |</p>
<table>
<thead>
<tr>
<th>POLICY TYPE</th>
<th>POLICY TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary approaches</td>
<td></td>
</tr>
<tr>
<td>9. <strong>Information, guidance and recognition</strong></td>
<td>• Moral suasion diversion campaigns (e.g. Zero Waste).</td>
</tr>
<tr>
<td>(Including outreach)</td>
<td>• Public outreach and education.</td>
</tr>
<tr>
<td></td>
<td>• Promote alternate models (e.g. Cradle to cradle, Closed-loop construction, circular economy, dematerialization, modern methods of construction, durability).</td>
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<tr>
<td></td>
<td>• Promote and provide databases of lifecycle assessment of materials, assemblies and structures.</td>
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<tr>
<td></td>
<td>• Competition and awards.</td>
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<tr>
<td></td>
<td>• Deconstruction &amp; salvage guidelines and case studies.</td>
</tr>
<tr>
<td></td>
<td>• Waste management tools (CWM plan templates, on-line tracking and reporting systems).</td>
</tr>
<tr>
<td></td>
<td>• Building design tools (catalogues of product and assemblies, directories of service providers, master specifications and templates).</td>
</tr>
<tr>
<td></td>
<td>• Guidelines for preserving heritage and cultural important buildings.</td>
</tr>
<tr>
<td></td>
<td>• Benchmarking, data gathering and reporting frameworks.</td>
</tr>
<tr>
<td>10. <strong>Assistance, training and other business</strong></td>
<td>• Training and capacity building for industry (e.g. Job site training and recycling programs, deconstruction, etc.).</td>
</tr>
<tr>
<td>supports</td>
<td>• Technical assistance (e.g. lifecycle assessment, technology assessment, green building).</td>
</tr>
<tr>
<td></td>
<td>• Enable reuse (waste exchange program, free CW collection @ builders’ supplies stores, free/subsidized pick-up from sites).</td>
</tr>
<tr>
<td>11. <strong>Voluntary plans, goals</strong></td>
<td>• Industry-government MOUs.</td>
</tr>
<tr>
<td></td>
<td>• Industry leadership and self-managed programs (stretch goals).</td>
</tr>
<tr>
<td></td>
<td>• Waste management, diversion, salvage and/or disassembly plans (non-binding).</td>
</tr>
<tr>
<td>12. <strong>Labelling and certification</strong></td>
<td>• Product certification and labelling schemes (e.g. Environmental choice label, Environmental Product Declarations).</td>
</tr>
<tr>
<td></td>
<td>• Life-Cycle assessment (LCA) of building materials, assemblies and structures.</td>
</tr>
<tr>
<td></td>
<td>• Green building rating systems.</td>
</tr>
<tr>
<td>13. <strong>Government leadership</strong></td>
<td>• Waste policies.</td>
</tr>
<tr>
<td></td>
<td>• Emergency / natural disaster planning.</td>
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<tr>
<td></td>
<td>• Sustainable procurement policies &amp; regulations that promote the use of recycled building materials and require high diversion on public projects (e.g. through green procurement specifications such as building certifications (e.g. LEED, BOMA BES)) , green building codes and other standards).</td>
</tr>
<tr>
<td>POLICY TYPE</td>
<td>POLICY TOOLS</td>
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<tr>
<td>Cross cutting</td>
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<tr>
<td>14. Zero Waste goals</td>
<td>• Zero waste goals address environmental impacts acting across the whole material chain and therefore can be brought to bear on the building design process as well as construction and end-of-life.</td>
</tr>
<tr>
<td>15. EPR approaches</td>
<td>• Depending on the approach, EPR and “chain of custody” strategies can use all four of the policy categories noted above: they may be voluntary or mandatory.</td>
</tr>
</tbody>
</table>
Appendix B: Key CRD materials, recycling and re-use markets and considerations for diversion

<table>
<thead>
<tr>
<th>Description and sources</th>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Architectural salvage, high value items</td>
<td>There is high demand for good quality antique or vintage architectural salvage. Many demolition contractors will remove these items prior to demolition and for sale through established channels. There are numerous online markets for architectural salvage. Re-use centres (such as Habitat for Humanity’s Restores) are present in many urban centres and will take a wide range of salvaged products. Equipment and appliances that are in good working order (and safe to use) can be re-sold. Established markets exist across the country in the form of antique stores, re-use centres and online. Collection points at transfer stations or CRD waste facilities can help to divert saleable items to re-use centres. Where they exist, some re-use centres offer “house-stripping” services whereby high value items are carefully removed prior to demolition.</td>
<td>High value</td>
</tr>
<tr>
<td>Architectural salvage (balustrades, doors, mantels, plumbing fixtures, decorative features), wood or steel beams and columns, equipment and appliances, furniture, etc. Sources: • High value items come from renovation or demolition – especially of “character” buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Wood (40% total CRD waste stream by weight) a. Clean Wood (49% of total wood waste)</td>
<td>The value of clean wood varies by location, market conditions and the available supply. In most regions, there are markets for: • Framing wood, and structural members can be recovered for resale, • Re-milled wood beams can be used in structural and aesthetic applications, • Chips for panel products (e.g. particle board), • Landscape mulch and compost amender, • Erosion control on construction sites, • Livestock bedding, • Land-clearing and green waste can be composted. There are many uses for clean wood waste, however the challenge can sometimes be in creating functional / economically sustainable markets. Markets that do exist may need support to develop sufficient capacity to process the volumes of waste generated. The end uses for CRD waste wood are sometimes limited because the wood is commingled with other materials and contaminants or is in such poor condition that the cost of processing and cleaning limits the economic viability of processing and reusing the material.</td>
<td>Simple to divert</td>
</tr>
<tr>
<td>Clean wood (also known as white wood) is not treated with chemicals (e.g. for pressure treatment), paint or other coatings. It includes solid wood, lumber, and pallets that are unpainted, unstained, untreated, and free of glue. The wood may be pierced with nails or other metal fasteners, such as screws and staples. Some facilities delineate between different grades of clean wood waste, for example: Clean wood (#1 Grade) – Dimensional lumber, pallets, wood panel products in limited quantities and other clean wood. Clean wood (#2 Grade) – Cedar (new/old), logs,</td>
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<table>
<thead>
<tr>
<th>Description and sources</th>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>sawdust, medium density panel board, forming wood without adhering concrete or aggregate, new or weathered clean wood, and disassembled cable reels without bolts or plates. <strong>Green waste</strong> - Clean land-clearing waste such as brush and small branches. <strong>Sources:</strong></td>
<td>The markets for engineered wood are mostly similar to clean wood. In most regions, there are markets for:  - Some re-use value through deconstruction.  - Most engineered wood is generally accepted by CRD facilities where it can be de-nailed and processed into chips  - Some markets accept composite wood with clean wood in animal bedding.  - Plywood, particleboard and OSB can be composted.  - Some plastic-wood composites may be recycled.</td>
<td>Note:  - Some facilities refuse nails &amp; screws.  - Some facilities refuse large land clearing waste such as stumps, large branches, root balls, etc.  - The production of low-value products, such as alternative daily landfill cover, is able to consume a large percentage of the wood waste stream, but is energy / GHG intensive, commands a low dollar value and is ecologically only marginally preferable to landfiling.  - Formwork rental can reduce plywood waste significantly.  - Acceptable contamination levels vary by facility, but are generally less than 10 per cent.</td>
</tr>
</tbody>
</table>

<p>| b. Engineered (Composite) Wood (23% of total wood waste) | Simple to divert | |
| Engineered (composite) wood refers to manufactured plywood, particleboard, medium-density fibreboard (MDF), oriented strand board (OSB), veneers, glu-lam beams, etc., which may include nails, metal plates, glues and other chemicals. <strong>Sources:</strong> | See clean wood waste. | |</p>
<table>
<thead>
<tr>
<th>Description and sources</th>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>c. Painted Wood (20% of total wood waste)</strong></td>
<td>Painted wood contains a coating (e.g. paint, varnish, sealer, stain) applied onto or impregnated into clean, engineered or treated wood. It includes: Trim, doors, cabinets, flooring, some siding, balustrades, baseboards.</td>
<td>Limited options</td>
</tr>
<tr>
<td><strong>Sources</strong></td>
<td>Market options depend on the coating. Some painted wood may contain hazardous or toxic substances and, because it may be difficult to test the type of paint, it is usually not possible to divert from landfill.</td>
<td>Stripping out high value painted wood items (trim, mouldings, etc.) prior to demolition for re-use comprises a very small portion of the waste stream. Mostly, it is not possible to divert painted wood waste from landfill.</td>
</tr>
<tr>
<td>• The largest quantities come from demolition and renovation.</td>
<td>• Painted wood recycling and re-use markets also depend on the wood substrate (i.e. clean, engineered, treated).</td>
<td><strong>Note:</strong></td>
</tr>
<tr>
<td>• Off-cuts, ends and scrap are generated from new construction and renovation.</td>
<td>• Some markets may allow a small amount of painted wood to be incorporated into clean wood waste processing.</td>
<td>• With growing awareness of the importance of indoor environmental quality in buildings, more low or non-toxic paint is being used, which may make it easier for facilities to accept painted wood waste over time.</td>
</tr>
<tr>
<td><strong>d. Treated Wood (8% of total wood waste)</strong></td>
<td>Treated wood refers to wood that is pressure treated or coated with wood preservatives to protect it against decay, mould, and insects. It includes: Fencing and wood for exterior applications, marine pilings, railway ties and products that has been treated with stains or preservatives.</td>
<td>Limited options</td>
</tr>
<tr>
<td><strong>Sources</strong></td>
<td>Wood treated with “safer” modern preservatives or, sometimes, with creosote (in small amounts) may be accepted by recycling facilities. However, some wood preservatives may contain hazardous or toxic substances, such as arsenic and chromium.</td>
<td>In most regions, there are very few (if any) markets for treated wood.</td>
</tr>
<tr>
<td>• The largest quantities are generated from demolition and renovation.</td>
<td>• Depending on quality, some materials may be deemed worthy of removal for sale.</td>
<td><strong>Note:</strong></td>
</tr>
<tr>
<td>• Off-cuts, ends and scrap are generated from new construction and renovation.</td>
<td>• A few landfills accept treated wood as daily cover.</td>
<td>• It is typically not easy distinguish safer types of treated wood from the older types of treated wood that contained toxic chemicals.</td>
</tr>
<tr>
<td></td>
<td>• Treated wood that does not contain CCA or creosote may be accepted by WtE facilities.</td>
<td>• Those recycling facilities that may accept treated wood will usually require it to be tested for toxic substances prior to acceptance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wood treated with chrome, copper, arsenic, and lead. CCA-treated or lead-painted wood is not suitable for WtE or for composting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Regulatory approaches can be used to ensure correct disposal.</td>
</tr>
</tbody>
</table>
### Description and sources

**3. Asphalt Roofing (10% total CRD waste stream)**

Roofing shingles and asphalt sheeting are made from fiberglass or organic backing, asphalt cement, sand-like aggregate and mineral fillers.

**Sources**
- Large quantities are generated from demolition and renovation.
- Frequently, there is significant scrap from new construction.

**Recycling and re-use markets**

While recycling of asphalt paving is well accepted, recycling rates for asphalt shingles are much lower because they can be contaminated with other products and some may contain asbestos. Asphalt shingles, remnants and scrap are ground up with 100 per cent of the constituents re-used in:

- Manufactured Shingle Additive (MSA) in paving materials such as hot mix asphalt (HMA), cold patch mix asphalt, aggregate substitute, base course, mineral filler and granular base stabilizer.
- Shingles are often used in Process Engineered Fuel (PEF) for industrial burners such as cement kilns (grit removed) as this solution requires less sorting than for HMA.
- Granular grit portion of shingles for landfill site pads and roads, pavement and trails project.

**Considerations for diversion**

Processing facilities for asphalt roofing exist in most major urban centres, but recycling can be challenging in other parts of the country due to lack of infrastructure.

Where markets do exist, they may need support to develop sufficient capacity to process the volumes of waste generated.

Hauling waste materials long distances may be hard to justify economically.

**Note:**
- No materials containing asbestos are allowed in processing facilities.
- Metal (nails, flashing, etc.) is usually accepted.
- The use of shingles in HMA may be limited due to pavement/engineering standards.

### Description and sources

**4. Drywall (9% total CRD waste stream)**

Also called gypsum, plasterboard, sheetrock, gyproc, and wallboard.

**Sources**
- Clean scrap is generated from renovation and new construction.
- Large volumes are generated from demolition.

**Recycling and re-use markets**

Drywall is easy to recycle into new drywall products and most manufacturers have now established systems for re-processing. 100 per cent of clean drywall waste can be re-used in new products.

- Gypsum can be used as a soil amendment in the agricultural sector and as an additive at composting facilities.
- The backing paper can be made into low-grade paper products
- Gypsum and paper together are used to make animal bedding.
- Markets for demolition drywall are more selective based on potential for contamination.
- Gypsum board may decompose to hydrogen sulphide gas.

**Considerations for diversion**

Processing facilities for drywall exist in most major urban centres and will usually take for scrap from new installation that is without paint, tape, nails, screws, corner bead, etc.

Markets that do exist may need support to develop sufficient capacity to process the volumes of waste generated.

Drywall recycling can be challenging in other parts of the country due to lack of infrastructure.

Hauling waste materials long distances may be hard to justify economically.

Until about 1990, the tape and joint compound ("mud") used to seal the seams and fill gaps between drywall boards sometimes contained asbestos.
<table>
<thead>
<tr>
<th>Description and sources</th>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>under wet anaerobic conditions, such as in landfill sites. Hydrogen sulphide gas can pose risks to human health and the environment.</td>
<td>Note:</td>
<td>• No drywall containing asbestos is allowed in processing facilities.</td>
</tr>
<tr>
<td>• The gypsum and paper can be accepted at composting facilities, not just the gypsum.</td>
<td>• Drywall attached to other materials (wood, wiring, outlets, etc.) is usually not accepted.</td>
<td>• Painted or wallpapered drywall is usually not acceptable.</td>
</tr>
<tr>
<td>• Some facilities do not accept wet drywall.</td>
<td></td>
<td>• Some facilities do not accept wet drywall.</td>
</tr>
<tr>
<td>5. Concrete (4% total CRD waste stream)</td>
<td>Simple to divert</td>
<td>There are few limitations to recycling fresh or cured concrete. Recycling infrastructure exists in urban centres but may need support to grow and develop, especially in smaller markets to develop sufficient capacity to process the volumes of waste generated.</td>
</tr>
<tr>
<td>Poured in place, pre-cast components, and “cinder” blocks.</td>
<td></td>
<td>A key consideration is providing sufficient space for crushing and grinding equipment.</td>
</tr>
<tr>
<td><strong>Sources</strong></td>
<td></td>
<td>Some types of crushing and grinding equipment are mobile and can be taken to locations likely to generate large quantities of material to create aggregate on site for use as clean fill.</td>
</tr>
<tr>
<td>• Large volumes are generated from demolition and renovation.</td>
<td></td>
<td><strong>Note:</strong></td>
</tr>
<tr>
<td>• There is very limited waste from new construction.</td>
<td></td>
<td>• Concrete containing steel rebar typically should be separated from brick, block and concrete without rebar.</td>
</tr>
<tr>
<td>Fresh (uncured) concrete can be returned to the batch plant. Some plants will use leftover concrete to make blocks and pre-cast modules. Specialist concrete recycling facilities crush cured (dry) concrete (retrieving any reinforcing steel) to make clean fill and aggregate products of various diameters. In some cases, the facilities wash, screen, and sort the crushed concrete in order to use it as input material for new concrete blocks that can be used for retaining walls and other new construction applications.</td>
<td></td>
<td>• The cost of crushing concrete increases with large re-bar components.</td>
</tr>
</tbody>
</table>
### Description and sources

#### 6. Plastics (4% total CRD waste stream)

<table>
<thead>
<tr>
<th>a. Rigid Insulation</th>
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</thead>
<tbody>
<tr>
<td>Polyurethane (PU), polyisocyanurate (PIR, polyiso, or ISO), polystyrene (PS) insulation boards.</td>
<td></td>
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<tr>
<td><strong>Sources</strong></td>
<td></td>
</tr>
<tr>
<td>• Often, there is significant scrap generated from renovation and new construction.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
<th>Complex to divert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markets for foam boards exist but are largely low value:</td>
<td>Recycling facilities and markets are only available in a limited number of locations. Re-use centres (where they exist) may accept whole insulation boards. Insulation board is relatively cheap and re-use may be constrained by limited applicability in building envelope applications where energy performance is increasingly demanding.</td>
<td></td>
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<tr>
<td>• Large clean rigid insulation boards of any type can be removed and re-sold. However, only a few niche markets for salvaged foam boards currently exist.</td>
<td></td>
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</tr>
<tr>
<td>• There are a few green builders who seek out re-used rigid insulation for roofing, etc.</td>
<td></td>
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</tr>
<tr>
<td>• Demolition firms that have worked with the movie industry report potential for reusing a large volume of hard Styrofoam in set construction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Styrofoam can be pressed into dense blocks and up-cycled into new items such as picture frames, crown mouldings, and base boards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Foam insulation can be used as part of the light or heavy fractions and processed as engineered fuels.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycling facilities and markets are only available in a limited number of locations. Re-use centres (where they exist) may accept whole insulation boards. Insulation board is relatively cheap and re-use may be constrained by limited applicability in building envelope applications where energy performance is increasingly demanding.</td>
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</table>

<table>
<thead>
<tr>
<th>b. Carpet</th>
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<tbody>
<tr>
<td>Synthetic carpet (sheet and tile) is generally made of nylon with PVC backing.</td>
<td></td>
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<tr>
<td><strong>Sources</strong></td>
<td></td>
</tr>
<tr>
<td>• Large quantities from replacement, demolition, renovation.</td>
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<tr>
<td>• Significant scrap from new installation. Carpet is the most significant portion, by weight, of the plastics listed.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
<th>Complex to divert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Several manufacturers (particularly in the commercial office sector) accept their own or other carpet for recycling into new carpet.</td>
<td>Recycling facilities and markets are only available in a limited number of locations. Support may be needed to particularly to grow and develop carpet-recycling infrastructure capacity (particularly to include the residential sector and rural locations).</td>
<td></td>
</tr>
<tr>
<td>• Carpet is taken apart into multiple materials which are then recycled separately.</td>
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<td></td>
</tr>
<tr>
<td>• Carpet can also be used in building materials, plastic lumber, cushion stuffing new carpet pad, and auto parts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycling facilities and markets are only available in a limited number of locations. Support may be needed to particularly to grow and develop carpet-recycling infrastructure capacity (particularly to include the residential sector and rural locations).</td>
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</tbody>
</table>

Notes:
- Materials that are mouldy or contain asbestos are not accepted by recyclers.
- Spray foam insulation is difficult to separate from its substrate. It is often not feasible to separate into pieces that are large enough for re-use. Some WtE facilities may take a certain amount of wood / foam mixed materials.
- Some processing facilities will not accept large amounts of adhesive.
### Description and sources

#### Recyclable materials

<table>
<thead>
<tr>
<th>Description</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>c. Plastics #1 - #5</strong></td>
<td></td>
</tr>
<tr>
<td>#1 High-density polyethylene (HDPE) – piping.</td>
<td>Markets are in an early stage of development and not available everywhere. They may need support to address the cost differential between landfilling and disassembly, sorting and transportation as well as ensuring facilities are conveniently located and with sufficient capacity to process the volumes of waste generated.</td>
</tr>
<tr>
<td>#2 Polyethylene terephthalate (PET) - bottles and packaging.</td>
<td>Notes:</td>
</tr>
<tr>
<td>#3 PVC – vinyl doors, windows, piping, flooring.</td>
<td>* Most plastics are not recovered from CRD wastes and are disposed as residue.</td>
</tr>
<tr>
<td>#4 Low-density polyethylene (LDPE) – packaging.</td>
<td>* A major challenge is separation of the different types of plastic and preventing contamination.</td>
</tr>
<tr>
<td>#5 Polypropylene (PP) – piping, furniture.</td>
<td>* Where specific plastics are recovered from CRD waste, they generally do not have a high value, as they are usually not consistent, clean, high quality streams of one resin.</td>
</tr>
</tbody>
</table>

**Sources**

- Small to large quantities are generated from demolition and renovation.
- Small to large quantities come from new construction, depending on feasibility of source separation.

**Solutions for plastics exist in most regions but prices for plastic scrap may vary:**

- All plastics #1-5 can be recycled into new products.
- Plastic scrap should to be carefully sorted to ensure that different types of plastics are not mixed in order to attract the highest market value.
- #2 PET scrap is usually in particular demand because of its versatility in being able to be converted into other consumer products.
- When sold as mixed scrap, plastics generally have either no value (the plastic end markets will accept them but not pay for them, but this is still a benefit to the CRD recycler), or a small value (around $20/tonne). Alternatively, a tipping fee may have to be paid to deliver the scrap to the end market.
- Many plastics (including the difficult-to-recycle products such as laminates) can be converted into an “engineered fuel” for WtE.

**Markets are in an early stage of development and not available everywhere. They may need support to address the cost differential between landfilling and disassembly, sorting and transportation as well as ensuring facilities are conveniently located and with sufficient capacity to process the volumes of waste generated.**

**Notes:**

- Most plastics are not recovered from CRD wastes and are disposed as residue.
- A major challenge is separation of the different types of plastic and preventing contamination.
- Where specific plastics are recovered from CRD waste, they generally do not have a high value, as they are usually not consistent, clean, high quality streams of one resin.

---

### 7. Metals (3% total CRD waste stream)

#### Ferrous Metals

<table>
<thead>
<tr>
<th>Description</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural metalwork, sheet metal, structural and framing steel.</td>
<td>Markets for metals are well established across the country.</td>
</tr>
</tbody>
</table>

**Sources**

- Framing scrap comes from new construction and renovation.
- Re-bar may be extracted from concrete if crushing occurs on site.
- Typically, there is very little structural steel waste from new construction or renovation.

**Metals are valuable and purchased by recycling facilities and scrap markets to be remade into new products:**

- Steel is generally worth in the range of $250/tonne but the value varies depending on general economic conditions, the demand for steel and the available supply.
- Because of its value, metal is frequently collected and sold off the job site to recyclers.
<table>
<thead>
<tr>
<th>Description and sources</th>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non Ferrous Metals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum, copper, brass and alloys from electric, plumbing, and HVAC.</td>
<td>Metals are valuable and purchased by recycling facilities and scrap markets to be remade into new products.</td>
<td>See ferrous metals.</td>
</tr>
<tr>
<td><strong>Sources</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Often, there is significant scrap in demolition, renovation and new construction.</td>
<td>• Highest value if separated by metal at point of generation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Non-ferrous metals can be mixed and marketed with ferrous metals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Aluminum and copper are the most valuable metals, with values in the range of $1,500 to $1,800/tonne for aluminum and up to $6,000/tonne for copper, depending on the quantity (larger loads or a reliable supply each month fetch a better price), and processor location.</td>
</tr>
</tbody>
</table>

**8. Cardboard (1% total CRD waste stream)**

Packaging.  
**Sources**  
- None generated from demolition.  
- Small to large quantities from renovation and new construction.

Cardboard can be sold to the paper industry for fibre recycling. Other markets exist for:  
- Feedstock for roofing materials,  
- Cardboard shred for compost amendments,  
- External markets.

It is a valuable commodity if clean and volumes are large enough, revenues of $150-$250/tonne are possible depending on location, demand, etc.

**Simple to divert**

Markets for cardboard are well established across the country.  
**Notes:**  
- Cardboard can easily become contaminated making it difficult to sell and is frequently not generated in sufficient quantities to be of interest to recyclers.

**9. Other (29% total CRD waste stream)**

**a. Rock, gravel and aggregates**  
Rock, gravel, crushed ceramics (e.g. plumbing fixtures such as sinks, toilets).  
**Sources**  
- Waste materials are generated from demolition and renovation only.  
- Usually, there is no waste material from new construction.

These products are relatively easy to process. Rock, gravel and crushed ceramics (plumbing fixtures, tiles, etc.) can be crushed and used as clean fill similar to concrete or decorative chip.  
- There are sometimes challenges with grading and quality control sufficient for the end product to be re-used in situations such as road base.

**Simple to divert**

Markets for aggregates are well established across the country. In some regions, support may be needed to address the cost differential between landfiling and crushing, grading and transportation as well as ensuring facilities are conveniently located.
<table>
<thead>
<tr>
<th>Description and sources</th>
<th>Recycling and re-use markets</th>
<th>Considerations for diversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>b. Asphalt paving</strong></td>
<td></td>
<td><strong>Simple to divert</strong></td>
</tr>
<tr>
<td>Asphalt paving, waterproofing, etc.</td>
<td>It is routine in urban areas for many road builders and paving companies to remove and recycle old road materials into new pavement – less so in rural areas.</td>
<td></td>
</tr>
<tr>
<td><strong>Sources</strong></td>
<td></td>
<td>Markets and processing facilities are well established across the country.</td>
</tr>
<tr>
<td>• Almost exclusively from parking areas.</td>
<td>• Typically asphalt recycled separately from other materials.</td>
<td></td>
</tr>
<tr>
<td>• Limited waste from new construction.</td>
<td>• Asphalt paving can also be used for Hot Mix Asphalt (HMA), cold patch mix asphalt, base course, mineral filler and granular base stabilizer.</td>
<td></td>
</tr>
<tr>
<td><strong>c. Bricks</strong></td>
<td></td>
<td><strong>Simple to divert</strong></td>
</tr>
<tr>
<td>Bricks, clay-based masonry units also include terracotta, roof tiles</td>
<td>Most clay-based masonry can be crushed and used as fill like concrete but there are high-value re-use markets for some brick in most regions.</td>
<td></td>
</tr>
<tr>
<td><strong>Sources</strong></td>
<td></td>
<td>Markets for reclaimed and crushed bricks are well established across the country. However, support may be needed to address the cost differential between landfilling and disassembly, cleaning and transportation.</td>
</tr>
<tr>
<td>• Largely from demolition and renovation.</td>
<td>• Clay-based masonry units can also be crushed and used as clean fill similar to concrete. They are often placed in mixed aggregate markets, with concrete and block.</td>
<td></td>
</tr>
<tr>
<td>• Limited waste from new construction.</td>
<td>• Used in aggregate production.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Good quality reclaimed bricks and terracotta tiles have value in the market place and may be sold directly from the demolition site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• There are costs associated with taking down and cleaning the mortar from used bricks. It can be a time consuming manual process.</td>
<td></td>
</tr>
<tr>
<td>Description and sources</td>
<td>Recycling and re-use markets</td>
<td>Considerations for diversion</td>
</tr>
<tr>
<td>------------------------</td>
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</tr>
</tbody>
</table>
| **d. Ceiling tiles**   | Manufacturers will generally accept and recycle most ceiling tiles, when consolidated to truckload volumes.  
- Most manufacturers will take tiles for testing prior to recycling. Some will even pick up tiles so long as the shipment meets certain criteria. | Ceiling tile recycling is heavily dependent on programs operated by manufacturers.  
**Notes**  
- Materials that are mouldy or contain asbestos are not allowed.  
- Materials that are contaminated are usually not accepted (e.g. with vinyl, fabric, foil facing, cardboard-like face or contain visible wood pulp). |
| Metal, plastic or cement fibre modular tiles with metal suspension system.  
**Sources**  
- Largely from demolition and renovation.  
- Generally limited waste from new construction. | **Complex to divert** |

| **a. Equipment and “white goods”** | In most cases, old equipment is inefficient or no longer functional and should be broken down with the components recycled.  
- Scrap markets may accept equipment with high metal content.  
- Good quality or nearly new items may be taken back by the supplier or resold.  
- Some utilities offer a free pick-up and take-back program for inefficient appliances such as fridges. | Building re-use centres and scrap metal markets exist in most regions. However, market acceptance is highly dependent on the age and condition of the used equipment and “white goods”.  
**Notes:**  
- Some appliances should be disposed of carefully because they contain hazardous constituents (e.g. lead, cadmium, mercury) and/or ozone depleting refrigerants. |
| Fridges, washing machines, ovens, air conditioners, elevators  
**Sources**  
- Demolition and renovation only.  
- Usually none from new construction | **Simple to divert** |

| **b. Mixed glass** | Uses for recycled glass are primarily related to ground glass “cullet” which can be used in similar applications as other aggregates (road based, drainage backfill, etc.). Other uses include:  
- Some glass can be melted and remanufactured into fibreglass.  
- Incorporating ground glass into a glass and asphalt blend, or is being stirred into the reflective yellow and white paint used on roads.  
- Broken glass can be combined with concrete to create | There are significant limitations on the recycling potential for window glass due to lack of available infrastructure and because of the different types and treatments of glass (e.g. tinting, tempering, coatings, etc.), which cannot be combined to create a new product.  
Window glass has a different chemical composition and melting temperature than the container glass that is accepted for curbside recycling, meaning the two products cannot be recycled together. |
| Curtainwall, windows, mirrors, picture frames.  
**Sources**  
- Significant window glass comes from demolition,  
- Some mixed glass scrap is generated from renovation and new construction. | **Complex to divert** |

<table>
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| Fridges, washing machines, ovens, air conditioners, elevators  
**Sources**  
- Demolition and renovation only.  
- Usually none from new construction | **Simple to divert** |

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Window glass has a different chemical composition and melting temperature than the container glass that is accepted for curbside recycling, meaning the two products cannot be recycled together. |
| Curtainwall, windows, mirrors, picture frames.  
**Sources**  
- Significant window glass comes from demolition,  
- Some mixed glass scrap is generated from renovation and new construction. | **Complex to divert** |
### c. Fibreglass

**Batt insulation, window frames, doors.**

**Sources**
- The majority of fibreglass comes from demolition.
- Some fibreglass scrap (mostly from batt insulation) is generated from renovation and new construction.

**Description and sources**
- Fibreglass additionally contains polyester and can be used as a process engineered fuel (PEF) in cement kilns (e.g. asphalt shingle backing).
- Commercial uses for surplus fibreglass in Europe include as a substitute constituent for cement but this is not available in Canada.

**Recycling and re-use markets**
- A few markets exist in Canada for fibreglass as PEF.

**Notes:**
- Technology to recycle fibreglass is available but in an early stage of development. It is not focused on construction products (more to auto sector)
- Insulation from demolition is often mouldy and/or unfit for recycling.

### d. Paint

**Water based (latex, emulsions, etc.), oil-based I containers and in spray form.**

**Sources**
- Generally, there is limited waste from renovation and new construction.

**Description and sources**
- Paint recyclers are present in most provinces and territories, although they may set limits on how much paint they will accept at once. Programs may include:
  - Paint, varnish and stain (wet and dry)
  - All paint sold in aerosol containers
  - Empty paint containers
- Latex paint can be recycled into new paint. Oil and spray paints must be disposed of separately and mostly end up as a fuel blend. The metal or plastic containers can be recycled.
- The highest value solution is recycling fresh paint into new paint. However, this involves getting paint back to the recycler quickly as possible.

**Recycling and re-use markets**
- Recycling facilities and markets are available in many locations as a result of regional Extended Producer Responsibility (EPR) programs.
- Some regions (such as Alberta) are striving to ensure that all areas of their jurisdiction have equitable access to the program.
- However, diversion rates on construction sites may be low. It is challenging for waste generators to justify a special trip to a recycler. Given their small size, paint cans easily find their way into garbage.
- To recoup the costs of dealing with paint containers correctly, some jurisdictions apply surcharges on paint to the paint industry on product they supply to the region.
Appendix C: Emerging methods for tracking and reporting CRD waste management

CRD waste minimization is an important parameter when describing the overall environmental performance of a building project. The construction industry is becoming familiar with tracking and reporting the performance of their projects for green building rating systems (such as LEED) as well as regulatory compliance. In fact, some amount of recycling is already ingrained in the industry. Demolition contractors in particular have been segregating wastes for many years, either to capture revenue (e.g., wiring, structural steel), or to reduce disposal costs (e.g., concrete, brick).

To assist contractors in demonstrating compliance with waste diversion targets, many governments across North America (including over 500 in the US) have adopted online tracking software systems that are designed to help contractors first plan, then track and report CRD waste generated and what happens to it once it leaves the project site. CRD waste that is re-used on site can also be tracked. The systems impose consistency in terms of the documentation required (such as photos and weigh bills issued by the receiving facility).

A typical CRD waste management report can be submitted to the local government, summarizing all the different CRD materials, how much is generated and how much is diverted from landfill measured either by volume (cubic meters or cubic yards) or weight (tonnes). The data generated provides governments with valuable information:

- Track industry performance against CRD waste management goals and shows quantitative improvement over time
- Alerts governments to CRD waste management system shortcomings such as over-burdening of processing facilities
- Contractors can be encouraged to submit data voluntarily (as part of green building rating system checklist submissions) so governments can benchmark local industry capacity prior to establishing a waste diversion policy and targets.

For the data to be useful on a national basis, the definitions of materials, what is to be tracked and the metrics should all be consistent. Currently, there is still no standard definition in Canada for what constitutes CRD waste when it comes to tracking and reporting. For example, some jurisdictions count the waste that is generated then re-used on site, others do not.

Waste diversion goals and the requirements for data gathering are increasingly common in the US. To make the introduction of the CRD waste management policy go as smoothly as possible, many jurisdictions have adopted web-based software tools that are designed to easily and cost-effectively facilitate the real-time tracking of CRD waste for municipalities. Specifically, these tools can:

- Allow for the easy evaluation of waste management performance and compliance with bylaw requirements
- Track submission of documentation
- Make it easier for permit applicants, recyclers and other entities to comply with regional and municipal recycling regulations.
- Enable governments to review, analyse and monitor waste diversion activities in their community on a real-time basis
- Be applicable to all types of demolition projects and preferably all construction project types as well.
- Be applicable to municipalities of all sizes and sufficiently flexible to work within a range of regulatory environments
• Allow permit applicants to manage many projects in many different municipalities

There are over 500 jurisdictions in North America, most notably in California and Wisconsin, where web-based tracking software has been adopted. In some locations, these tools have been in use for more than five years. In the UK, CRD waste tracking software was used to manage and report on waste diversion during the construction of the 2012 London Olympic Games venues.161

Figure 16 Example of online CRD waste management tracking and reporting tool
Appendix D: Case studies of CRD waste management policies working together

The jurisdictions that have had the most success with reducing and diverting CRD waste have implemented a combination of complementary foundational, primary and secondary policies. These case studies provide a sample of some of these approaches.

Case study 1: State of Massachusetts

The State of Massachusetts has been focused on reducing CRD waste for over ten years. In that time it has developed a holistic suite of policies that work to mutually reinforce each other and the overall CRD waste diversion goals.

The Massachusetts Solid Waste Master Plan 162 established a state-wide goal of 88 per cent reduction in CRD waste by 2010. As of 2012 they had achieved a CRD diversion rate of 73 per cent. 163

To achieve this goal, the State banned a wide range of CRD waste materials from disposal, incineration or transfer for disposal at a solid waste facility including asphalt pavement, brick, clean drywall, white goods, concrete and ferrous and non-ferrous metal. Additionally, treated and untreated wood was banned from disposal or transfer for disposal at landfills. It also operates EPR regulations for packaging and paint. 164

The waste ban regulation imposes requirements on facilities operators, stating that, “no landfill, transfer facility or combustion facility shall accept the restricted material except to handle, recycle or compost the material” in accordance with a detailed Waste Ban Plan that they should submit to the governing body. The plan should demonstrate in detail:

- How the facility operator will not dispose, or transfer for disposal, banned materials, and
- How the facility will, to the greatest extent possible, separate out from waste loads banned materials for subsequent reuse or recycling.

Once approved, a Waste Ban Plan becomes a part of the facility’s permit and the facility should implement it.

For building owners and contractors, the State has developed a wide range of resources including sample specifications for construction and demolition recycling. These specifications can be included in Requests for Proposals and contract language to assure that recycling will be part of the project. They allow the specification writer to identify what materials are to be recycled, and include planning, reporting, and recordkeeping requirements.

Relevant policy tools deployed

- Extended Producer Responsibility (EPR)
- CRD waste management plans and targets for projects
- CRD waste disposal bans (all materials)
- Transportation requirements
- Differential tipping fees
- Building codes
- Green building certification
- Environmental product standards and labelling
- Deconstruction standards
- Investment in infrastructure
- Public procurement
- Industry outreach, education and resources
- Benchmarking and tracking CRD waste data
• A comprehensive and detailed specification that lays out very specific procedures for preparation of the Waste Management Plan, material tracking, recordkeeping, and reporting.  

• A simple specification that provides requirements for recycling, recordkeeping, and reporting, but is less prescriptive in providing detailed instructions and requirements on the contractor.  

• A “Fixed Asset Recovery” specification stipulates the reuse or recycling of fixed assets (doors and windows, millwork, flooring, sinks and toilets, bathroom partitions, etc.) before demolition contractors begin wrecking a structure and render usable goods worthless. In almost all instances, recovering fixed assets is a good financial move, even as it provides social and environmental benefits.

Case study 2: Dutch Chain-Oriented Waste Policy

The Netherlands has a strong history in waste management and has developed an effective, integrated policy-driven life-cycle approach that is predicated upon a landfill ban on CRD waste. Annually, the Netherlands generates about 60 million tonnes of waste of which 40 per cent (25 million tonnes) is CRD waste.

CRD waste is such a large proportion of the total waste stream compared to Canada (which is about 16 per cent) because the Netherlands sends a great deal of municipal solid waste to WtE facilities and does not count it as disposed.

By 2012, recycling and recovery rates for CRD waste had reached 95 per cent, which in part has been attributed to the “command and control” approach adopted by the government in 2001, following the centralization of waste management. At €107.49 per tonne, the Dutch also impose some of the highest landfill taxes and levies in the world. Landfill taxes, which are levied on solid waste by volume, weight or material type, have also been useful tools in stimulating waste diversion strategies.

Now, Dutch policy makers are looking beyond what they believe to be isolated policy instruments (e.g. landfill fees, landfill bans) because, despite the Dutch system imposing some of the highest taxes and levies on waste, on their own, they are no longer sufficiently effective to further reduce environmental pressure on a larger scale. The Netherlands’ National Waste Management Plan 2009-2021, called “Towards a Material Chain Society”, describes the government’s ambitions to minimize environmental pressures over the whole supply chain and to harmonize policy in different areas (e.g. natural resources, products/design, waste management, and concepts such as cradle-to-cradle) by means of a chain-oriented waste policy. Fundamentally, a chain approach considers the entire material chain, including all the stages in the life cycle of a product or material from raw material mining, production and use, to waste and possible recycling, as opposed to concentrating on “end-of-pipe” solutions.

<table>
<thead>
<tr>
<th>Relevant policy tools deployed</th>
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</thead>
<tbody>
<tr>
<td>- Extended Producer Responsibility (EPR)</td>
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</tr>
<tr>
<td>- Benchmarking and tracking CRD waste data</td>
</tr>
</tbody>
</table>
The chain approach identifies the stages in the material chain where the greatest environmental benefit can be obtained efficiently and the necessary actions for realizing this benefit. The overarching aim is to reduce the environmental impact of material chains throughout the life cycle in the most cost-effective manner, and establish a single integrated policy framework for the whole material chain. It is most important that the environmental benefit in one stage does not cause a higher environmental impact for another stage or another chain. The Dutch are actively moving towards creating a circular economy for all waste materials.

As well as setting out various targets relating to waste prevention, recovery and diversion from landfill, the plan sets out an indicative objective to: “Reduce the environmental impact for each of the seven priority streams which will be targeted in the context of chain-oriented waste policy by 20 per cent”. The seven priority streams, of which CRD waste is one, referred to were selected from the list of all 110 waste streams for which the Netherlands has a waste policy, on the basis of a life cycle assessment (LCA) over the whole chain.

A critical element to this approach is the establishment of partnerships between stakeholders from different links in the chain, facilitated by government. Each material stream will submit an action plan, detailing measures by which to reduce the environmental impact of the material chain by 20 per cent. The 20 per cent reduction in environmental pressure will be calculated in terms of end-of-life waste tonnages, volume of CO₂ emissions, pollution and land use. The ultimate aim is to establish more concrete and measurable goals, relating to specific impacts such as percentages of separate collection and waste prevention. The elements of the Dutch waste policy are:

- **Commitment to the 5R’s waste hierarchy**: reduction and prevention, re-use, material recycling, energy-recovery, incineration and land filling.
- **Stringent standards** for CRD disposal and recycling: decrees on landfill and incineration, standards for building materials, organic fertilizers (such as soil amenders, compost, etc.), ban on landfill. Comingled wastes are separated at government certified material sorting plants and landfills accept waste only from certified operators, who sort and certify loads.
- **Economic instruments to reduce waste volumes and to steer the waste to the preferred treatment** which include a municipal waste tax paid by citizens and one of the highest landfill taxes in the EU.
- **Planning at the national level** which starts with concessions for collection and treatment, a pro-market approach and integral national waste planning.
- **Cooperation between 3 levels of government** (municipal, regional and national).
- **Education and communication** to create awareness and enhance participation with separate collection schemes. The CRD focus is on source separation of recyclables with the provision of collection bins on the construction site.
- **Extended Producer Responsibility (EPR) programs** which are paid by consumers, producers and/or importers (such as recycling fees) for car tires, batteries, paper and cardboard, packaging, (more materials to be added soon).
- **Notification and registration of waste transports**: from separate to one integral system of registration and notification of waste transports.
- **Control and enforcement** which includes a total landfill ban on CRD waste and closed borders to the transportation of waste out of the country. CRD waste is highly mobile so controls are in place to prevent haulers from shipping waste from locations with high disposal costs and stringent regulations to neighbouring locations that may be more lax.

The Netherlands’ 12 provinces regulate disposal of CRD waste. They gather information about waste streams and monitor disposal and processing by requiring quarterly reports from waste collection and processing companies. Used building material reuse and recycling is estimated to be as high as 90 per cent. Asphalt, concrete and mixed granulates are used in road building. Almost all flyash produced in the country is currently used in concrete. There are limits to the amount of
materials that can be left on site and mixed with soil after demolition, and also regulations stipulating what materials can be reused (e.g. recycled aggregate in place of gravel in concrete). These measures have been effective at encouraging industry’s acceptance of CRD waste diversion.

The new 20 per cent reduction target provides a goal to which industry can work towards and is intended to drive innovation throughout the chain, targeting flows that can be dealt with most cost effectively. However, it is not a binding target and there are no penalties tied to non-compliance. Instead, operational targets for specific projects are formulated in co-operation between stakeholders, which are made binding by various forms of agreement. Therefore, the success of this policy relies on the presence of viable markets for the recycled materials. There is also significant research into waste minimization solutions and alternative uses for materials destined for disposal underway. Dutch buildings are starting to be designed with waste management strategies in mind such as dematerialization (using less material in the building project) and disassembly.
6. REFERENCES


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23 www.calrecycle.ca.gov/carpet/Law.htm
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28 Statistics Canada data represent the best available, most consistently gathered and nationally accepted source of information on CRD waste statistics in Canada at this time. However this data not include:
   • Waste managed and recycled or re-used on CRD project sites;
   • Waste transported directly from CRD project sites to end markets for re-use or recycling;
   • Waste transported directly from CRD project sites to disposal facilities outside of the country;
   • CRD waste managed within residential and non-residential waste streams that is not identified and recorded as CRD waste;
   • CRD waste from large construction projects which is not disposed in municipal solid waste landfills; and
   • CRD waste from civil engineering, marine and large public infrastructure projects.
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