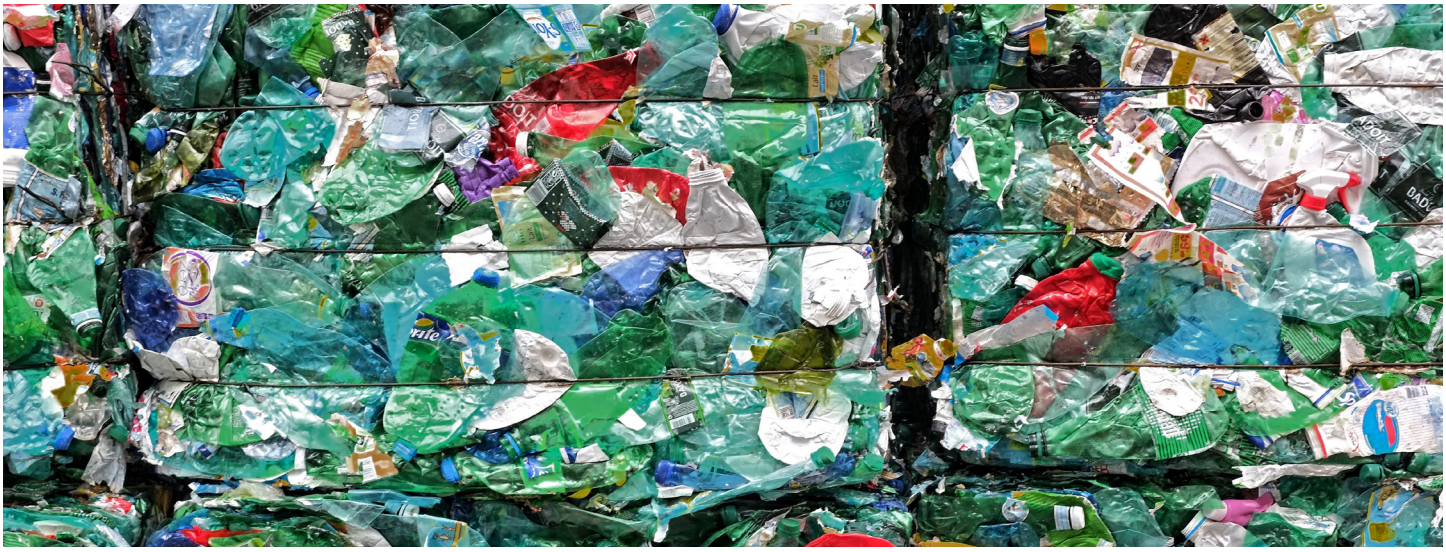
CANADA'S **ECOFISCAL** COMMISSION
Practical solutions for growing prosperity

# CUTTING THE WASTE

## How to save money while improving our solid waste systems

**October 2018**



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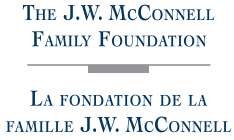






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# EXECUTIVE SUMMARY

**Improving how Canadian communities manage their solid waste may not seem like an urgent issue. Every week or two, we put our garbage, organics, and recyclables out for collection and it disappears, never to be seen again. We quickly forget about it and move on with our busy lives, until the next time we do it all over again. But how we manage our solid waste *does* matter.**

### Solid waste management matters for cities, people, and the environment

The more waste we produce, the costlier it is to manage—particularly for local governments and taxpayers that fund these services. Finding sites for new landfills is also a lengthy and contentious process: nobody wants a landfill near their backyard.

Our solid waste also imposes environmental costs that cannot be ignored. Solid waste can contain toxic or hazardous substances that cause environmental damage as they degrade in landfills or are incinerated. Landfills emit roughly 20% of all Canadian methane emissions and are a significant contributor to global climate change. When our waste ends up as litter, it accumulates in our forests, waterways, and oceans where it pollutes and degrades fragile ecosystems.

Canadian communities can clearly improve how they manage their solid waste. On average, each Canadian throws out about 400 kilograms of solid waste each year, most of which ends up in landfills. When factoring in commercial waste, this figure rises to nearly one tonne of waste generated for each Canadian—nearly double the amount of waste generated by those in other high-income countries. Canadians make up 0.5% of the world's population yet produce about 2% of the world's municipal solid waste.

### Ultimately, we must improve the *efficiency* of our waste management systems

Given this performance, it is perhaps unsurprising that municipal and provincial waste management policies have focused on *diverting* more waste—through organics and recycling programs—and *disposing* less. Indeed, municipal and provincial waste diversion targets have become a central, driving force of policy development.

Yet the economics of waste management are complex. Increasing diversion is important but is not always the best or only solution. Depending on the local context and existing service levels, diversion can be expensive: some recycled materials have a low value relative to the cost of collecting, sorting, and processing them. In other cases, recycling technologies that sort and process materials are still developing and are costly to deploy. Diversion systems also have an environmental footprint, albeit typically smaller than waste disposal systems.

*Preventing* waste from being generated in the first place is another key solution. However, there are limits to how much waste consumers and producers are willing or able to eliminate. Measuring progress on waste prevention is also far more challenging than measuring progress on disposal and diversion.

This report argues that we should reframe our waste management objectives. Rather than simply seeking to reduce waste disposal (or increase diversion), we should seek to improve

the efficiency of our waste systems. Creating efficient waste management systems is about achieving a socially optimal balance between waste disposal, diversion, and prevention—a balance that delivers greater benefits at lower costs. Critically, this includes assessing all costs and benefits in waste systems, including both financial and environmental factors.

But there is no single model of an efficient waste management system: describing efficiency in practice is challenging. An efficient balance between waste disposal, diversion, and prevention depends on many factors, including local context, current states of technologies, and even international markets for recyclable materials.

In practice, we argue that the best way to improve efficiency is to make waste management systems work more like well-functioning markets.

## Addressing six distinct—but interrelated—problems provides a map to making waste systems more efficient

As we find in this report, however, waste management markets are *not* normal, well-functioning markets. Prices for waste management—where they exist—do not reflect the true costs and benefits associated with waste management services and materials.

We identify six interconnected problems that cascade throughout solid waste markets. Each of these issues make waste management systems inefficient:

### 1. Most Canadian households do not pay directly for waste management

Households typically pay for waste collection through property taxes or as a monthly fee. In other words, the amount residents or businesses pay for waste management has—in many cases—no connection with the quantity or composition of solid waste they generate.

As a result, people tend to generate and dispose more solid waste than they otherwise would if they paid directly for the service. Low waste disposal prices also weaken the incentive to divert waste through recycling or composting.

### 2. Landfills do not charge large waste generators the full cost of disposal

Waste disposal prices are more transparent for the commercial sector, including businesses, large buildings, institutions, and industry. Commercial waste is typically hauled directly to landfills, where waste generators pay a fee to dump their waste based on the weight or type of waste being tipped.

In many cases in Canada, however, the fee for disposing every tonne of garbage is less than the full cost, encouraging waste generators to landfill more waste than they would otherwise. Fees in Canada often do not reflect the long-term costs of landfilling—that is, the future costs of building new landfill sites when existing ones reach capacity. Similarly, fees often exclude some of the environmental and social costs of landfilling, such as environmental risks to water and soil, greenhouse gas emissions, and impacts on local property values due to odour and unsightliness.

### 3. The porous boundaries of solid waste management systems make it difficult for municipalities to price waste disposal at its full cost

The boundaries of solid waste management systems are porous. Unlike municipal water and wastewater systems, where municipalities have near complete control over treatment and distribution infrastructure, solid waste systems—and the flows of waste within them—are more decentralized. These porous boundaries can make it difficult for municipalities to charge the full cost of waste disposal and can undermine environmental performance.

First, even though municipalities may want to set tipping fees that reflect the full cost of service, doing so can encourage waste haulers to "export" their waste to jurisdictions where tipping fees are much lower. In Metro Vancouver, for example, where waste disposal fees are relatively high, waste shipments to the U.S. doubled between 2012 and 2015.

Considering that tipping-fee revenues are the primary way to pay for waste disposal systems, waste exports can undermine a municipality's ability to recover its costs. Building, maintaining, and closing landfills is capital intensive, meaning that a large portion of disposal costs is fixed. If waste exports increase, municipalities generate less revenue to cover these fixed costs. This can also undermine environmental outcomes if waste is exported to landfills that are less secure or to waste systems that put less emphasis on waste diversion and resource recovery.

Second, raising the price of waste disposal can encourage an increase in illegal dumping. Most communities already struggle with illegal dumping—in alleys, parks, and forests—which poses a health and environmental risk and is costly to clean up. Without appropriate policies in place, increasing the price of waste management can make illegal dumping worse.

### 4. Markets alone may provide inadequate waste diversion opportunities for some materials

Municipal governments play an integral role in providing waste diversion infrastructure, particularly for the residential sector. Most municipalities provide curbside recycling, and a growing number now provide curbside organics collection.

**Box 1: Improving Waste Management in Calgary, Alberta**

**To explore the challenges of waste management in practice, and to illustrate the broader ideas laid out in this report, we develop a detailed case study on the City of Calgary, Alberta. It considers the progress that Calgary has made so far, the policies that Calgary plans to implement in the near future, and opportunities for further policies in Calgary and Alberta.**

Calgary has made considerable progress over the past two decades. It increased tipping fees at its three landfills to better reflect the cost of service. It also implemented an organics collection program to help divert a significant quantity of waste from its landfills. Finally, Calgary is considering a pay-as-you-throw program for household garbage collection, strengthening the link between how much waste people produce and how much they pay.

Progress at the provincial level, however, has been slower. Most notably, Alberta is the only province that does not have legislated extended producer responsibility (EPR) programs and is falling behind in its commitments under the Canada-wide Action Plan for EPR. If Alberta were to follow the lead of other provinces, such as B.C., and implement full EPR programs, it would make producers financially and physically responsible for managing the waste generated from their products. Such policies could also strengthen waste diversion infrastructure and increase the quantity and quality of waste diversion. An EPR program for residential recycling would also remove the financial burden from municipalities.

Overall, our case study provides a framework for how municipalities (and provinces) can systematically assess their waste management systems. This framework can help governments assess the efficiency of waste management systems and support the development of new policies to further improve those systems, throughout the lifecycle of municipal waste.

But why do governments provide these services or require that industry provide them? If recovering and selling the resources embedded in waste can generate benefits, why does the private sector not provide more opportunities for households and the commercial sector to recycle and compost?

Issues #1, #2, and #3 are a big part of the problem: waste disposal prices are artificially low and increasing them can be difficult. Disposal prices set the benchmark for other types of waste management. Low disposal prices inadvertently discourage the private sector from capitalizing on new waste management opportunities.

Yet even if waste disposal were priced according to its true cost, the private sector would not necessarily provide adequate diversion alternatives. Collection and management systems for waste disposal and diversion often make financial sense only when operated on a broader scale. Achieving this scale can be difficult, particularly in small, rural, and northern communities.

Another reason is that providers of waste diversion services have limited control over how residents and businesses sort and manage their waste before it enters the solid waste collection system. Municipal recycling and organics programs, for example, rely on residents to sort their waste according to the local requirements. This lack of control causes persistent contamination issues at recycling and composting facilities, which can increase processing costs and make the end product less valuable. As a result, contamination can deter the private sector from providing more waste diversion services.

### 5. Municipal pricing policies have limited effect on goods manufacturers

If waste management services were priced according to their full cost—in all jurisdictions—consumers would have clear incentives to purchase goods made with fewer materials or materials that are easier to recycle or compost. Producers, in turn, would have incentives to design and manufacture goods that generate less waste.

But even if *individual* municipalities charged residents directly for waste disposal, and even if these prices approached the full cost of

the service, prices would have a negligible impact on the decisions of upstream producers. Waste is priced locally, and municipalities are too small to affect the decisions of manufacturers in other provinces or countries. Only disposal pricing in a large number of municipalities, globally, would increase demand for goods with less disposable waste.

### 6. Extracting and processing natural resources generate negative environmental externalities further upstream

The majority of materials and consumer goods produced in the economy use virgin materials, extracted and processed from the natural environment. These processes, however, can cause significant environmental damages that are unpriced or underpriced in markets. In other words, the firms extracting and processing these materials do not pay the full cost associated with these upstream processes.

Underpricing upstream environmental damages effectively subsidizes the use of virgin materials and distorts markets further downstream for recycling, reuse, and prevention. Firms have an incentive to use more virgin materials and fewer recycled and reused materials in their manufacturing processes.

This last issue, however, is unlike the other five. It refers to a problem that ultimately *affects* waste but is not fundamentally about waste management systems. Other policies—such as carbon pricing or improved financial assurance for resource development projects—are better suited to address these upstream issues.

## We make five recommendations for improving waste management in Canada

These issues represent a significant opportunity for municipal and provincial policy-makers. Policies that address the six problems can improve the overall efficiency of waste management systems by allowing our waste systems to rely more on market forces. These six problems—along with recommended solutions—are illustrated in the report's detailed case study on the City of Calgary (see Box 1).

### RECOMMENDATION #1
### Municipalities should charge tipping fees that reflect the full costs of disposal, including environmental costs

Creating more efficient waste management systems starts with smarter disposal pricing. ***Tipping fees*** are the most common way to price waste disposal both in Canada and internationally. They are the fees that landfills charge on waste brought to landfills—typically from non-residential waste generators. They can vary, based on the type, volume, or weight of the material. Fees can be set by private landfill operators or municipal governments.

Tipping fees that cover the full costs of waste disposal have several main advantages.

First, and most importantly, they can drive waste reduction at a lower cost. Governments cannot know the optimal or lowest-cost waste management options for the thousands or millions of residents and businesses. Tipping fees allow each waste generator to determine the least expensive way of managing their waste. Some waste generators, for example, might spend more time diverting their waste to avoid paying more in tipping fees. Others may be willing to pay the tipping fee and continue to landfill the same amount of material, because the costs of waste diversion are greater than the tipping fee.

Second, tipping fees generate revenues that pay for the service and recover costs. These revenues ensure that waste disposal infrastructure is properly built, monitored, and maintained. They ensure that landfills have the funds to provide the service, and they also help reduce environmental costs. Revenues, for example, ensure that landfills have the required technologies to collect and treat leachate, capture GHG emissions, cap facilities after they close, and regularly monitor operations during and after their lifetime.

Third, aligning tipping fees with the full cost of waste disposal is a fairer way to pay for our waste management systems. Those that dispose of more material, or materials that are costlier to manage, should pay more.

Provinces play a key role in ensuring that landfills charge tipping fees that reflect the full environmental cost of waste disposal. Regulations and standards can require landfills and incineration operations to reduce their environmental impacts, both during operation and after the site has been closed. Waste disposal sites can then pass on the costs of complying with these policies in the form of tipping fees consistent with the full cost of disposal.

### RECOMMENDATION #2
### Municipalities should implement *pay-as-you-throw* programs and charge households directly for waste disposal

Municipal ***pay-as-you-throw (PAYT) programs*** charge households directly for garbage collection services. They might charge for collection based on volume, weight, or the number of bags put out for collection. Each approach shares a common principle: households that generate less waste pay less. As a result, households have a continuous incentive to dispose of less waste.

PAYT programs can generate several benefits:

- First, less waste disposal in response to higher prices can allow municipalities to defer future landfill costs. Savings can be significant in communities that have limited landfill capacity or that ship waste to neighbouring communities.

- Second, PAYT programs can reduce operating collection costs if residents put out less garbage at the curb (though these savings may be offset by higher collection and processing costs for diverted materials).
- Third, the revenues generated from PAYT programs reduce or eliminate the need to cross-subsidize disposal services through property taxes or other revenue sources.
- Finally, at a broader scale, increased waste diversion can create environmental benefits if greater resource recovery leads to decreased use of virgin materials.

### RECOMMENDATION #3
### Provincial governments should expand, reform, and harmonize extended producer responsibility programs

Disposal pricing—covered in the two recommendations above—is a necessary but not sufficient step toward efficient waste management systems. Given the set of interrelated challenges described in this report, multiple policies are necessary.

Of the complementary policies considered, we identified ***extended producer responsibility (EPR) policies*** as a key part of efficient waste management systems. EPR programs make producers financially and physically liable for the ultimate management of the materials in the products they produce. These programs, in other words, can ensure that producers have a clear price incentive to improve the way their goods are managed after their useful life. If designed well, EPR programs can also encourage manufacturers to make their goods with fewer materials or materials that are easier to recycle and compost.

Some provincial governments are already making good progress on expanding and reforming EPR programs. British Columbia became the first province to have "full EPR" for all of its programs, making producers fully responsible for managing the waste from their products. Notably, it is the only province that has a full EPR program for its municipal curbside recycling programs, which shifts the financial burden of operating these programs from municipalities to manufacturers.

Progress in other provinces, however, has been slow. Alberta remains the only province without any regulated EPR programs; the Atlantic Provinces have adopted limited EPR programs but have not reached their commitments under the Canadian Council of Ministers of the Environment (CCME) Canada-wide Action Plan for EPR.

Harmonizing EPR programs across provinces should be a long-term objective. EPR programs are administratively complex, especially considering the patchwork of programs across Canada that have developed over time. Streamlining these regulations across Canada can reduce costs, provide a more unified pricing signal for manufacturers, and make these programs more transparent and easier to evaluate.

### RECOMMENDATION #4
### Provincial and municipal governments should implement policies that improve how organic waste is separated and managed, designed according to their own context

While EPR programs can ensure that manufacturers have incentives to improve how recyclables are managed, extending these programs to organic waste is difficult. As a result, municipalities and provinces may also need policies that specifically target and improve how organics are collected and managed. Generalizing about the best approach to do so, however, is challenging. Specific policies should be chosen according to local context and on a comprehensive analysis of costs and benefits.

For many municipalities, implementing municipal collection programs for organic waste might be a good starting point. Far fewer Canadians have access to curbside organics collection compared to recycling programs, indicating that more progress could be made. The accompanying processing facilities could be built based on community or regional needs, using technologies that range from sophisticated and capital intensive to basic and lower cost. Still, for smaller communities, limited economies of scale could mean that organic collection programs are too expensive. Other initiatives, such as incentives for backyard composting, may be more appropriate and cost-effective.

Provinces can also play an important role. They could, for example, provide targeted and temporary funding for municipal initiatives that cost-effectively divert organics. They could also take a more direct approach by banning all organic waste from landfills, forcing municipalities and landfills to provide alternatives. However, because disposal bans are less flexible than pricing policies, they tend to be a costlier way to divert waste. Such policies should be considered only if provinces can demonstrate that bans can improve overall efficiency.

**RECOMMENDATION #5**

**To improve the evaluation, assessment, and transparency of waste management policies, federal and provincial governments should expand and standardize data-collection methods and make these data more available to the public**

The lack of data on waste management in Canada is a big roadblock to improving waste management systems. Limited and inconsistent data make it impossible to answer important questions, such as:

- How many active and inactive landfills exist in Canada?
- What types of environmental protections do Canadian landfills have in place?
- What is the composition of waste being disposed at landfills?
- What is the average tipping fee charged at landfills?
- How many Canadian municipalities use PAYT programs?
- What are the economic and environmental impacts of EPR programs, and how do they compare across provinces?

Some provinces are ahead of others on some of these key areas of data collection. However, all governments in Canada can improve their data resources, especially when it comes to standardizing methods across jurisdictions.

Improving data access and availability is critical for two reasons. First it allows governments and researchers to assess the extent to which our current systems are efficiently managing waste (or not). Improving data, in other words, can help make our performance on waste management more transparent. Second, it helps evaluate the performance of new policies and approaches over time. It can help policy-makers determine how policy changes have affected waste flows and system efficiency, and subsequently to adjust and adapt policies to further improve performance. Better data can also assist with harmonizing policies across Canada.

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Ultimately, the case for improving our waste management systems is an economic one. Updates to municipal and provincial solid waste policies can improve the efficiency of our systems, reducing costs and increasing benefits for municipalities, taxpayers, and the environment. See the full report for more details.

# CONTENTS

# 1 INTRODUCTION

**Improving how Canadian communities manage their solid waste may not seem like an urgent issue. Every week or two, we put out our garbage, organics, and recyclables for collection and it disappears, never to be seen again. We quickly forget about it and move on with our busy lives, until the next time we do it all over again.**

But the solid waste that we each generate, and how we manage it, *does* matter.

Canadians are generating more solid waste than ever. In 2014, the average Canadian threw out 416 kilograms of waste, an increase of 16% from 2002. When factoring in non-residential waste, this figure rises to nearly *one tonne* of solid waste for every Canadian—double the amount of waste generated by those in other high-income countries. Canadians make up 0.5% of the world's population yet produce about 2% of the world's municipal solid waste.

As we produce more solid waste, the costs to manage it increase.

Most of our waste in Canada ends up in landfills. Yet building and operating landfills is expensive, especially with increasingly stringent environmental standards. Finding sites for new landfills is also a lengthy and contentious process: few people want more landfills in their community. And considering that many landfills are operating at or near capacity in Canada, all communities will eventually need to reckon with a shortage of landfill space and the high costs associated with finding new alternatives.

Our solid waste also imposes environmental costs that cannot be ignored. Solid waste can contain toxic or hazardous substances that cause environmental damage as they degrade in landfills or are incinerated. Landfills emit roughly 20% of all Canadian methane emissions and are a significant contributor to global climate change. When our waste ends up as litter, it accumulates in our forests, waterways, and oceans, where it pollutes fragile ecosystems.

The environmental costs associated with solid waste also extend further up the supply chain. Extracting and processing natural resources—through mining, logging, agriculture, and oil and gas extraction—are major sources of pollution to air, water, and soil. A significant portion of the world's total greenhouse gas emissions, for example, comes from the energy used to produce, process, transport, and dispose of the material goods produced and consumed in the economy.

Diverting and preventing solid waste from being disposed is a clear solution, but these options can be costly, too. Facilities that compost and recycle solid waste are expensive to build and operate, as are the municipal and industry-run programs that collect our organics and recyclables from the curb. There are also limits to how much solid waste consumers and producers are willing or able to eliminate.

All these factors present important challenges to governments. Why do Canadians generate so much solid waste, and why does so much of it get landfilled? How can governments discourage waste disposal (e.g., landfilling) while minimizing the costs of waste diversion (e.g., recycling, composting) and prevention (e.g., reducing)? In other words, what is the optimal balance between waste *disposal, diversion*, and *prevention*?

This report investigates these critical questions. In a nutshell: we find that our solid waste management systems could rely more on market forces. In particular, using market-based pricing policies can create better incentives to reduce waste disposal and lower the overall costs of our waste management systems. Pricing policies, in other words, can make our waste management systems more efficient.

Pricing policies change *how* we pay for waste management. Households in Canada generally do not pay for waste management services directly. Municipalities often fund garbage collection, through property taxes or flat fees. Aligning the prices we pay with the costs of managing waste ensures that households that generate less waste, pay less.

Pricing policies also change *how much* we pay for waste management. Generators of non-residential waste, for example, often pay for waste disposal directly at landfills; however, the prices they pay (called tipping fees) are often less than the full financial and social costs of managing their waste. Passing the full cost of waste disposal back to waste generators provides a clear incentive to prevent waste generation in the first place, or to reuse, recycle, or compost materials instead of throwing them in the landfill.

The good news is that we can already find examples of waste-pricing policies across Canada. At the commercial level, many landfills have increased their tipping fees to better reflect the full cost of the service. At the household level, a small but growing number of municipalities are adopting *pay-as-you-throw* (PAYT) programs that charge households directly for the waste they generate. Improving and expanding these policies could help reduce costs, decrease landfilling, and improve diversion.

Yet relying on markets and pricing policies alone is not enough. Markets for waste management are incredibly complex. A range of issues prevent them from working efficiently. Full-cost waste pricing is often difficult to implement in practice. The boundaries of waste systems are porous: higher prices can increase illegal dumping and encourage people to transport their waste to cheaper jurisdictions. The limited reach of municipal policies means that local waste management prices have little or no effect on how national and international companies design and manufacture their products.

As a result, efficient waste management systems also require other, additional policies beyond disposal pricing. In particular, *Extended Producer Responsibility* (EPR) policies have a key role to play. EPR policies make producers financially and physically liable for waste generated from their products and provide market-based incentives to make products and materials that generate less waste. They can, in other words, help overcome key challenges in waste markets that disposal-pricing policies alone cannot.

This report is structured as follows. Section 2 describes waste management systems in Canada and explores how much solid waste we generate and how it gets managed. Section 3 argues we should reframe how we approach waste management problems by focusing on *system efficiency* and addressing six key issues in waste management markets. Section 4 pivots toward solutions by assessing the case for full-cost disposal pricing as the foundation of efficient waste management. Section 5 then assesses the role of additional, complementary waste management policies. Section 6 applies our analytical framework with a case study on the City of Calgary. Section 7 concludes with five recommendations for municipal, provincial, and federal governments.

# 2 CONTEXT: WASTE MANAGEMENT IN CANADA

**To lay the groundwork for our analysis, we describe the fundamentals of waste management and how these complex systems operate. We then consider Canada's performance more specifically.**

## 2.1 A QUICK PRIMER ON SOLID WASTE MANAGEMENT

What is municipal solid waste? Why must we manage it? And how do we manage it in Canada?

### Our focus is on municipal solid waste

*Solid waste*, broadly defined, is the unwanted and discarded materials generated from economic activity. *Upstream solid waste* is generated when resources are processed and manufactured into goods and materials, while *downstream solid waste* is generated after goods or materials are consumed (Statistics Canada, 2012; US EPA, 2017).

This report focuses narrowly on downstream solid waste, better known as *municipal solid waste*. This includes solid waste, such as packaging, electronics, newspapers, and food waste, from households. It also includes solid waste from industrial, commercial, and institutional activities. This comprises food waste from grocery stores and restaurants, old equipment and furniture from businesses, and waste from construction and demolition sites.

Upstream waste issues are important and fundamentally connected to municipal solid waste (see Box 2). However, we consider these impacts in much less detail and only when they result from policies that specifically target municipal solid waste. Municipal solid waste policies can, for example, encourage producers to design and manufacture products such that they generate less waste or use fewer resources.

### Solid waste management systems provide an essential service

Solid waste management systems play an invaluable role in our municipalities. These systems collect and remove the garbage produced by millions of households, businesses, and institutions. They also manage waste in ways that protect human health, such as disposing of garbage in sanitary landfills or composting organics in ways that disinfect the material.

Similarly, recycling and composting facilities recover value embedded in some wastes, often reducing the financial costs and environmental footprint from landfilling. Most communities in Canada now have curbside and community-based recycling programs, and a growing number have composting programs (ECCC, 2016).

Together, waste management systems help keep our communities clean and reduce the health and environmental risks associated with improperly managed waste. They are particularly important in dense urban municipalities that generate hundreds

**Box 2: Issues Associated with Upstream Solid Waste**

## In absolute terms, most solid waste in Canada—and in the world—is generated "upstream" from extracting and refining natural resources and processing these resources into consumer goods.

In Canada, oil sands production and mining are the biggest sources of solid and semi-solid waste, generating over one billion tonnes of waste tailings in 2008 (Hoornweg & Bhada-Tata; 2012; MacBride, 2012; Statistics Canada, 2012).

When poorly managed, upstream waste can be a significant source of air, water, and soil pollution, including greenhouse gas (GHG) emissions. The US EPA, for example, estimates that 42% of total GHG emissions in the U.S. are from the energy used to produce, process, transport, and dispose of the material goods produced and consumed in the economy (Rushton, 2003; US EPA, 2009).

We return to these upstream issues, and how policy might address them, in Section 3.

of tonnes of solid waste each day. Past strikes by the waste management sector are a powerful reminder of how quickly our waste piles up when these services are no longer available.

### Solid waste is either disposed, diverted, or prevented

All solid waste generated within municipalities must be managed. There are three options for doing so: *disposal, diversion*, and *prevention*.

*Waste disposal* includes landfilling, incineration, and waste-to-energy facilities. Landfilling has been the most common way to manage waste in Canada, with over 2,000 landfills across the country. There are also six large-scale waste-to-energy facilities in Canada, along with several smaller-scale waste incinerators (CCME, 2014a; ECCC, 2018; PPP Canada, 2015).[1]

*Waste diversion* refers to recyclables and organics that are diverted from the disposal stream. Generally, these processes recover a higher proportion of the energy and material embedded in solid waste compared to waste disposal. Recyclable materials are sorted, processed, and sold on secondary markets where they are then used to make new materials and products. Organic waste is sorted and processed in large facilities that produce compost and, in some cases, energy from methane. Waste diversion also includes materials that are reused or repurposed, which defers the need for new materials.

*Waste prevention* refers to actions that avoid generating waste. On one hand, producers can reduce the amount of material in a given product to generate less waste. On the other, consumers can consume less or purchase products that generate less waste. Waste prevention is harder to measure than waste disposal and diversion, as it represents waste that was never created (Skumatz, 2000).

### Waste management cuts across multiple levels of government and the private sector

In Canada, provincial and territorial governments regulate solid waste management. Provinces and territories develop, approve, license, and monitor municipal and private waste operations and set standards that protect public health and the environment. They can also legislate targets for waste disposal and diversion and can institute landfill bans and requirements for goods manufacturers (CCME, 2014a; PPP Canada, 2015).

Within the legislative framework in each province and territory, municipalities are generally responsible for managing the solid waste generated by households. They also have the authority to set objectives and develop waste management plans and policies that achieve these objectives (Government of Canada, 2017; PPP Canada, 2015).

The federal government has played a less direct role in solid waste management. Its primary role is to set guidelines and

[1] Waste-to-energy facilities recover more of the resources (i.e., energy) from waste than landfilling but are less resource efficient than other waste management options, such as recycling, composting, and prevention. Waste-to-energy facilities that incinerate waste to create electricity (i.e., mass burn) typically have energy recovery efficiencies between 14% and 27% (Stantec, 2011). They also depend on a consistent and steady flow of disposed waste to remain financially viable. For these reasons, waste-to-energy facilities in Canada are considered a form of waste disposal rather than waste diversion.

requirements for managing hazardous (e.g., nuclear) waste and interprovincial movements of solid waste. In conjunction with the provinces, the federal government also provides grant funding for waste management initiatives and convenes and facilitates national initiatives through the Canadian Council of Ministers of Environment (Government of Canada, 2017; PPP Canada, 2015).

Finally, the private sector plays a crucial role in waste management and provides the bulk of waste management services in Canada.[2] The private sector owns and operates a large portion of waste disposal and diversion services, particularly for commercial, industrial, and institutional waste. And while it is common for municipalities to own their waste management infrastructure (e.g., landfills, collection systems), some landfills in Canada are privately owned and operated. Municipalities also often contract private firms to manage residential waste on their behalf (Statistics Canada, 2012).

## 2.2 WASTE MANAGEMENT TRENDS IN CANADA

Where does Canada stand in terms of managing its waste? Here we unpack some of the data on solid waste management in Canada. However, due to limitations and inconsistencies in data collection at all levels of government, we are limited to describing high-level trends. See Appendix A for details on the data used in this section and its limitations.

In general, it appears Canada has much room to improve how it manages solid waste. In 2017, the OECD noted that "Canada is among the most material-intense economies in the OECD," and suggested that Canada can improve its resource recovery. The Conference Board of Canada, in its Environmental Report Card, ranked Canada last out of 17 countries for the amount of municipal solid waste it generates and landfilled (OECD, 2017; Conference Board of Canada, 2018).

### Canadians are among the biggest generators of waste in the world

Canadians generated roughly 34 million tonnes of municipal solid waste in 2014, or about one tonne of solid waste per person.[3] As Figure 1 illustrates, this makes Canadians some of the biggest per capita generators of waste in the world. Canadians make up 0.5% of the world's population and produce about 2% of the world's municipal waste (Kaza et al., 2018).[4]

About 40% of Canada's solid waste is generated by the residential sector, which includes waste from single-detached houses, duplexes, townhouses, and a portion of apartments, condominiums, and small businesses. The total amount of residential waste (including both disposal and diversion) increased by over 30% from 2002 to 2014, exceeding Canada's population growth rate. The amount of residential waste per person, in other words, increased over this period (Statistics Canada, 2018a; 2014b; Monahan, 2018).

Non-residential waste accounts for the remaining 60% of Canada's municipal solid waste. It includes waste generated by industrial, commercial, and institutional (ICI) sectors and construction and demolition (C&D) sites. It also includes waste from most apartments, condominiums, and businesses. Overall, the total amount of solid waste generated by the non-residential sector rose by 6% between 2002 and 2008 but decreased by 11% between 2008 and 2016.

### Waste management systems rely heavily on *disposal*, despite increased *diversion*

Most residential and non-residential solid waste generated in Canada is disposed.[5] In 2016, for instance, three-quarters of our waste, or roughly 24 million tonnes, ended up in landfills.[6] In absolute terms, this represents a 4% increase in landfilled waste from 2002. A small share of Canada's waste—roughly 1 million tonnes per year—is disposed at waste-to-energy facilities (Statistics Canada, 2018a; ECCC, 2018).

Relative to economic activity, however, Canadians are disposing less waste over time. Figure 2 shows the disposal intensity in each province in 2002 and 2014, which measures the amount of waste disposal per unit of gross domestic product (GDP). Given that economic activity is a key determinant of both waste generation and disposal, this metric

[2] In 2008, roughly four-fifths of the waste management labour force worked in the private sector, while the remaining one-fifth were employed by government (Statistics Canada, 2012).

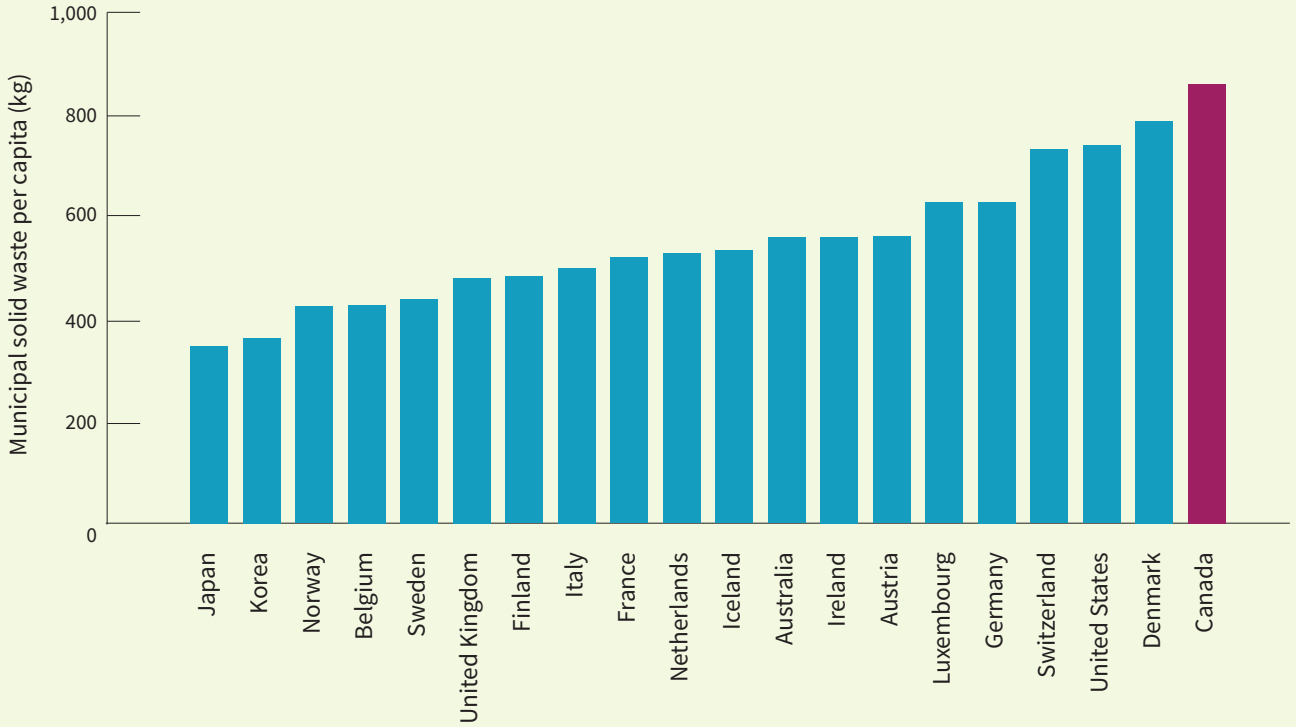
[3] This estimate includes all materials that were either disposed or diverted. It is likely an underestimate; see Appendix A for more information.

[4] The total amount of waste generated in each province is similar after controlling for economic activity. On average, most provinces generate between 13 and 14 tonnes of waste per $1 million in GDP. The notable exception is Nova Scotia, which generates roughly 8 tonnes of municipal solid waste per $1 million. A combination of early policy action (see Box 3) and gaps in data collection (Appendix A) help explain the substantial gap between Nova Scotia and other provinces.

[5] Generating and landfilling waste is not necessarily a problem in and of itself. Canada has abundant land, making landfilling a relatively cheap option for waste management (although not all land is suitable for landfilling, especially in the north). Only when we factor in the full financial and environmental impacts from different waste management options do we get a more complete picture of disposal costs. We explore these in Section 3.

[6] Roughly 3.5 million tonnes of this total were exported to landfills in the U.S. (ECCC, 2018).

**Figure 1: Municipal Solid Waste per Capita in Select OECD Countries, 2014**




**This figure shows the average amount of municipal solid waste managed across 20 OECD countries in 2014. It includes all municipal solid waste, including materials that are ultimately recycled or composted. Canada produced the highest amount of waste per capita, at 858 kg per person. Note: data for each country—excluding Canada—is from the OECD; Canadian data is from Statistics Canada. The methods used by both Statistics Canada and the OECD, however, are comparable. Both datasets exclude construction, renovation, and demolition (CRD) waste. When CRD waste is included, total waste generation in Canada increases to 961 kg per capita.**

Source: OECD (2018) and Statistics Canada (2018a)

facilitates a more accurate comparison across provinces and across time compared to other measures, like waste disposal per capita.[7]

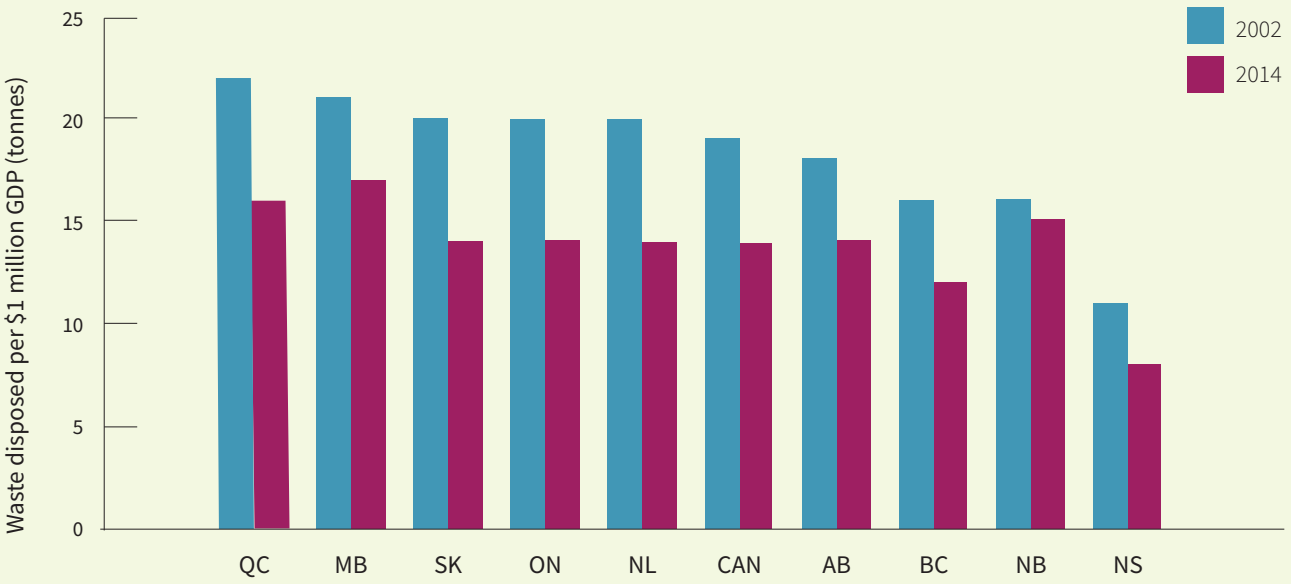
Figure 2 illustrates that while all provinces have reduced their disposal intensity, progress varies. In 2002, for example, Quebec had the highest intensity, disposing roughly 22 tonnes of waste for every $1 million GDP. By 2014, its disposal intensity fell to 16 tonnes per $1 million GDP, representing the second highest disposal intensity next to Manitoba. Nova Scotia, on the other hand, had (and continues to have) the lowest disposal intensity in the country, falling from 11 tonnes for every $1 GDP in 2002 to 8 tonnes in 2014 (see Box 3 for why Nova Scotia outperforms the other provinces).

The simple explanation for the marked decrease in disposal intensities is that more recyclables and organics are diverted from landfills. Between 2002 and 2014, the total amount of diverted waste in Canada increased by 36%. Diversion from the residential sector increased by 72% over this period, while that from the non-residential sector increased by 10% (Statistics Canada, 2014a).

Despite this progress, however, landfilling is still the primary method of waste management, particularly in provinces with high disposal intensities, such as Quebec, Manitoba, Saskatchewan, Ontario, and Newfoundland. Canada also diverts a much smaller share of its waste compared to other high-income countries. In

[7] Waste disposal per capita is a more traditional, commonly cited metric; however, waste disposal per capita does not capture different levels of economic activity across provinces, which is a strong predictor of waste generation. Using waste disposal per capita—instead of disposal per unit GDP—changes the relative ranking of provinces slightly. Nova Scotia, for example, is still the top performer, followed by British Columbia. However, Alberta disposes the most amount of waste in Canada on a per capita basis, likely because it has the highest income per capita in the country.

**Figure 2: Waste Disposal Intensity across Provinces, 2002 and 2014**




**This figure shows the amount of waste disposed per unit of GDP in 2002 and 2014. According to this metric, Quebec disposes the most solid waste relative to the size of its economy. Nova Scotia and British Columbia are the top performers as of 2014, disposing roughly 8 and 12 tonnes of waste for every $1 million in GDP, respectively. Prince Edward Island and the territories are excluded due to insufficient data.**

Source: Statistics Canada (2018a; 2018b)

2014, Canada diverted 27% of its total solid waste, compared to an average of 41% across 23 other OECD countries. Germany had the highest diversion rate at 66% (OECD, 2018).

Poor data on waste diversion in Canada is an overarching challenge. Gaps and inconsistencies in how data is collected make it impossible to compare waste diversion performance across provinces and municipalities. Some jurisdictions, for example, include backyard composting as diversion, while others do not. In other cases, like in Quebec, biosolids from wastewater count toward waste diversion. Without better standardization, researchers are unable to accurately evaluate progress and the efficacy of waste management policies (see Appendix A for more details).

## Most governments are not meeting their disposal and diversion targets

Provincial governments have established a wide array of waste targets as a foundation for waste management policy. Quebec, for example, had a target to divert 70% of its recyclables and 60% of organics by 2015. Nova Scotia set the country's most stringent disposal target of reaching 300 kg of waste disposal per person by 2015. Ontario's Climate Change Action Plan commits to diverting 40% of its organic waste by 2025 and 60% by 2035 (Government of Ontario, 2018).

Municipalities also rely on targets to drive policy development. The City of Guelph, for example, has a target of diverting 70% of its residential waste from landfilling by 2021. The City of Calgary set a goal of diverting 70% of its waste by 2025 (City of Guelph, 2017; City of Calgary, 2017a).

Overall most provinces and municipalities are struggling to reach their targets. Table 1 provides a sample of diversion and disposal targets with each jurisdiction's actual performance to date. The table also shows a wide range of metrics used across jurisdictions, each with different degrees of stringency. Notably, because provincial and municipal targets are often based on different metrics that use different definitions, it is difficult to accurately compare progress across jurisdictions.

Nova Scotia, for example, has one of the lowest waste disposal rates in the country at roughly 380 kg per person, yet the province's current disposal rate is 25% above its 2015 target. The City of Edmonton originally had a target to divert 90% of its residential

**Box 3: Nova Scotia Has Led the Way on Waste Management Policies**

**Government policies are a key reason why disposal intensities vary across provinces. Generally, diversion rates are highest—and disposal rates are lowest—in provinces with stringent and comprehensive waste management policies. The early and progressive actions taken in Nova Scotia are a clear illustration of how policy can affect waste management outcomes.**

Prior to making a fundamental shift in the 1990s, Nova Scotia was one of the largest per capita generators of solid waste in Canada. To turn things around, the province enacted several waste management policies, starting with establishing the country's most stringent waste diversion target at the time (to divert 50% of materials from landfills by 2000). This was followed by banning all organics and many recyclables from landfills in 1996, encouraging municipalities and the private sector to build and operate composting and recycling facilities. The province also implemented a deposit-refund program for beverage containers in the same year, diverting billions of beverage containers from landfills. Revenues from this program (and its tire recycling program) have helped finance the province's diversion credit program, which provides municipalities with waste management funding based on disposal rates (Walker et al., 2004).

Municipal policy has also played a key role in Nova Scotia. Almost all municipalities in the province, including the Halifax Regional Municipality, require that households put their garbage in clear bags so that waste operators can refuse those that contain banned substances. Many municipalities, like Argyle and Antigonish, have also shifted to bi-weekly waste collection, making waste disposal less attractive.

Taken together, provincial and municipal policies in Nova Scotia have helped it achieve the lowest disposal rate in the country. Critically, however, the province's stringent policies have come at a cost. Nova Scotia has the highest waste management costs in Canada measured on a cost-per-tonne basis. We return to these important trade-offs in Section 3 (Government of NS, 2015).

waste by 2012, which was later revised down to 65% by 2018. The City's current diversion rate is 36% (down from 50% in 2013). The Ontario government committed to increase the provincial diversion rate to 60% by 2008; however, as of 2015, the provincial diversion rate was 25%. It has since set a new, lower target (Ward, 2016; Mertz, 2018).

### Waste management is getting more expensive in Canada

As Canada generates more solid waste, the costs of managing it are increasing. Some of these costs are borne by municipalities and industry in building and operating waste management systems. Some costs are borne by consumers when industry passes higher costs on through higher prices. Lastly, some costs are borne by society as a whole, through increased greenhouse gas emissions, environmental and health risks, or amenity losses from living near waste management facilities.

Canada lacks robust data on each of these cost factors. However, Figure 3 shows an index of some of these costs. The figure includes an index of public expenditures related to waste management between 2002 and 2014, combined with an index of how much waste was diverted and disposed of during this period at the residential level.[8] Given that non-residential waste is typically managed by the private sector, we exclude this portion of the waste stream to provide a more accurate comparison.

[8] Public expenditures include any costs borne by local governments, waste management boards and commissions, and provincial bodies responsible for the delivering waste management services. Disposal costs include operating costs at disposal facilities and waste transfer stations, as well as contributions for post-closure and maintenance funds; diversion costs include operating costs at organics and recycling facilities.

**Table 1: Municipal and Provincial Waste Management—Targets vs. Performance**

| Province/ City | Waste Management Target | Date Est. | Performance | Sources |
|---|---|---|---|---|
| **Alberta** | Reduce per capita landfilled waste to 690 kg per person by 2014. | 2011 | Provincial rate of landfilled waste was 997 kg per person in 2014. | Government of Alberta (2011); Statistics Canada (2018a) |
| **Nova Scotia** | Divert 50% waste and reduce per capita landfill rate to 300 kg, per person by 2015. | 2007 | Provincial landfill rate was 380 kg, per person in 2015. Its diversion rate was 43% in 2014. | Government of NS (2016); Statistics Canada (2014a) |
| **Newfoundland & Labrador** | Divert 50% waste by 2010 based on 2002 levels. | 2002 | Provincial diversion rate was 24% in 2015. | Government of NL (2002; 2017) |
| **Ontario** | Old target: Divert 60% waste by 2008.<br><br>New Target: Divert 30% waste by 2020, 50% by 2030, and 80% by 2050. | 2004<br><br>2017 | Provincial diversion rate was 25% in 2016. | Government of Ontario (2004; 2017); ECO (2017) . |
| **Quebec** | Reduce waste disposal to 700 kg per capita by 2015. | 2011 | Provincial landfill rate was 685 kg per person in 2015. | Government of Quebec (2017a); Recyc-Quebec (2015) |
| **Winnipeg** | Divert 50% residential waste by 2020. | 2011 | Residential diversion rate was 33% in 2016. | City of Winnipeg (2018) |
| **Saskatoon** | Divert 70% waste by 2023. | 2009 | City diversion rate was 22% in 2016. | City of Saskatoon (2018a) |
| **Edmonton** | Divert 90% residential waste by 2012. | 2007 | City diversion rate was 36% in 2016. | City of Edmonton (2018) |
| **Toronto** | Old target: Divert 70% waste by 2010.<br><br>New target: Divert 70% waste by 2026. | 2007<br><br>2016 | City diversion rate was 52% in 2012; 53% in 2017. | HDR (2015); City of Toronto (2018) |
| **Vancouver** | Reduce waste disposal by 50% by 2020, based on 2008 levels. | 2012 | City reduced waste disposal by 27% as of 2015. | City of Vancouver (2012; 2017) |

Overall, the public expenditures for both diversion and disposal have increased substantially over time, particularly for waste disposal. The quantity of disposed waste from the residential sector increased by 18% between 2002 and 2014, while total public expenditures increased by 115%. The quantity of diverted waste (recycled and composted) increased by 72%, while the costs to manage it increased by 128%.

Several factors explain increasing waste management costs in Canada, though not all are represented in Figure 3.

First, landfills are increasingly expensive to build, operate, and close. Provinces have been shutting down older, unlined facilities and replacing them with larger sanitary facilities that meet new environmental standards.[9] Newfoundland and Labrador, for example, has closed 161 (68%) waste disposal sites since 2002, requiring municipalities to either build new, safer landfills or ship waste to landfills in other communities. Both options can increase the financial costs of disposal (Government of Newfoundland and Labrador, 2017; CCME, 2014a).

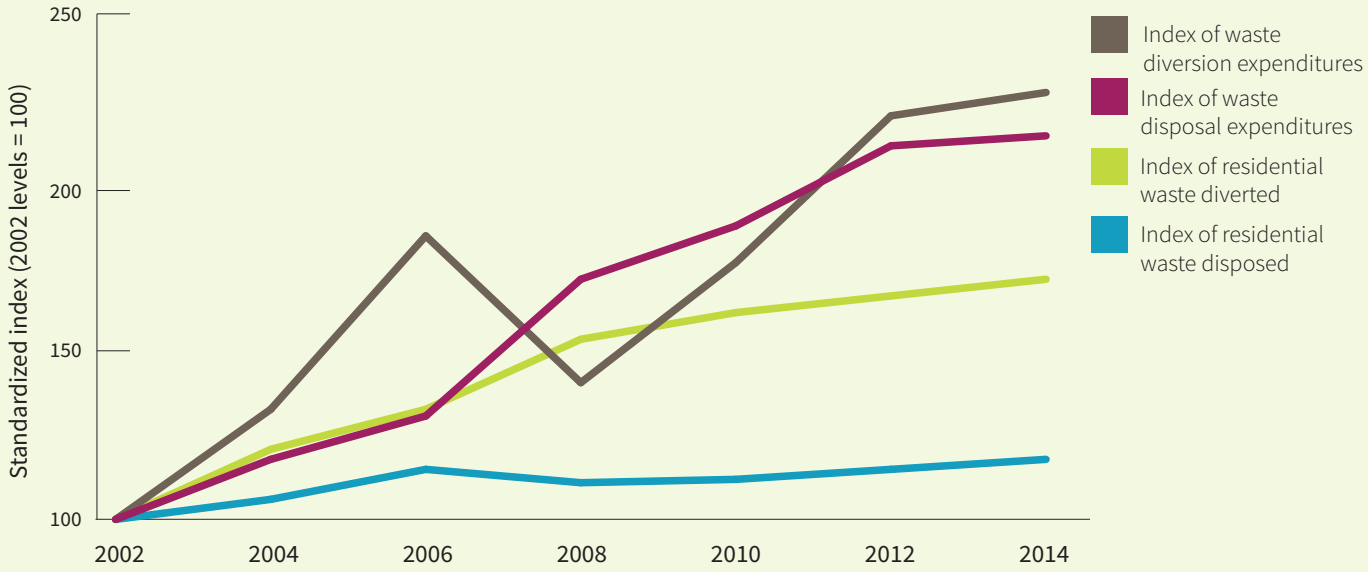
Second, waste diversion systems are becoming increasingly complex. On one hand, manufacturers are using a wider, more complex range of materials to manufacture and package consumer goods. On the other, recycling systems are accepting a broader range of these materials, many of which are difficult and costly to recycle, such as lightweight plastics, beverage cartons, and polystyrene (e.g., Styrofoam) (ECO, 2017; Lakhan, 2015a).

Third, Figure 3 excludes important financial costs—for example, the amortized capital costs of existing facilities and the opportunity costs associated with filling remaining landfill space—which may increase over time (see Section 3 for more detail). Considering that over 30% of Canadian landfills exceeded capacity in 2010, future capital costs will likely be significant (Hird, 2013).

Fourth, the figure excludes social costs associated with waste disposal, such as environmental risks, greenhouse gas emissions, and amenity losses (for example, noise and odours) to nearby residents from landfilling. Improvements to environmental standards have helped reduce some of these costs, but they cannot

[9] Environmental standards have also improved for waste-to-energy (incineration) facilities. Research by Moy et al. (2007) finds that air pollution regulations in the U.S. reduced emissions of certain pollutants by a factor of nearly one hundred.

**Figure 3: Index of Public Waste Management Expenditures and Residential Waste Flows, 2002 to 2014**




**This figure shows an index of public expenditures on waste disposal and diversion in Canada (dollars per year, nominal) and the total quantity of residential waste disposed and diverted (tonnes per year), normalized to 2002 levels. It shows that both disposal and diversion costs have increased at a faster rate than the total quantity of waste disposed and diverted. While these costs do not provide a complete picture, they include public operating costs at disposal and diversion facilities, the costs associated with municipal collection, the costs of operating transfer stations, and the costs associated with decommissioning and monitoring old landfills. Note that cost data from 2002 to 2008 do not include post-closure expenditures due to changes in Statistics Canada's methodology.**

Source: Statistics Canada (2014a; 2014b; 2018a)

be eliminated entirely and can accumulate over time as more disposal sites are required.

Waste diversion also has social costs that are not represented in the figure above. Building and operating diversion systems can increase transportation and processing emissions; they can also cause odours and increased traffic for neighbouring residents. Recycling can impose environmental damages in the countries that process and recycle waste from countries such as Canada.

Finally, the data in Figure 3 exclude waste management costs paid by the private sector (i.e., not by governments). In particular, it excludes the costs of hauling and managing non-residential waste, which is often handled by private waste management operators. Here too, evidence suggests these costs are increasing. While the amount of non-residential waste (disposed and diverted) remained relatively unchanged from 2002 to 2014, expenditures of private waste management firms increased by 72% (Statistics Canada, 2014c).

## 2.3 SUMMARY

Solid waste comes from all parts of the economy, but our focus in this report is on municipal solid waste. Municipalities can manage solid waste in three ways: disposal (i.e., landfilling, waste-to-energy), diversion (i.e., recycling, composting, reusing), and prevention (i.e., reducing).

The evidence suggests that we can do much better at managing municipal solid waste in Canada. Canadians generate large quantities of waste compared with other OECD countries, and this waste mostly ends up in landfills. And while waste diversion has steadily increased —varying considerably across provinces—municipal and provincial governments continue to fall short on their waste reduction and diversion targets. At the same time, as we generate more waste, the costs of managing it have increased.

How should Canadian municipalities address the challenges of excessive landfilling, low rates of waste diversion, and higher costs of waste management? A key first step might be to frame the problem of waste management differently.


# 3 REDEFINING THE PROBLEM OF WASTE MANAGEMENT

**The data presented in Section 2 suggest that Canada's waste management systems are not working as well as they could. But why? What policy challenges underpin these data? We argue that reframing the policy problem is useful.**

## 3.1 OBJECTIVES OF SOLID WASTE MANAGEMENT POLICY

In the past, waste management policy has often focused on diverting more waste and disposing less. Reducing disposal is important, yet is not always the best solution; depending on context and existing levels of service, diversion can be expensive. And in some cases, excessive waste disposal is a symptom of deeper, more systemic issues.

Instead, governments should pursue a broader objective: improving the overall *efficiency* of our waste management systems. More efficient systems deliver greater benefits of waste management at lower costs. Critically, those costs and benefits must include both financial and environmental factors.

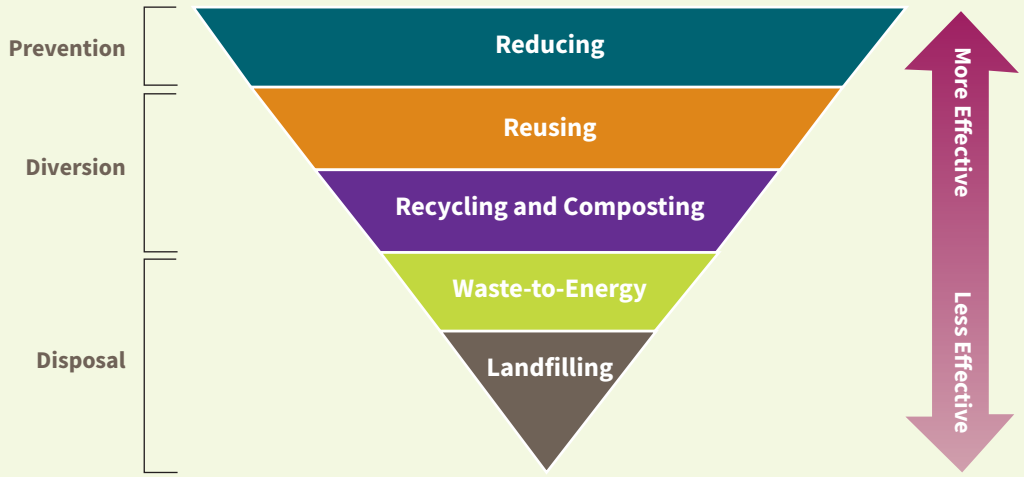
As we discuss below, the best way to improve efficiency is to make waste management systems work more like well-functioning markets.

### *Resource recovery* only tells part of the waste management story

The waste hierarchy, illustrated in Figure 4, provides the framework many governments use to prioritize and assess resource recovery. Actions near the top of the hierarchy are generally preferred because they reduce the quantity of waste generated or improve resource recovery (Dijkgraaf & Vollebergh, 2004; Hoornweg & Bhada-Tata, 2012).

The hierarchy prioritizes waste prevention, for example, because preventing waste from being created in the first place avoids having to manage it. Likewise, it prioritizes recycling over landfilling because it typically recovers a higher proportion of the energy and resources embedded in waste, uses less energy than creating goods from virgin materials, and extends landfill life.

Figure 4: Waste Hierarchy




**The waste hierarchy, pictured above, shows the preferred ranking of waste management options based on the ability to recover the resources embedded in waste materials. Waste prevention is at the top of the hierarchy and includes any action that reduces the creation of waste materials, such as producers choosing to use fewer packaging materials. Waste diversion includes any action that diverts material away from disposal, such as recycling, composting, or reusing materials. Waste disposal is at the bottom of the waste hierarchy and includes waste-to-energy (e.g., incineration with energy capture) and landfilling.**

Moving further up the waste hierarchy—toward greater resource recovery—has become a key objective of waste management policy over the past few decades. It is often the starting point for how governments conceptualize the problems and solutions associated with solid waste.[10] The "reduce, reuse, recycle" heuristic, for example, is derived from the waste hierarchy and is an ingrained part of the policy and political discourse.

The waste hierarchy and the objective of greater resource recovery also serve as the basis of waste management targets. These targets—often set without a full understanding of their costs or trade-offs—have become the driving force behind provincial and municipal policies such as curbside recycling and compost programs, producer responsibility policies, and plastic bag bans. The push for "zero waste" is the most recent emanation of the waste hierarchy (Walker & Xanthos, 2018).

The objective of moving further up the waste hierarchy has merit. It can, in most cases, increase the amount of material and energy that we recover from solid waste resources and reduces the amount of waste that gets landfilled (ECCC, 2016).

Yet focusing *solely* on resource recovery paints an incomplete picture.

### Instead, waste management policies should seek to improve overall *system efficiency*

Section 2 illustrated that all types of waste management, whether through disposal, diversion, or prevention, impose costs on society. Smart waste management policies seek to minimize these financial *and* social costs while maximizing the benefits of waste diversion and prevention, where they exist.

[10] The waste hierarchy is used by the U.S. Environmental Protection Agency, the European Union, and governments across Canada. The hierarchy first appeared in the 1970s in Ontario's Pollution Probe, responding to the financial, environmental, and social challenges with managing waste (Hoornweg & Bhada-Tata, 2012; Murray, 1995; PPP Canada, 2015).

**Table 2: Potential Costs and Benefits of Waste Management Policies**

| Impact on Waste Flow from Policy | Potential Costs | Potential Benefits |
|---|---|---|
| **Decrease in Disposal** | • Decrease in revenue at landfills, which may undermine cost recovery<br>• Administrative costs of policy | • Decrease in financial costs of disposal (e.g., deferred capital costs to build new landfill)<br>• Decrease in social costs associated with landfilling (e.g., reduced odour, environmental risk, GHG emissions) |
| **Increase in Diversion** | • Increase in collection/processing costs or system expansion<br>• Increase in GHGs and other air pollutants associated with collection and processing | • Increase in revenues from selling material<br>• Increase in environmental benefits from displacing the need for extracting and processing virgin materials |
| **Increase in Prevention** | • Increase in financial costs to produce goods that generate less waste<br>• Increase in financial costs for consumers to purchase goods that generate less waste<br>• Increase in costs in the form of time and effort in preventing or sorting waste | • Increase in environmental benefits from displacing the need for extracting and processing virgin materials<br>• Decrease in distribution and transportation costs<br>• Increase in benefits for those that are willing to pay more for improving environmental outcomes |

To fully capture the implications of solid waste management policies, and to ensure that they drive continual progress, they should seek to improve *overall system efficiency*.

System efficiency is a broader and more comprehensive objective than simply increasing resource recovery. Fundamentally, improving system efficiency considers the costs and benefits of potential policy changes. Policies that improve system efficiency increase net benefits; that is, this occurs when the incremental benefits from a change in policy exceed the incremental costs.

Evaluating whether a policy improves the efficiency of a waste management system requires an assessment of the *full* range of costs and benefits. To illustrate, Table 2 lays out the potential costs and benefits of a generic waste management policy that decreases disposal and increases waste diversion and prevention.

The costs and benefits identified in Table 2 increase or decrease depending on the objectives, scope, and design of policy. They also depend on the local context, as we explore in our case study in Section 6. New policies can interact with older policies, which affect the overall efficiency of the system. Determining whether policies lead to net benefits requires carefully considering these incremental impacts.

Reframing the objectives of waste management highlights an important tension: moving further up the waste hierarchy is not *necessarily* the most economically efficient way to manage waste, even though in some—or most—cases it *might* be. Just as landfilling all our waste is not an efficient or optimal outcome, trying to divert all of our waste is not efficient or optimal either. In both cases, the costs would outweigh the benefits.

The challenge for all waste management systems is to find the optimal balance between waste prevention, diversion, and disposal that maximizes net benefits for society.

### Well-functioning markets are good drivers of system efficiency

Assessing policies based on system efficiency is inherently more complex than determining whether a given policy improves resource recovery (i.e., whether it moves us up the waste hierarchy). This may, in part, explain why improving the overall efficiency of waste management systems receives less attention than simply increasing resource recovery.

Yet driving greater system efficiency does not always have to be more complicated. Markets are generally very good at efficiently allocating resources. If market-based policies are designed well—i.e., when waste management prices reflect their true costs—the resulting decisions of households and businesses can move us closer to a more efficient balance between waste disposal, diversion, and prevention.

## 3.2 SIX ISSUES WITH WASTE MANAGEMENT MARKETS

At first blush, waste management may not seem to meet the requirements for a traditional market with buyers and sellers. After all, we throw away items at our work, at home, or in sidewalk receptacles without paying directly for the service or seeing where our waste actually goes. As a result, waste systems are often out of sight, out of mind.

Yet there *are* markets for waste management services. They start locally, where waste from households, businesses, and institutions is collected, sorted, and supplied into the market. Landfills, recycling facilities, and organics facilities receive and manage this waste.

Markets also exist for recyclables and organic materials. The compost and energy from the processing of organics can be sold locally and help offset the cost of providing the service. Recyclables are bought and sold on national and international markets and generate revenue for recycling facilities and programs.

Like markets for other goods and services, waste markets function efficiently when waste generators pay the full cost of having their waste managed. When prices reflect their true financial *and* environmental costs, waste markets efficiently allocate resources across the different ways we can manage our waste (DEFRA, 2011; Lavee, 2007; Porter, 2002).

If, for example, it costs less to recycle waste than to landfill it, waste generators have an incentive to recycle more. However, if the cost of recycling a particular material is exceedingly high—higher than the cost of landfilling—there is an incentive to recycle less of it and landfill more. Pricing can signal when it is economic to landfill certain materials and when it makes sense to recycle, compost, reuse, or prevent waste.

The market for solid waste management, however, is *not* a typical, well-functioning market. Various peculiarities and imperfections of waste markets help explain why prices of waste management do not reflect its true costs. These structural problems with waste management markets may, for example, help explain why Canadians generate so much waste and why most of it gets landfilled.

As a result, addressing the following six issues represents an opportunity to improve the performance and efficiency of our waste management systems.

### Issue #1: Most Canadian households do not pay directly for waste management

Households typically pay for waste collection through property taxes or as a monthly fee. In other words, the amount residents or businesses pay for waste management has—in many cases—no connection with the quantity or composition of solid waste they generate. With no incentive on the margin, people tend to generate and dispose of more solid waste than they otherwise would if they paid directly for the service.

Artificially cheap waste disposal also weakens the incentive to divert waste through recycling or composting. Yet households rarely pay directly for waste diversion services either. Recycling and composting programs are typically funded through a mix of property taxes, fixed monthly fees, producer-funded programs, and fees at landfills. Like garbage collection, the actual cost that each waste generator imposes on the system is disconnected from the quantity or type of waste diverted.

A relatively small number of municipalities in Canada, however, charge households directly for their disposed waste, through *pay-as-you-throw* (PAYT) programs. These programs charge households based on the size of their garbage bin or by the quantity of garbage bags they put at the curb. We return to PAYT programs in Section 4.

### Issue #2: Landfills do not charge large waste generators the full cost of disposal

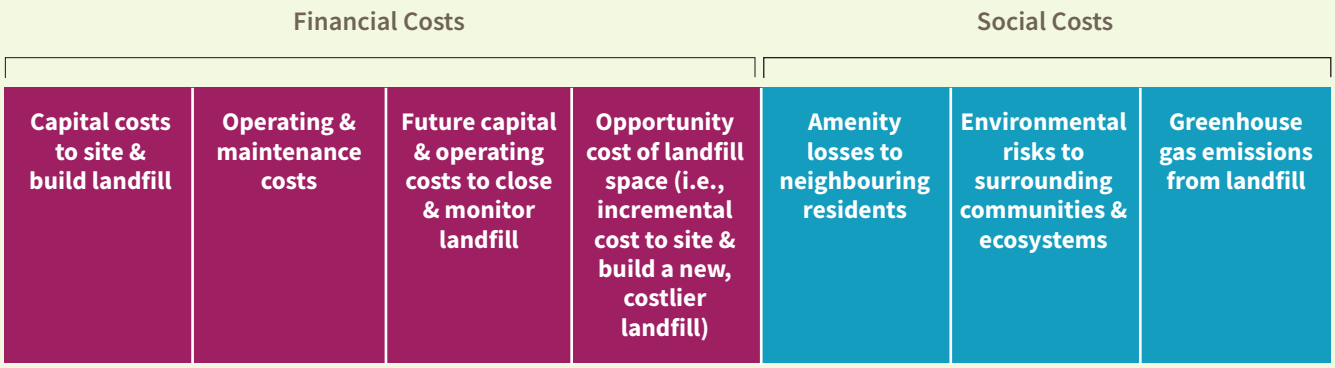
Although most Canadian households do not pay directly for waste management services, prices are more transparent for the commercial sector, such as businesses, large buildings, institutions, and industry. Commercial waste is typically hauled directly to landfills, where waste generators pay a fee to dump their waste—called a *tipping fee*—based on the weight or type of waste being tipped. Tipping fees also trickle down to the residential level and can affect how municipalities pay and charge for waste disposal.

But even here, the *level* of tipping fees may be artificially low in Canada. In many cases, the rate people pay for disposing of every tonne of garbage is less than the full cost, encouraging waste generators to landfill more waste than they would otherwise.

Based on the principles of full-cost accounting and full-cost recovery, the fees charged at disposal facilities should reflect the full spectrum of costs illustrated in Figure 5.[11] Tipping fees should

[11] Full-cost accounting lays the groundwork for full-cost recovery and is a recommended best practice in the industry. This process assesses all existing and future financial costs of waste disposal, including all amortized capital costs and operating costs. Comprehensive full-cost accounting also includes estimating the social costs associated with waste disposal systems, discussed later in this section. Tipping fees can then be set based on the full cost of disposal (US EPA, 1997; Kijak and Moy, 2004).

### Figure 5: Full Spectrum of Financial and Social Costs of Landfilling




**This figure shows the full spectrum of financial and social costs associated with landfilling (other modes of waste disposal, such as waste-to-energy, would have similar types of costs). The financial costs include all amortized capital and operating expenditures of the existing waste management facility. Financial costs also include the future costs of closing down landfills, operating costs to monitor the closed site, and the capital costs associated with siting and building a replacement landfill. The social costs of landfilling include amenity losses, environmental risks, and GHG emissions. While the magnitude and distribution of these costs vary across communities and depends on the local context, each cost component is relevant for all landfills.**

include basic cost factors, like operating and (amortized) capital costs to build and close existing landfills. They should also include the opportunity cost of landfill space, which is a proxy for the future costs of having to build new, costlier landfills once the existing facilities reach their capacity.[12] Tipping fees at each landfill should also be differentiated, as some materials are costlier to landfill than others (Dewees, 2002; Government of Alberta, 2007; Kinnaman, 2014; Porter, 2004; US EPA, 1997).

Full-cost recovery also requires that tipping fees include the broader, social costs associated with waste disposal. These social costs are borne by households and firms external to the waste management system, such as greenhouse gas emissions and the risk of soil and water contamination from landfills (El-Fadel et al., 1997; Porter, 2004).

Although comprehensive data is unavailable, evidence suggests that tipping fees at Canadian landfills generally do not reflect the full costs of disposal.

Privately owned landfills tend to charge fees that reflect most financial costs, ensuring operators generate enough revenue to cover the costs of building, operating, and closing the facility. Fees rarely, however, reflect the opportunity costs of existing landfill space. This is likely because private landfill operators set prices based on the costs of their disposal site, not the future costs to the waste management system after their landfill is closed.

Fees at private landfills may also fail to reflect the long-term environmental risks of landfills after they are closed—or the costs of managing these risks. Although most provinces require operators to assume liability for closed landfills for a few decades after their closure, environmental risks can extend beyond these liability periods.

Tipping fees can be even lower at publicly owned landfills, for multiple reasons.

Some municipalities keep tipping fees below the financial costs to keep rates at what are thought to be affordable for residents or because it is politically difficult to increase rates. Some landfills—

[12] The opportunity cost of landfill space increases over time as they approach their capacity. Generally, siting and building new landfills increases net disposal costs (scarcer land, better environmental standards, etc.). Each additional tonne of waste in the existing landfill therefore hastens the time that a new, costlier alternative needs to be built. The opportunity cost is equivalent to the incremental cost of siting and building the next landfill, discounted based on the remaining life of the existing landfill (Dewees, 2002).

including some in Saskatchewan, Manitoba, and Nunavut—do not charge tipping fees at all. The municipal landfill for the City of Brandon, Manitoba, for example, does not charge for loads under 500 kilograms (Valdivia, 2010; CCME, 2014a; City of Brandon, 2018).[13]

Tipping fees at some publicly owned landfills are also set below the full cost because capital costs are partially financed through provincial and federal grants. The landfill in southwest New Brunswick, for example, received $4.5 million to install a new leachate collection system and treatment ponds.[14] Although such funding helps improve disposal infrastructure and reduces environmental risks to nearby residents, any costs covered from grants can no longer be included within tipping fees, which again limits incentives to reduce waste (Government of New Brunswick, 2017).[15]

Waste generators also do not pay for the full social costs associated with landfilling. Living near waste disposal facilities, for example, imposes amenity losses to nearby residents from potential odour, unsightliness, and social stigma, all of which can depress nearby property values. Landfills also impose a range of environmental risks, even with state-of-the-art technologies. Moreover, environmental protections (e.g., liners) can fail and financial assurance requirements may be insufficient to cover environmental risks. Landfills are also a significant source of GHG emissions that contribute to global climate change (ECO, 2017 Reichert et al., 1991; Kinnaman, 2006; Hirshfeld et al., 1992; CMAP, 2015).

Improvements to environmental regulations have internalized some of these social costs, allowing site operators to pass these extra costs onto waste generators. However, environmental standards vary across provinces, particularly for older, less secure landfills that are still in use or have already been closed.

Finally, a scan of disposal sites across Canada suggests that few are charging differential tipping fees. Many disposal sites simply charge basic rates for household and commercial waste, regardless of what *types of waste* are being disposed.

### Issue #3: The porous boundaries of solid waste management systems make it difficult for municipalities to price waste disposal at its full cost

The boundaries of solid waste management systems are porous. Unlike municipal water and wastewater systems, where municipalities have near complete control over treatment and distribution infrastructure, solid waste systems—and the flows of waste within them—are more decentralized. These porous boundaries make it difficult for municipalities to charge full-cost tipping fees, which can undermine cost recovery and environmental performance.

A big part of the issue stems from the fact that municipalities have limited control over non-residential solid waste, which is often hauled and managed by the private sector. Waste haulers typically have several options for commercial disposal, so waste generally flows to jurisdictions with the cheapest tipping fees (after factoring in transportation costs). In Metro Vancouver, for example, where tipping fees are relatively high, waste exports to the U.S. doubled between 2012 and 2015. At the national level, waste exports to the U.S. more than tripled between 1999 and 2016 (Bula, 2014; ECCC, 2018).[16]

Waste exports may not seem like a problem on the surface. If all waste disposal facilities operated at the same level of environmental performance, differences in tipping fees would reflect the relative costs of building, operating, and closing each facility. The competition between disposal facilities could actually *improve* system efficiency by allowing waste generators to seek the lowest-cost method of disposal.

In practice, however, the issues associated with waste exports are more complicated.

Even though municipalities may want to set tipping fees that reflect the full cost of service, the potential for waste exports may prevent municipalities from doing so. Underpricing disposal not only discourages waste diversion and prevention (discussed above)

[13] Municipally-owned landfills can charge artificially low rates because they can make up the difference with other revenue sources. In many cases, publicly owned waste-disposal systems are financed (partially or fully) through property taxes. In the Regional District of Kitimat-Stikine and the City of Terrace in B.C., for example, operating costs for several new waste management facilities (including a landfill) are financed 50% through property tax revenues and 50% through tipping fees (Regional District of Kitimat-Stikine, 2016).

[14] Leachate forms when rainwater moves down through landfills, mixing with metals, chlorides and other minerals, nutrients, chemicals, and other toxic materials (ECO, 2017).

[15] Because tipping fees are often considered a municipal user fee, rates at public facilities can reflect only the net costs of a service (i.e., user fees cannot generate surplus revenues).

[16] Waste exports are most prevalent in municipalities near the U.S. border. Tipping fees are generally much lower in U.S. border states, creating significant trans-border waste flows from Canada. Roughly 70% of U.S. landfills receive their revenues either exclusively from general taxes (i.e., not through tipping fees), or a combination of tipping fees and general tax revenues. Tipping fees in Michigan, for instance, are as low as 50 cents per tonne (US EPA, 2007; 2014).

**Box 4: Managing Waste in Canada's North**

**Waste management systems in Canada's north are still quite rudimentary and face a broader, more complex array of challenges than in southern communities. Populations are smaller, more dispersed, and typically located farther from disposal or recycling facilities. The financial costs of managing waste are therefore much higher in northern communities (ECCC, 2017; Lakhan, 2015b).**

The health and environmental risks associated with waste disposal are also much higher in Canada's north. Landfills are often unlined and built above ground due to the region's geology (i.e., bedrock, permafrost) and pose a greater risk of leaching toxic chemicals into the soil and surrounding waterways; some communities still practice open burning (Danon-Schaffer, 2015; ECCC, 2017; CCME, 2014a; Government of Nunavut, 2012).

Waste diversion is also less viable in northern communities. Some larger communities in the mid-north, such as Thunder Bay, Ontario, collect their recyclables and transport them to facilities farther south. However, for most small and northern communities, recycling and composting is simply too expensive, especially when tipping fees are set below cost (City of Thunder Bay, 2013).

For these reasons, provincial and territorial governments often provide grants to northern communities to help finance diversion programs. Other policies, like Extended Producer Responsibility programs can also help distribute the costs of recycling more evenly across provinces. Provincial landfill tipping fees can also help provide revenues to help support diversion systems in northern communities. See sections 4 and 5 for more details.

but can undermine a municipality's ability to recover its costs. Building, maintaining, and closing landfills is capital intensive, meaning that a large portion of disposal costs are fixed. If waste exports increase, municipalities generate less revenue to cover their fixed costs.

In some cases, low tipping fees reflect weaker environmental standards, particularly at older, less secure landfills. Cheaper tipping fees may also reflect a weaker emphasis on waste diversion and resource recovery. Second-generation landfill facilities, such as the Otter Lake landfill in Halifax, Nova Scotia, use costlier technologies to sort and pretreat waste before it is buried, reducing environmental impacts and improving resource recovery. These technologies, however, have increased tipping fees in the Halifax Regional Municipality to the point where all non-residential waste was exported to other communities in 2017 (Mirror, NS, 2018).

The porous boundaries of solid waste systems also mean that increasing the price of waste management services can increase the risk of illegal dumping. Most communities, if not all, already struggle with illegal dumping—in alleys, parks, and forests—which poses a health and environmental risk and is costly to clean up. Without appropriate policies in place, increasing the price of waste management can make illegal dumping worse.

### Issue #4: Markets alone may provide inadequate waste diversion opportunities for some materials

Municipal governments have played a key role in providing waste diversion infrastructure. Most municipalities provide curbside recycling, and a growing number now provide curbside organics collection. To a lesser extent, these systems also provide waste diversion opportunities for the commercial sector.

But why must governments provide these services or require that industry provide them? If recovering and selling the resources embedded in waste can generate benefits, why does the private sector not provide more opportunities for households and the commercial sector to recycle and compost?

Issues #1, #2 and #3 are part of the problem: waste disposal prices are set below the full cost of the service, and municipalities may find it difficult to increase prices due to the porous boundaries of the waste system. Disposal prices set the benchmark for other types of waste management; low disposal prices inadvertently

**Box 5: The Global Recycling Market is Turned on Its Head**

**Recent policy reforms in China—the world's largest importer of recyclable materials—have jolted the global recycling market. In early 2018, the government banned 24 different types of recyclables, including plastics, unsorted paper, and textiles. It also lowered contamination thresholds for materials it still accepts, such as boxboard and paper (Staub, 2017).**

The changes in China are having major implications for Canadian municipalities, most of which are responsible for managing their own recycling programs and sent a significant portion of their recyclables to China prior to the new policies. Municipalities are scrambling to find new markets for their materials; some have been forced to stockpile materials and, in rare cases, have landfilled or burned them. Other municipalities are investing in new capital equipment to help reduce contamination at processing facilities. The glut of materials globally has also depressed commodity prices, resulting in significantly less revenue for municipal recycling programs (Bula, 2018; Corfu, 2018; Hounsell, 2018).

discourage the private sector from capitalizing on new waste management opportunities.

Yet even if waste disposal was priced according to its true cost, the private sector will not necessarily provide adequate levels of waste diversion.

In some cases, recycled materials may not have clear use or market demand. This is less a problem with waste management markets and more an issue about the materials that manufacturers choose to use (Issue #5). It also highlights the limitations of recycling technologies: recycling some materials may be too expensive compared to alternatives, even if markets priced these materials correctly.

More importantly, economies of scale can be challenging to realize with waste diversion systems. Similar to waste disposal, systems for waste diversion can be more efficient when operated on a broader scale. Problems with insufficient scale are particularly challenging in small, rural, and northern communities (see Box 4) (Porter, 2002; OCED, 2013).

Lastly, providers of waste diversion services have limited control over how residents and businesses manage and sort their waste before it enters the solid waste collection system. Municipal recycling and organics programs, for example, rely on residents to sort their waste according to the local requirements that vary across municipalities. This lack of control causes persistent contamination issues at recycling and composting facilities, which can deter the private sector from providing more waste diversion services (ECO, 2017).

Inevitably, materials end up in recycling and composting systems that do not belong.[17] For organics processing, this contamination can degrade the quality of compost and the value of the end product. For recycling, it can slow down processing, break equipment, and degrade the quality and marketability of the end product. And while contamination has always been an issue, recent policy developments by the Chinese government have amplified these problems and made recycling markets more unpredictable (see Box 5). An estimated 1,000 recycling centres and processing plants in California, for example, have recently shut down due to increasing costs from contamination (Bornstein, 2018; Kummer, 2018).

### Issue #5: Individual municipal pricing policies have limited effect on goods manufacturers

If waste management was priced at its full cost—in all jurisdictions—consumers would have clear incentives to purchase goods made with less material or materials that are easier to recycle or compost. Producers, in turn, would have an incentive to design and manufacture goods that generate less waste (OECD, 2001; 2016).

[17] Contamination rates at recycling facilities vary across Canada. They are typically higher in municipalities that use single-stream-collection systems, where all household materials are placed into one bin. In Toronto and Edmonton, for example, which both use single-stream collection, contamination rates were 26% and 24%, respectively, meaning that one-quarter of materials ended up going to landfill (Chung, 2018).

## Box 6: How is Solid Waste Management Connected to the Circular Economy?

**Solid waste issues are innately connected to the broader discussion of creating a more "circular economy" (CE). CE argues for reducing waste—broadly defined—from economic activity and for decoupling the use of scarce resources from production and consumption processes. In theory, it offers a sustainable alternative to the linear, "take-make-waste" approach to how most goods are currently produced, consumed, and disposed of (Lacy & Rutqvist, 2015).**

The science and policy research behind CE, however, is still in its infancy. In fact, the exact definition of CE is unclear and based on a loose collection of ideas that cut across multiple disciplines. The precise role of government policy in achieving a circular economy is equally unclear and requires more study (Kirchherr et al., 2017; Korhonen et al., 2018).

Still, waste management policies can play an important role in creating more circular approaches to how goods are produced, consumed, and used after the end of their useful life. Indeed, many of the waste management policies described in this report contribute, albeit indirectly, toward this end. Extended Producer Responsibility programs, for example, covered in Section 5, make manufacturers physically and financially responsible for managing the waste generated from their products and materials. Such policies can improve how materials are recycled, reused, and repurposed and displace the need for virgin materials.

Yet even if *individual* municipalities charged residents directly for waste disposal, and even if these prices approached the full cost of the service, prices would have a limited impact on upstream production. Waste is priced locally, and municipalities are too small to affect the decisions made by goods producers in other provinces or countries.

Indeed, supply chains are *global*. Even with harmonized pricing policies across Canada, manufacturers would still have incomplete incentives to produce fewer waste-intensive products. Canada is a small market relative to the rest of the world; our policies therefore have limited effect on the decisions of multinational corporations.

The lack of incentives for producers may help explain the shift to making goods with materials that are less recyclable and reusable. Manufacturers prefer using lighter, thinner, and more complex materials, which are cheaper to produce and transport. This trend, known as the *evolving tonne*, has helped reduce the weight of waste materials; however, it has made recycling more challenging and expensive (ECO, 2017; Morawski et al. 2015).

### Issue #6: Extracting and processing natural resources generate negative environmental externalities further upstream

This last issue is unlike the other five. It refers to a problem that ultimately *affects* solid waste, but is not fundamentally about waste management systems. As a result, this issue is not a central focus in this report but is nevertheless worth noting.

The majority of materials and consumer goods produced in the economy use virgin materials, extracted and processed from the natural environment. These economic activities, including mining, logging, agriculture, and oil and gas extraction can cause significant environmental damages that are unpriced or underpriced in markets (see Box 2). In other words, the firms extracting and processing these materials do not pay the full cost associated with these upstream processes (ECO, 2017; Korhonen et al. 2018).

Underpricing upstream environmental damages effectively subsidizes the use of virgin materials and distorts markets further downstream for recycling, reuse, and prevention. Firms have incentives to use more virgin materials and less recycled and reused

| Table 3: Six Key Issues with Solid Waste Management Systems | |
|---|---|
| 1 | Most Canadian households do not pay directly for waste management |
| 2 | Landfills not charge large waste generators the full cost of disposal |
| 3 | The porous boundaries of solid waste management systems make it difficult for municipalities to price waste disposal at its full cost |
| 4 | Markets alone may provide inadequate waste diversion opportunities for some materials |
| 5 | Municipal pricing policies have limited effect on upstream goods manufacturers |
| 6 | Extracting and processing natural resources generate negative environmental externalities further upstream |

materials in their manufacturing processes. Box 6 discusses how these issues fit within the broader concept of "circular economy" (ICF Consulting, 2005; ECCC, 2016).

Despite the importance of these upstream environmental costs, waste management policies are an inefficient way to address them. A better approach is to implement policies that directly address these issues. Carbon pricing, for example, is the most cost-effective approach to managing greenhouse gas emissions. Better risk-management policies are a cost-effective approach to addressing environmental risks associated with tailings ponds from mining (Canada's Ecofiscal Commission, 2018a; 2018b).

Because upstream environmental externalities require a different set of policies, they are mostly beyond the scope of our analysis. This is not to say, however, that we ignore these issues completely. As we discuss below, a comprehensive analysis of costs and benefits of waste management policies requires that upstream impacts be considered.

### When left unaddressed, these six issues make our waste management systems inefficient

The problems with waste management markets in Canada—summarized in Table 3—are complicated, layered, and dynamic. They are interconnected and cascade throughout waste management systems. And while they are different in each community, shaped by local context, they all affect Canadian communities to some extent.

Policies that address these six issues can make our waste markets work better, improving the overall performance and efficiency of waste management systems in Canada. The next two sections consider concrete policy options for doing so.

# 4 THE CASE FOR SMARTER DISPOSAL PRICING

**Creating efficient waste management systems starts with smarter disposal-pricing policies. Disposal prices set the benchmark for the entire waste management system, changing the relative prices of waste diversion and prevention. By making waste generators pay the full cost of waste disposal, these policies address Issues #1 and #2 discussed in the previous section.[18] If disposal-pricing policies are designed well, they can even address Issue #3 by reducing the porous boundaries of waste systems (see Table 3).**

There are two main ways to price waste disposal: landfill tipping fees and "pay-as-you-throw" programs. This section considers the strengths of each.

## 4.1 LANDFILL TIPPING FEES

Tipping fees are the most common way to price waste disposal both in Canada and internationally. Landfills charge user fees directly on waste brought to landfills—typically from non-residential waste generators—based on the type, volume, or weight of the material. Fees can be set by private landfill operators or municipal governments.

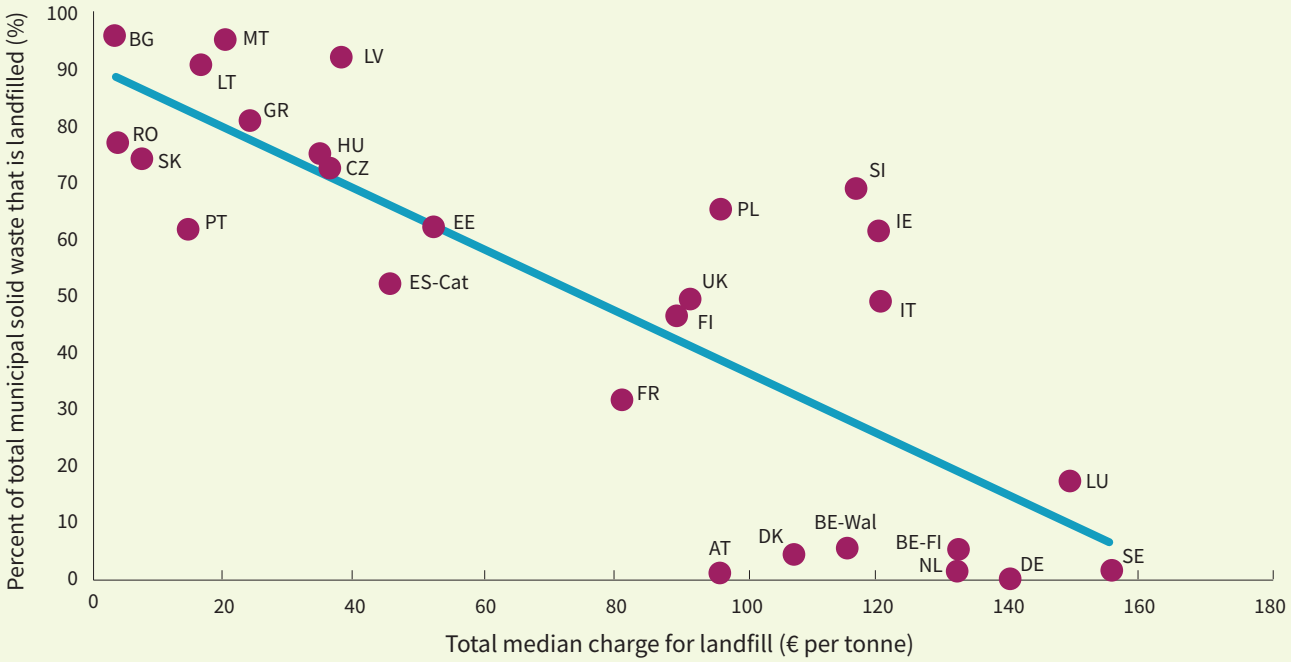
### Tipping fees can create an incentive to reduce waste disposal and generate revenues

Evidence from around the world illustrates a strong link between higher disposal prices and reductions in landfilled waste. Figure 6 shows the relationship between disposal prices and the amount of waste disposal in 27 European countries. In general, higher disposal prices are associated with lower disposal rates. A study in the U.S. finds a similar correlation, showing a clear relationship between states with higher disposal fees and lower landfill rates (Goldstein et al., 2010).[19]

[18] Pricing diversion can further improve system efficiency, but it is typically more complicated to implement, particularly for recycling. There may also be a case for subsidizing diversion systems to encourage more recycling and composting.

[19] Importantly, these studies do not definitively conclude that higher tipping fees cause lower landfilling rates. Isolating the impacts from tipping fees in any study is difficult. Other factors also contribute to disposal rates, such as policies and programs that encourage waste diversion and prevention. Moreover, a decrease in landfilling rates can cause an increase in the cost of landfilling, putting upward pressure on tipping fees—indicating the potential for a reverse correlation. Nevertheless, the data and analysis do imply an important connection between price and waste disposal.

**Figure 6: Relationship between Tipping Fees and Landfilling in the European Union, 2009**




**This figure shows the median tipping fees (plus applicable taxes) across 27 jurisdictions in the European Union from 2009. Overall, it shows that jurisdictions that landfill a smaller share of municipal solid waste (expressed as a percentage of the total amount managed waste) tend to also have higher landfill tipping fees (€ per tonne). The data does not prove that higher prices lead to less disposal: given other waste management policies in each jurisdiction, tipping fees are not the only driver for lower landfill rates. Nevertheless, the data is suggestive. See CEWEP (2017) for more information on the complementary policies used in each country.**

Source: Watkins et al., 2012

Tipping fees that more closely reflect the costs of waste disposal have two main advantages

First, and most importantly, they can drive waste reductions at a low cost. Governments cannot know the optimal or least expensive waste management options for the thousands or millions of residents and businesses. Tipping fees allow each waste generator to determine the cheapest way of managing their waste. Some waste generators, for example, might spend more time diverting their waste to avoid paying more in tipping fees. Others may be willing to pay the tipping fee and continue to landfill the same amount of material, because the costs of waste diversion are greater than the tipping fee (GIZ, 2015).

Second, tipping fees generate revenues that pay for the service and recover costs. These revenues ensure that waste disposal infrastructure is properly built, monitored, and maintained. They ensure that landfills have the funds to provide the service, but they also help reduce environmental costs. Revenues, for example, ensure that landfills have the required technologies to collect and treat leachate, capture GHG emissions, cap facilities after they close, and monitor regularly during and after operation. Provincial policies, such as surcharges on local tipping fees, can also help generate revenues to pay for the system (see Box 7).

Municipalities *are* shifting toward full-cost tipping fees, though data limitations make it challenging to assess this progress in full.

The two largest landfills in western Newfoundland, for example, doubled their tipping fees in 2018, from $75 per tonne to $164. The higher fees reflect escalating disposal costs: the two landfills have reached their capacity and turned into transfer stations (Bird, 2018).

In some cases, provincial policies are providing the impetus for full-cost pricing in municipalities. Legislation in British Columbia, for example, requires all regional districts to charge fees that reflect the full cost of the service. As a result, regional districts such as Metro Vancouver must fully recover the capital and operating costs of its regional disposal system through tipping fees (Government of BC, 2015).

## Box 7: Provincial Surcharges on Local Tipping Fees

**Provincial governments can implement tipping-fee surcharges, which are levied in addition to local tipping fees. Surcharge tipping fees (i.e., landfill taxes) are common in Europe and several states in the U.S. In Canada, Quebec and Manitoba are the only two provinces that currently charge tipping fee surcharges (EEA, 2009; US EPA, 2014; CEWEP, 2017).**

The main benefit of surcharge tipping fees is that new revenues can help fund waste management projects throughout the province. In Quebec, an additional $22 is charged for every tonne of waste disposed at landfills, with the revenues entirely earmarked for diversion programs. The Manitoba government, by contrast, charges an additional $10 per tonne, where 80% of revenues support waste diversion and prevention at the municipal level and the remaining 20% supports provincial waste diversion efforts (CCME, 2014a; Government of QC, 2017b; Government of Manitoba, 2018).

In theory, provincial surcharge tipping fees can also help municipalities charge the full cost of disposal. The challenge, however, is setting fees that accurately reflect the full costs of disposal at each waste disposal facility within a given province. Disposal costs are location specific and depend on a variety of factors, such as engineering standards, environmental protections, and proximity to sensitive ecosystems. Older landfills in particular may lack basic technologies that are now commonplace in others. Prorating the provincial surcharges based on these cost factors at each landfill could address this heterogeneity but would be difficult (if not impossible) in practice (CEWEP, 2017).

### Differentiated landfill tipping fees drive more targeted reductions in waste

Tipping fees need not be the same for every material. In fact, differentiated tipping fees can provide a more direct and accurate pricing signal by establishing different rates: materials that cost more to manage—such as large appliances that have hazardous components, or mattresses that take up more space in landfills—are charged at a higher rate. Rates may also vary based on the size of waste loads to reflect the higher per-tonne cost of processing smaller loads (Metro Vancouver, 2018).

Tipping fees for small waste loads in Metro Vancouver, for example, are 67% higher than large waste loads, reflecting the proportionately higher costs of processing smaller loads. Similarly, tipping fees at the landfill in the City of Nanaimo are between 100% and 190% higher for waste loads that contain recyclable materials (Regional District of Nanaimo, 2018).

The United Kingdom's landfill tax illustrates how differential tipping fees can change solid waste flows.[20] The tax—introduced in 1996—sets two different rates: a standard rate for biodegradable wastes (e.g., organics), and a rate for inactive wastes (e.g., concrete). The standard rate started at £10 ($17) per tonne in 1999 and rose to £86 ($150) by 2017, while the rate for inactive waste has remained relatively unchanged at £2 ($3) per tonne.[21] The tax applies to all landfills—public and private—and is levied on top of local tipping fees (UK National Statistics, 2018).

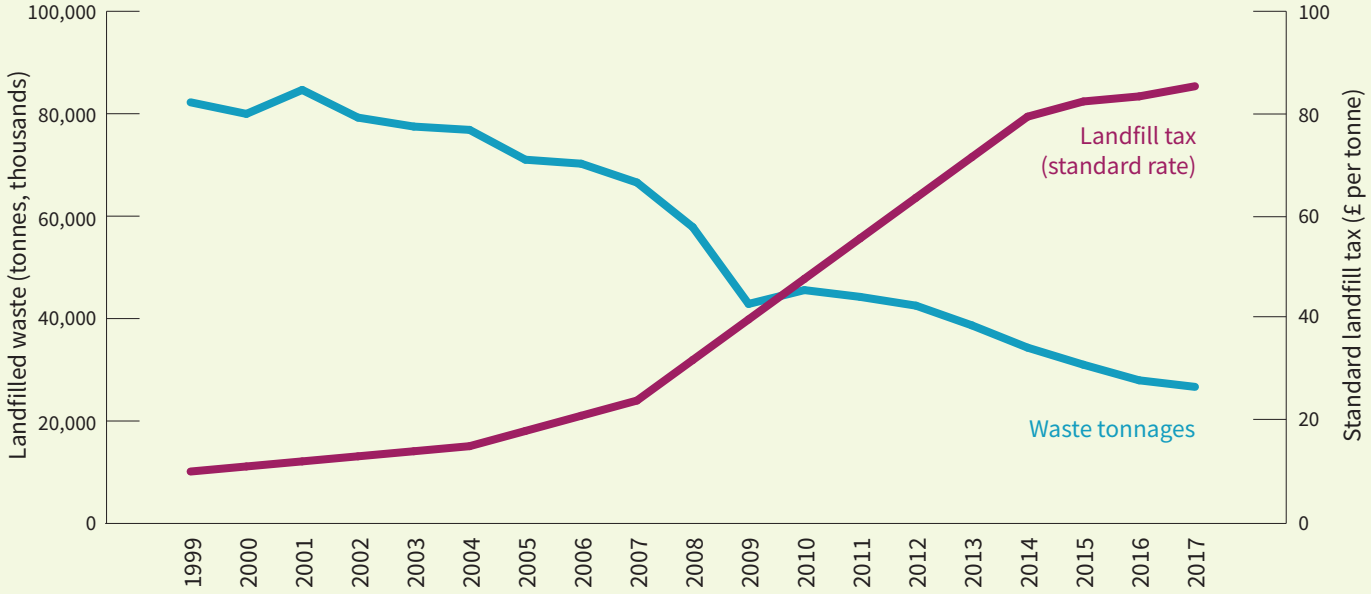
The tax appears to have had a significant impact (see Figure 7):

- As the tax rate increased, a smaller share of U.K. waste went to landfills. Quantities of landfilled waste fell 67% between 1999 and 2017, from 83 million tonnes to 27 million tonnes.
- Diversion rates increased from 12% to 49% between 2001 and 2010.

[20] Aggregated data on differential tipping fees—and their impact on waste disposal—are limited in Canada. While individual municipalities confirm that differential tipping fees have helped reduce waste disposal, there are limited data to support these claims.

[21] The landfill tax values (nominal) were converted into Canadian dollars, using the exchange rate of 1 Canadian dollar = 0.58 British Pound (July 4, 2018).

**Figure 7: Quantity of Landfilled Waste in the U.K. and the Landfill Tax Rate, 1999 to 2017**




**This figure shows the U.K.'s landfill tax rate over the 1999–2017 period, rising from roughly £10 per tonne in 1999 to £86 per tonne in 2017. Over this same period, the intake of landfilled materials fell by 67%, from 83 million tonnes to 27 million tonnes.**

Source: UK National Statistics, 2018

- Net GHG emissions from all UK solid waste management systems (including landfills, incinerators, recycling and composting facilities, transportation, and avoided emissions) decreased by two-thirds between 1990 and 2010 (Watson, 2013).

The landfill tax was not the only policy that the U.K. implemented during this period. The government also implemented a cap-and-trade system for residential waste between 2005 and 2013 that set limits on landfilled waste. Together these policies contributed to the reduction in landfilled waste. Notably, however, the volume of commercial and industrial landfill waste covered only by the tax dropped by more than 40% (DEFRA, 2012).

## Better environmental regulations can help internalize social costs in tipping fees

Tipping fees can include, or internalize, some of the social costs associated with waste disposal. They can, in other words, include the costs to society, such as environmental damages or, more precisely, the costs of avoiding environmental damages. In fact, this was the original intent of the U.K. landfill tax by setting a higher rate for organic materials compared to inert materials.

Governments across Canada have taken steps to address environmental costs associated with waste disposal through tightening standards at landfills. Most provinces require landfill operators to build sites with leachate collection and treatment, landfill gas capture, and groundwater monitoring. In British Columbia, for example, landfills are required to manage issues around dust, noise, litter, odour, and wildlife attraction. They are also responsible for monitoring and maintaining the site for at least 30 years after it closes. Each of these requirements increases the cost of building, operating, and closing landfills, which can be passed on through higher tipping fees (Government of BC, 2016).

Landfills can also strike agreements with neighbouring residents to address local concerns. To address amenity losses associated with operating the Green Lane Landfill in Ontario, for example, the operator signed an impact benefit agreement with two neighbouring communities. These two communities split 4% of the total revenue generated from the landfill, equal to about $500,000 for each community per year. This provides compensation for things like odour, unsightliness, and increased traffic (Albert, 2018).

### Depending on circumstances, two-part tipping fees might address challenges around waste exports

While waste exports are not necessarily a problem, they can raise challenges in some circumstances.

In particular, exports can undermine municipal cost recovery, particularly if local facilities are built to a higher environmental standard. Disposal facilities with stronger environmental standards (e.g., second-generation landfills, or landfills that have exceeded provincial standards to satisfy local stakeholders) must charge higher tipping fees reflecting costlier engineering and operations. Many of these costs are independent of the amount of waste processed. When waste is exported to other jurisdictions, the local owner/operator of the system is unable to recoup these fixed costs, creating a revenue gap.

Municipalities can adopt a *two-part tipping fee* to address this issue.

The first part of the fee can be levied on all waste generated within a given municipality or region, regardless of where it is ultimately disposed. The fee—charged by weight or volume—can reflect the fixed portion of a disposal system's costs.

The second part of the fee can reflect the variable costs of the disposal system and is paid only on waste that is disposed at a facility within the municipality. So, for waste that stays within the municipality where it was generated, the total disposal cost is no different than paying an ordinary tipping fee. For waste exporters, however, the total cost is equal to the fixed fee, plus whatever tipping fee is charged at the receiving facility.

Metro Vancouver adopted this two-part approach in 2018, called a *Generator Levy*. Haulers that dispose of their waste within Metro Vancouver pay the regular tipping fee (an average of $113 per tonne), which fully covers the fixed and variable costs of the system. Haulers that export their waste to other jurisdictions, however, must pay $40 for each tonne taken outside of the regional system, which covers the system's fixed costs (Metro Vancouver, 2017a).

While the generator levy in Metro Vancouver is still new, it illustrates a way to maintain environmental outcomes and improve cost recovery, while still permitting waste exports.

Two-part tipping fees, however, may not improve efficiency in every municipality or region. In some cases, municipalities may have overbuilt their disposal systems, leading disposal costs that are unnecessarily high. Waste exports, in this context, are simply a response to an inefficient system built to an inappropriate scale. In other cases, waste exports may simply not be an issue due to high transportation costs, particularly in rural and northern communities.

## 4.2 PAY-AS-YOU-THROW PROGRAMS IN CANADA

Canadian municipalities typically finance residential waste collection through local property taxes, creating an indirect link between how much waste households generate and how much they pay for the service.

Pay-as-you-throw (PAYT) programs address this issue by charging households directly for garbage collection services. These programs—which can be designed in a variety of ways—provide households with a direct incentive to reduce the amount of garbage they produce, either through increased diversion or prevention. PAYT programs can also be applied to organics and recyclables; however, this is uncommon in Canada (Folz & Giles, 2004).[22]

Data on PAYT is limited in Canada, but the most recent national survey from 2005 found that over 200 municipalities (or about 5% to 6% of all municipalities) used PAYT programs to finance garbage collection and disposal services.[23] This number has increased since 2005, as many municipalities have announced new PAYT programs in recent years, including Thunder Bay, Ontario, Grande Prairie, Alberta, and Beaconsfield, Quebec. We are unaware of any municipalities that have eliminated PAYT programs once established (Robins & Kelleher, 2005; Giles, 2018; Resource Recycling, 2018).

### Municipal PAYT programs reduce waste disposal and reduce costs

Overall, PAYT programs can drive significant reductions in waste disposal. Research shows that PAYT programs can decrease household waste disposal by 10% to 50%, depending on local context and design details. Increases in recycling and composting are the most important contributors to reduced disposal, though

[22] Pricing waste diversion services based on full social and financial costs would—like disposal pricing—improve system efficiency. Diversion pricing would signal the costs of managing different materials to households and businesses. As a result, consumers would choose the cheapest option based on the different costs of disposal and diversion, leading to a more optimal balance. Pricing waste diversion accurately, however, is difficult in practice, especially for recycling. To be efficient, prices would need to reflect the different costs of recycling different materials. But given the sheer number of materials in recycling streams, such a pricing system is impractical. As a second-best approach, municipalities can charge residents a monthly fee for recycling and organics programs instead of funding these programs through property taxes (Porter, 2002).

[23] Ontario is one of the only provinces that tracks PAYT programs. Between 1996 and 2016, for example, the number of municipalities with PAYT programs increased from 59 to 167 (Robins & Kelleher, 2005; ORPRA, 2016).

### Box 8: Creating Incentives for Multi-Residential Units Is an Important Policy Gap

**Although PAYT programs can be a powerful tool to encourage households to rethink how they generate and sort their waste, programs in Canada are only used for single-detached, duplexes, and townhouses. In large multi-family buildings, landlords often pay for waste management, not the tenants that generate the waste. Attributing waste from specific households is also difficult when waste receptacles are shared (Skumatz & Freeman, 2011; ECO, 2018; US EPA, 2016a).**

Cities outside Canada have dealt with this policy gap in creative ways. Many apartment buildings in Korea, for example, have centralized electronic disposal units that weigh residents' waste and charge them accordingly. These units have been instrumental in reducing food waste from large multifamily buildings (May Choon, 2016).

Such advanced types of PAYT programs for multifamily buildings are not currently used in Canada; however, municipalities are taking other steps to encourage waste diversion and prevention in multi-residential buildings. All multi-family buildings in Nova Scotia, for example, must provide recycling and composting bins to residents.

Individual building owners are also helping to address the problem. A condominium owner in Scarborough, Ontario, for example, retrofitted the building's waste management system to reduce the amount of garbage produced from residents. This included retrofitting the garbage chute for organics, making waste disposal less convenient. The building also offers segregated areas to recycle specific materials, like electronics and old paint. In total, the building has reduced its annual waste fees from $20,000 to $5,000, or from 20 dumpsters worth of garbage each month to one dumpster per month (Rider, 2016).

waste prevention is also a factor (Dewees, 2002, Munroe, 1999; Miranda et al. 1994; Skumatz, 2008; 2015).

PAYT programs can generate several benefits:

- First, less waste disposal in response to higher prices can allow municipalities to defer future landfill costs. Savings can be significant in communities that have limited landfill capacity or that ship waste to neighbouring communities.
- Second, PAYT programs can reduce operating collection costs if residents put out less garbage at the curb (though these savings may be offset by higher collection and processing costs for diverted materials).
- Third, PAYT programs generate revenue, reducing or eliminating the need to cross-subsidize the disposal services through property taxes or other revenue sources. In this sense, PAYT programs can improve fairness by making waste management fees more reflective of how much waste people generate.
- Finally, at a broader scale, increased waste diversion can create environmental benefits if greater resource recovery leads to decreased use of virgin materials.

Experience in the municipality of Beaconsfield, located on the Island of Montreal, Quebec, which implemented a PAYT program in 2016, illustrates many of these benefits.

Prior to switching to their "Smart Collection" PAYT program, Beaconsfield was one of the biggest generators of garbage per capita on the Island. The City charged residents for waste management collection through an annual fixed fee ($176 in 2015), offering no direct incentive to reduce waste disposal or encourage waste diversion (Recyc-Quebec & Eco Entreprises, 2017).

In 2016, however, Beaconsfield started charging an annual fixed fee based on bin size (between $152 to $162 in 2018) and a variable fee ($0.40 to $1.21 in 2018) each time their bins were collected (using radio frequency transponders, or RFID). Despite charging such a nominal amount, landfilled garbage in 2016 decreased by 51% per

**Table 4: System Efficiency Impacts from Different PAYT Program Designs**

| PAYT Type | How it Works |
|---|---|
| **Volume-based collection** | Residents lease garbage bins from the municipality that range in size; residents pay more for larger bins and less for smaller bins. Some volume-based programs also include a variable fee that households only pay when they put their cart out for collection. |
| **Bag-tag collection** | Households pay based on the number of garbage bags collected, identified by pre-purchased bag tags or stickers. |
| **Hybrid approach** | Households pay a higher fee for bigger bins. If residents have more waste than will fit in their bin, they can purchase tags for the excess bags. |
| **Weight-based collection** | Households pay based on the weight of their garbage, weighed by the garbage trucks. |

capita relative to 2013. In 2016, Beaconsfield produced the lowest garbage per capita out of the 33 municipalities and boroughs on the Island (Recyc-Quebec & Eco Enterprises Quebec, 2017).

Beaconsfield's PAYT program has also helped reduce costs to government and taxpayers. The cost for garbage collection and transport alone decreased from $553,000 in 2013 to $330,000 in 2016. Beaconsfield uses some of the savings to provide more frequent collection of yard waste and bulky items and to support backyard composting, each of which improves alternatives to waste disposal. At the same time, 78% of residents paid less than before the PAYT program due to residents' efforts to put their bins out less frequently for collection (City of Beaconsfield, 2017).

Importantly, the success of PAYT in Beaconsfield is, in part, due to a high proportion of single-detached households in the municipality (roughly 93% of all dwellings). PAYT programs work best for single-detached houses, duplexes, townhomes, or low-rise apartment buildings, or wherever it is possible to distinguish how much each household produces. Extending PAYT programs to multi-residential buildings remains a significant challenge (see Box 8).

## PAYT programs can be designed in different ways

Table 4 illustrates the three main types of PAYT programs. Across the four types, municipalities can choose how to identify waste generators, how waste is measured, and the fee per unit of waste (Morlok et al., 2017).

Design choices affect system efficiency in terms of both administrative costs and impacts on waste flows. Weight-based systems, for example, provide a stronger and more direct incentive to reduce waste and can therefore generate larger benefits from reduced disposal and increased diversion and prevention. Weight-based systems, however, are typically more expensive to administer, which can offset some of these benefits. Weight-based systems are common in Europe, but municipalities in North America have yet to adopt these programs (Bel & Gradus, 2016; van Beukering et al., 2009; Hall et al., 2009; Dunne et al., 2008).

## Well-designed fees can address both concerns about fairness and illegal dumping

Charging higher prices for household garbage collection raises important concerns about fairness, particularly for low-income households. PAYT programs change *how* households pay for garbage collection, which can result in low-income households paying a greater share of their total income for garbage disposal, relative to other households. Similarly, charging more for waste disposal can exacerbate illegal dumping, as more people try to avoid paying higher fees.[24]

Each of these concerns, however, can be addressed through the way PAYT programs are designed. Municipalities can, for example, offer a basic allotment of garbage disposal before fees kick in. The Town of Selkirk, Manitoba, limits each household to two bags of garbage and charges one dollar for every additional bag. Even with this allotment, diverted waste increased by 47% in the first year after implementation. Providing this allotment also helps discourage illegal dumping (Robins & Kelleher, 2005; Skumatz & Breckinridge, 1990).

Another option to address fairness concerns is to provide financial relief specifically for low-income households. This approach is more complicated to administer but allows municipalities to charge all households on each additional unit of garbage to maintain the price signal. It then issues a rebate to qualified households after the fact (Skumatz & Breckinridge, 1990; US EPA, 2016b).

[24] Evidence suggests that concerns about illegal dumping may be overstated. About one-fifth of U.S. communities with PAYT programs experienced an initial increase in illegal dumping that subsided after a few months. In Ontario, communities with PAYT noted a small increase in illegal dumping during the first few months, but over time residences become accustomed to the programs and illegal dumping decreased. Illegal dumping is also less common when residents have substitutes to waste disposal, such as recycling and compost programs (Skumatz, 2008; Munroe, 1999; Denne, 2005; OECD, 2007).

### 4.3 SUMMARY

Pricing waste disposal according to its full cost—through tipping fees, PAYT programs, or both—has multiple benefits. The price creates incentives for waste generators to identify the best options for reducing the amount of waste they dispose of, based on their own preferences and budget constraints. This makes disposal pricing one of the most cost-effective ways to improve the efficiency of waste management systems.

Disposal pricing can also improve system efficiency over time. The incentive for waste reduction is continual: waste generators are always rewarded for producing less garbage by paying less in disposal costs. This provides the private sector with an incentive to develop new and innovative technologies that reduce waste management costs even further. Over time, new recycling technologies and better ways to manufacture or design products can further reduce costs.

Canadian municipalities (and provinces) can clearly do better on disposal pricing. Tipping fees are artificially low across Canada, and only a small number of households pay directly for their waste through PAYT programs. Improvements on both fronts can make our waste management systems more efficient.

At the same time, however, there may be limits to disposal-pricing policies. While disposal-pricing policies directly address issues #1 and #2 outlined in Section 3—and indirectly address issue #3 if designed appropriately—they leave the other systemic issues unaddressed. Multiple policies are needed to address multiple problems.

These limitations suggest that other, non-pricing policies are necessary in addition to disposal pricing.

# 5 BEYOND DISPOSAL-PRICING POLICIES

**Defining an optimal mix of waste management policies is complicated. Indeed, provincial and municipal governments can choose from—and have implemented—a wide array of waste management policies. However, not all of these policies, or combinations of policies, necessarily improve the efficiency of waste management systems. Some policies can cost more to implement than others, especially when layered on top of existing policies that have similar objectives.**

With these challenges in mind, this section explores the key trade-offs associated with three prominent waste management policies (other than disposal pricing): disposal regulations, municipal diversion programs, and extended producer responsibility programs. All three policies are used in Canada to some extent.

This section presents a systematic framework to identify the additional policies that might improve the efficiency of waste management systems. Our intent, however, is not to provide a comprehensive or complete list of potential waste management policies, nor to provide detailed advice on designing and implementing these complementary policies. Ultimately, the policies in this section require careful analysis of incremental costs and benefits of a given policy option, considered within the local context.

## 5.1 WASTE DISPOSAL REGULATIONS

Disposal regulations set hard limits on what can and cannot be disposed of. The most common type of disposal regulations is a landfill ban, which prohibits certain materials from being landfilled, such as organics, recyclables, or hazardous waste. Other disposal regulations restrict the quantity of solid waste that municipalities collect from households (e.g., garbage bag limits). Finally, disposal regulations can also prohibit the sale or use of certain materials, such as plastic bags or single-use plastics.[25]

Provinces and municipalities use waste disposal regulations in different ways. Table 5 illustrates examples both in Canada and internationally.

### What problems do waste disposal regulations solve?

Municipalities implement disposal regulations to reduce landfilled waste, encourage waste diversion, and, as a result, reduce environmental damages associated with waste management. Some disposal regulations—such as banning single-use plastics—are also designed to reduce litter and the adverse environmental impacts from improperly managed waste (e.g., plastics that end up in the ocean or other ecosystems).

Municipalities often use disposal regulations as a complement to disposal pricing, particularly when increasing tipping fees or implementing PAYT systems is not feasible. Policies such

[25] Technically, bans on certain products may be considered "distribution bans" or "sales bans." However, we include these policies within our term "disposal regulations."

**Table 5: The Effectiveness of Disposal Regulations**

| Policy Type | Jurisdiction | Description | Examples of Impacts | Source |
|---|---|---|---|---|
| Disposal Bans | Metro Vancouver, BC | Bans 15 materials from its landfill, including organics, paper, glass, metal, beverage containers, and a range of hazardous materials | Helped divert 60,000 tonnes of organics from landfills in its first year | Metro Vancouver, 2017b; 2017c |
| | Nanaimo, BC | Bans 12 different materials from the landfill, including commercial food waste | Helped reduce its annual disposal rate from 517 kg per capita in 2006 to 350 kg per capita in 2012 | Regional District of Nanaimo, 2017 |
| | Nova Scotia | Provincial bans on organics and recyclables in municipal landfills | Deemed as one of the most important policies in driving rapid waste diversion in the province | Nova-Knowledge, 2008 |
| | Belgium | Bans unsorted wastes (1998) and combustible residual waste (2000) | Helped reduce the proportion of landfilled waste from 25% in 1997 to 3% in 2007; diversion rates increased by 66% | SEC, 2014 |
| | Germany | Bans organic waste that has not been stabilized and made inert | Helped reduce the proportion of landfilled waste from 27% in 2000 to 1% in 2006; diversion rates increased by 25% | SEC, 2014 |
| Product Bans | Montreal, QC, & Victoria, BC | Bans retailers from providing plastic bags (2018) | To be determined. | |
| Bag Limits | Kingston, ON | Decreased its bag limit from two bags per week to one bag per week | Helped reduce landfilled waste by 3% and increased organics diversion by 13% | MacDonald, 2016 |
| | Peterborough, ON | Gradually decreased its bag limit from six bags in 1990 to two bags by 1995 | Helped reduce garbage disposal by 9% between 1994 and 1995 | AMO, 2004 |

as provincial landfill bans can also better regulate the flow of commercial waste and level the playing field across public and private landfills. Nevertheless, disposal regulations often overlap with disposal pricing: both policies can apply to waste generators at the same time.

### How do disposal regulations affect waste disposal, diversion, and prevention?

Generally, waste disposal regulations (if strictly enforced) can be an effective way to reduce landfilled waste. Regulations can impose immediate restrictions on producers and consumers that reduce disposal volumes, preserve landfill space, and increase the amount of material recycled or composted (Kelleher, 2017; OWMA, 2013a; SEC, 2014).

Table 5 summarizes impacts of disposal regulations in select jurisdictions. Note, however, that each jurisdiction listed in the table uses a range of other complementary waste policies concurrently with the disposal regulations, making it difficult to isolate impacts.

Adopting or broadening disposal regulations in Canada could drive additional waste diversion. Landfill bans for organics and recyclables are rare outside Nova Scotia and Prince Edward Island where they are mandatory under provincial law. A small number of municipalities set hard caps on garbage bags, and only 18 municipalities have implemented bans on plastic bags (Meloche-Holubowski, 2018).[26]

### To what extent do disposal regulations improve system efficiency?

Despite the effectiveness of disposal regulations, they typically cost more than disposal pricing. Disposal regulations impose restrictions on all waste generators, irrespective of the amount of waste they generate or their ability to generate less (Dewees, 2002; OWMA, 2013a).

Limiting the number of garbage bags each household can put out, for instance, may offer no alternative for large families that generate large amounts of waste. Similarly, product and landfill bans

[26] No municipality or province has extended retail bans to other single-use plastics; however, this idea is gaining momentum in other countries. France, for example became the first country in the world to ban plastic cups and plates (Eastaugh, 2016).

### Box 9: Can Banning Single-Use Plastics Improve System Efficiency?

**An increasing number of jurisdictions—such as Victoria and Vancouver, British Columbia, Montreal, Quebec, and France—are banning single-use plastics like bags, coffee cups, and straws. The bans are intended to reduce the environmental damages associated with plastics pollution and mitigate the upstream environmental impacts from manufacturing petroleum-based plastics. But does banning single-use plastics improve the efficiency of waste management systems?**

If strictly enforced, bans can be extremely effective at curtailing the use of specific materials. Banning single-use plastics can help reduce the prevalence of plastics in the environment and also help reduce the upstream environmental impacts from producing the materials.

At the same time, however, bans are a relatively blunt policy that can impose costs on consumers and producers if substitutes are not readily available. Using cloth bags instead of plastic bags, for instance, may be relatively cheap and painless; finding viable alternatives to plastic cups, however, may be more challenging and costlier for businesses to adapt. Some alternatives to single-use plastics may also have other, potentially larger environmental impacts. The extent to which banning single-use plastics generate a net benefit in a particular community (i.e., whether it increases system efficiency) ultimately depends on these details (Recyc-Quebec, 2017).

Another approach is to tax single-use plastics instead of banning them outright. Pricing can deter people from using single-use plastic bags but gives them flexibility to determine whether paying the additional fee is worth it for them. The Northwest Territories, for example, implemented a 25-cent fee on all plastic bags in 2011. The fee has discouraged people from using and disposing an estimated 30 million bags (Government of NWT, 2018).

Although pricing can be a cost-effective way to reduce single-use plastics, it may not be practical at the local level. Canadian municipalities do not have authority to introduce these types of taxes, whereas they have demonstrated the authority to implement bans (Zussman, 2018).

can increase costs when some waste generators have few viable alternatives.[27] Limiting the number of garbage bags also provides no incentive (or reward) to reduce waste below the established limit (Mueller, 2013). See Box 9 for a discussion on whether banning single-use plastics can improve system efficiency.

Disposal regulations are also costly to enforce if they are to be effective. Landfill bans, for example, need to be accompanied by regular audits on incoming waste loads, rejecting those that exceed specified thresholds (SEC, 2014).

## 5.2 MUNICIPAL DIVERSION PROGRAMS

Municipal diversion programs collect and manage recyclables and organic waste from households and businesses. Municipalities provide these services directly or contract them out to the private sector. These programs are primarily funded through property taxes, fixed monthly fees, and federal and provincial grants.

Recycling programs are ubiquitous in Canada. In 2007, for example, 95% of Canadians reported having access to at least one recycling program. Each of Canada's 50 largest cities now provide curbside recycling collection (Munro, 2010; Resource Recycling, 2018).

[27] These bans can send a powerful signal to producers, forcing them to find alternatives. However, these alternatives do not always have a smaller environmental impact and can be a costly way to achieve this change in producer behaviour. See SEC (2014) for a detailed cost-benefit analysis of landfill bans in Queensland, Australia.

Organics collection programs are less common but are gaining traction. In 1994, for example, less than one-quarter of Canadian households had access to curbside collection of yard and kitchen waste. By 2011, 41% had access to these collection programs. Like recycling programs, organics programs include curbside collection, drop-off facilities for larger waste generators, or both (Statistics Canada, 2015).

### What problems do municipal diversion programs solve?

Diversion programs provide residents and businesses with a clear alternative to landfilling. In this sense, they can complement disposal pricing by giving waste generators a way to avoid paying higher disposal fees.

Municipal diversion programs also fill a critical gap that is unlikely to be filled by the private sector. The private sector is particularly unlikely to provide organics and recycling services when disposal prices are less than the full cost of providing the service.

### How do municipal diversion programs affect waste disposal, diversion, and prevention?

Making alternatives to waste disposal accessible and convenient is a key factor in whether households and businesses divert their waste.[28] Diversion programs provide those alternatives (Mueller, 2013; Jenkins et al., 2000; Munro, 2010).

Most municipalities offer recycling programs that accept a core group of recyclables, such as paper, glass, metal, and cardboard. Expanding the list of accepted materials could increase diversion rates further, helping preserve landfill space and reduce demand for virgin materials. Some municipalities in Ontario, for example, already accept a wide range of materials, from the basics, such as aluminum, newspaper, and boxboard, to more difficult items to recycle, such as polystyrene (e.g., Styrofoam) and plastic film (e.g., plastic bags) (Lakhan, 2015a; Mueller, 2013; Statistics Canada, 2013).

Similarly, introducing or expanding organics programs could drive additional waste diversion. Organic and paper waste can comprise over 50% of household landfilled waste. Diverting this material through proper collection and treatment can preserve landfill space and dramatically reduce GHG emissions and landfill leachate. The organics collection and treatment program in Surrey, B.C., for example, helped reduce landfilled garbage by 43% in its first year of operation (CCME, 2014a; City of Surrey, 2017; Environment Canada, 2013).

### To what extent do municipal diversion programs improve system efficiency?

Even if all municipalities priced waste disposal at its full cost, the private sector would still likely provide an inadequate level of waste diversion services, particularly for the residential sector. As a result, organics and recycling programs have the potential—if designed well—to improve the efficiency of waste management services.

Introducing new composting and recycling programs can *complement* disposal pricing by giving residents convenient alternatives to waste disposal. They make disposal pricing work better, and thus contribute to avoiding high disposal costs (e.g., deferring the construction of new landfills).

In particular, composting programs may have the greatest potential to improve system efficiency for several reasons:

- Far fewer municipalities offer organics collection compared to recycling, leaving room for improvement.
- Organic waste often represents the largest component of the waste stream on a mass basis.
- Organics are essentially the sole contributor to landfill leachate and gaseous emissions. Composting programs can generate net benefits when considering full lifecycle costs. Analysis by Environment Canada, for example, finds that the benefits from avoided landfill space, avoided methane emissions, lower leachate levels, and the revenue from selling the compost outweigh the costs of building and operating an organics treatment system (Environment Canada, 2013).
- Municipalities can choose between a range of technologies to treat organics, some of which are relatively basic and inexpensive.

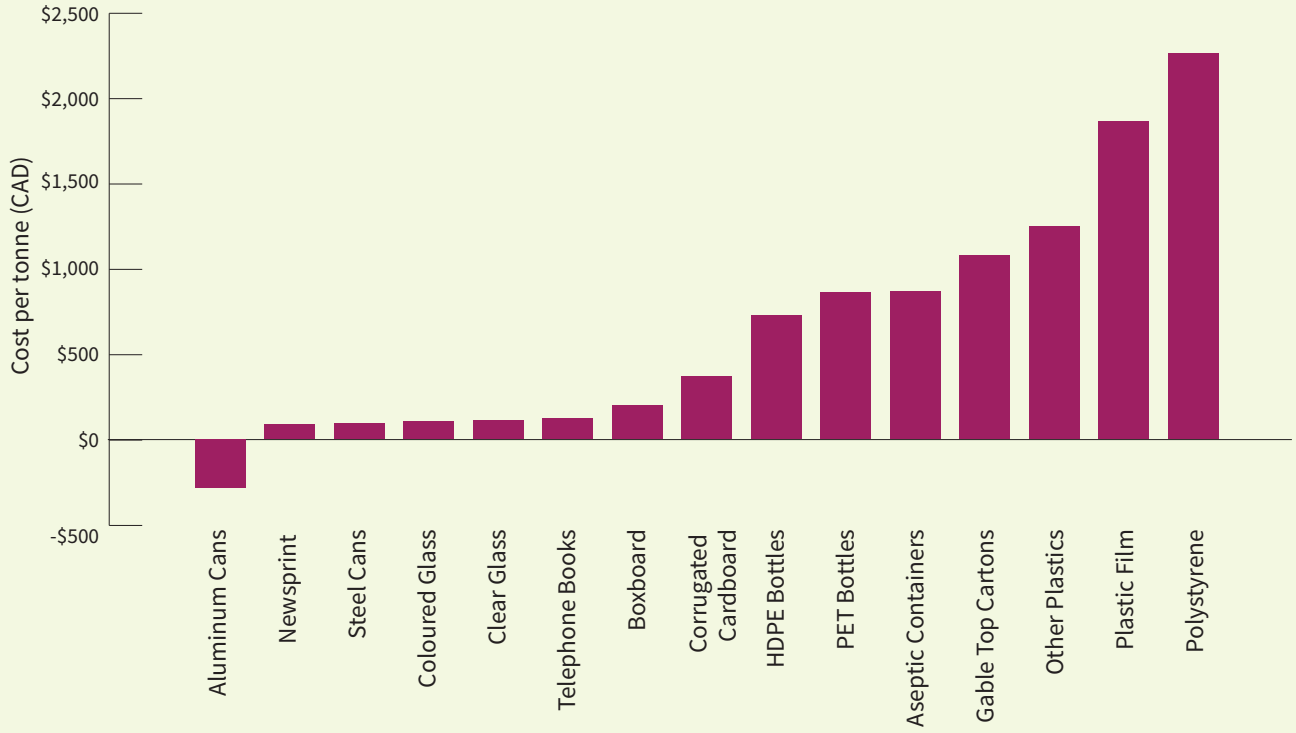
The case for expanding recycling programs beyond existing levels, however, is less clear. Figure 8 illustrates the net financial costs of recycling different materials in the Ontario blue bin programs: as municipalities accept more lightweight materials, costs increase substantially.[29] Analysis by Lakhan (2015a), for example, finds that Ontario municipalities can reduce costs by *excluding* some non-core materials from curbside programs, such as cartons, aseptic containers (e.g., juice boxes), and thin plastics (Lakhan, 2015b).[30]

[28] Based on a survey from Waste Diversion Ontario (now the Resource Productivity and Recovery Authority), nearly 90% of Ontario residents believe that access to the Blue Box programs is the main driver for their recycling habits (Chowdhury et al., 2017).

[29] The net cost of recycling aluminum is positive, at $286 per tonne, meaning the revenues from selling the material offsets the recycling costs. Aluminum is one of few materials that offers a profit.

[30] Importantly, however, the net financial costs in Figure 8 do not provide a complete picture. The analysis does not, for example, include the avoided landfill costs associated with each material. This omission is significant for materials like polystyrene that are lightweight and voluminous. Polystyrene may be expensive to recycle, but doing so avoids higher landfill costs (i.e., it takes up a disproportionate amount of space).

**Figure 8: Net Costs to Recycle Select Materials in Ontario, 2014**




**This figure shows the net costs of recycling select materials in the Ontario Blue Bin Program. Importantly, "net costs" includes only the costs to collect and recycle the materials, minus the revenues from selling the materials on secondary markets. The estimates do not include broader costs and benefits to the waste management system, such as avoided disposal costs. Many of these costs and benefits are material specific and would change the true net cost of recycling these different materials and their ranking. Lastly, these costs are not representative of the costs in other provinces; they simply illustrate that some materials are harder and costlier to recycle than others.**

Source: Stewardship Ontario, 2014

Based on the high costs of accepting a broader range of materials, several municipalities have scaled back their recycling programs. Dufferin County, Ontario, no longer accepts plastic bags and polystyrene, making it easier to sort and process the remaining materials. The City of Saskatoon also stopped accepting plastic bags in its recycling programs due to high costs and limited end markets. The City of London also decided not to expand its recycling program to due to high costs (Rogoff and Ross, 2016; Dufferin County, 2013; City of London, 2013; City of Saskatoon, 2018b).

In short, the high cost of recycling some materials suggests that landfilling them in some cases might improve system efficiency and reduce costs (Kelleher Environmental, 2014; Porter, 2002; Australian Government, 2006).[31]

Overall, the extent to which municipal diversion programs improve system efficiency depends on the local context and requires careful analysis. Only after completing this type of analysis can a community determine the "optimal" amount of waste diversion. We explore this framework in Section 6 with a case study on the City of Calgary (Porter, 2002).

## 5.3 EXTENDED PRODUCER RESPONSIBILITY PROGRAMS

Extended producer responsibility (EPR) programs make producers financially and physically responsible for managing the waste generated from their products. In doing so, EPR programs transfer the responsibility of waste management—and recycling in

[31] At the same time, some difficult-to-recycle materials—such as plastic film—might be in use only because upstream producers of goods have had no incentive to consider the post-consumer management of their products.

particular—from taxpayers and consumers to the companies that produce the materials in the first place. Programs can be developed for a broad range of product categories, including curbside recyclables (i.e., packaging and paper), tires, electronics, batteries, paint, used oil, and pharmaceuticals. In total, over 120 EPR programs currently exist in Canada (EPR Canada, 2017; OWMA, 2013b; 2015).[32]

Similar to disposal pricing, EPR programs take a market-based approach to increasing waste diversion and prevention. Programs require that firms pay (and therefore internalize) waste management costs associated with their products, which provides funding for improved resource recovery and but also creates incentives to design products that generate less waste.

The design and governance of EPR programs vary considerably in Canada.[33] A key feature, for example, is whether programs are voluntary or mandated through legislation. Another is the extent to which producers are physically and financially liable for waste management costs. *Full EPR* programs are financed and operated entirely by producers, while *partial EPR* programs share responsibility between producers and government.

EPR programs have been used in Canada since the 1990s, but provinces are now shifting from voluntary and partial EPR programs to legislated, full EPR programs in accordance with their commitments under the Canada-wide Action Plan on EPR. This action plan, developed through the Canadian Council of Ministers of the Environment (CCME), includes best practices for designing and implementing EPR programs and a timeline for provincial policy development (CCME, 2009; 2014b).

### What problems do EPR programs solve?

Whereas disposal pricing applies the "polluter pay" principle to waste generators, EPR programs shift the responsibility of recycling onto producers. In fact, EPR programs are designed to do what municipal policies cannot: they give upstream producers a direct financial incentive to improve the design and manufacturing of their products. At the same time, full EPR programs shift the financial costs of recycling from taxpayers to producers (Government of Canada, 2017; CCME, 2009).

Depending on the type, EPR programs can also help create scale economies for waste diversion. Programs are typically implemented province-wide and can create centralized systems that collect and manage materials. Creating centralized systems can also help reduce contamination in waste streams, as it gives the operators more control over how waste is sorted and managed (Australian Government, 2006).

### How do EPR programs affect waste disposal, diversion, and prevention?

Assessing and isolating the impacts of EPR programs in Canada is a challenge. Data on EPR programs is often inadequate, and different provinces have different reporting requirements, making it difficult to accurately compare performance across provinces. Moreover, each EPR program has distinct regulations, creating a patchwork of policies (OECD, 2001; 2016).[34]

Despite these issues with evaluation, evidence suggests that EPR programs increase waste diversion. A key metric to measure the success of EPR programs is the recovery rate: the amount of material collected by a program as a percentage of the total amount of material sold in a given a year. The EPR program in B.C. for packaging and printed paper achieved a recovery rate of 78% in 2016, while EPR programs for lead-acid batteries in Manitoba and B.C. had recovery rates of 143% and 80% in 2011, respectively.[35] In Europe, EPR programs for electronics resulted in recycling and reuse rates between 68% and 93% (Deloitte LLP, 2017; CCME, 2014a; OECD, 2016; Recycle BC, 2017).

Existing EPR programs in Canada may, however, not create complete incentives for waste prevention. In part, this is because most EPR programs—as currently designed—do not require producers to pay 100% of waste recovery costs. The EPR program for packaging and paper in British Columbia, for example, is the only one that requires producers to pay differentiated fees based on the end-of-life recyclability or environmental performance of their products. And even in these rare cases, the fees may be too small relative to other cost factors to encourage companies to improve the way they design and produce their goods (EPR Canada, 2017; OECD, 2016).

Critically, most EPR programs in Canada have been targeted at residential waste. This leaves waste from industry, businesses, and institutions—which can represent up to two-thirds of municipal solid waste in Canada—largely untouched by legislated policies to date. Expanding EPR programs to these sectors, where possible,

[32] See EPR Canada for more information on these different programs and how they compare.

[33] Some programs are voluntary and allow companies to opt in, while more stringent EPR programs are required by legislation. In many cases, producers pool their resources to create a centralized body that manages waste on their behalf (called Producer Responsibility Organizations). In other programs, though less prevalent in Canada, individual producers take direct responsibility for managing the waste from their products.

[34] Some programs operate across multiple jurisdictions, such as the Canadian Stewardship Services Alliance Inc.

[35] A recovery rate can exceed 100% when a substantial amount of material is returned from previous years.

## Box 10: British Columbia's EPR Program for Curbside Recycling

**British Columbia arguably has the most comprehensive and stringent EPR programs in Canada. All of its programs—covering 14 different product categories—make producers fully responsible for funding and managing the waste from their products. It is the only province to have received an "A" grade for its programs by EPR Canada, a non-profit (EPR Canada, 2017; AGBC, 2016).**

A cornerstone piece of EPR in B.C. is its program for packaging and printed materials (PPP), which are the materials commonly accepted in municipal curbside recycling programs. The EPR program, adopted in 2014, shifted the responsibility to fund and operate curbside recycling programs from municipalities and taxpayers to producers. Recycling programs are now organized and operated by a single organization, called Recycle BC, which manages, processes, and sells the recyclables on behalf of producers. These producers pay fees to Recycle BC that are commensurate with the quantity and recyclability of their materials sold in the BC market (Recycle BC, 2018).

Overall, the EPR program has created a centralized system for collecting and processing all PPP materials generated in the province. This centralization has allowed Recycle BC to establish province-wide standards for collection and processing, which has helped improve economies of scale while simultaneously reducing contamination rates.

Greater centralization has also allowed Recycle BC to optimize its system based on changing market circumstances. While most municipalities across Canada have struggled with the recent import bans/restrictions by the Chinese government (see Box 5), Recycle BC has managed to find end markets for most (if not all) of its materials, many of which are local. The EPR program has also insulated BC municipalities from the drop in global prices for recyclables (Paben, 2018).

could improve its overall impact (CCME, 2014a). It is also difficult (if not impossible) to include organic waste within EPR programs, leaving another significant gap in coverage.

### To what extent do EPR programs improve system efficiency?

EPR programs offer an efficient way to increase waste diversion. In effect, they fill a critical gap by doing what disposal pricing and other complementary policies cannot: they make producers pay the full cost of managing the waste generated from their products. EPR programs create market incentives for producers to find the least costly way to recycle products and rewards producers that find new and innovative ways to design products that generate less waste. Like disposal pricing, these incentives are strongest when producers are required to pay the full costs of managing their waste (OECD, 2001; 2014; 2016; EPR Canada, 2017).

At the same time, EPR programs can remove the financial burden of recycling from municipalities and taxpayers. In British Columbia and Quebec, for example, household recycling programs (for packaging and paper waste) are fully financed by industry (see Box 10).

Still, despite these benefits, the full extent to which EPR programs can improve the efficiency of waste management systems requires more study in Canada. And as provinces expand and reform EPR programs to meet their commitments under the Canada-wide Action Plan on EPR, several design and implementation details will directly affect the efficiency of these programs, including the following key factors:

- Financial incentives to reduce the waste generated from products (e.g., extent to which producers pay higher fees for using less recyclable material)[36]
- Transaction costs (e.g., extent to which policies are harmonized across Canada)

[36] See Deloitte LLP, 2017; EEB, 2017; OWMA, 2013b.

**Table 6: Extent to Which Different Policies Can Address the Six Issues with Waste Management Markets**

| Waste Management Issue | Tipping Fees | PAYT Programs | Disposal Regulations | Municipal Diversion Programs | Full EPR Programs |
|---|---|---|---|---|---|
| **#1: Most Canadian households do not pay directly for waste management** | Indirect Effect | Direct Effect | No Effect | No Effect | No Effect |
| **#2: Landfills do not charge large waste generators the full cost of disposal** | Direct Effect | No Effect | No Effect | No Effect | No Effect |
| **#3: Porous boundaries of solid waste management systems make it difficult for municipalities to price waste disposal at its full cost** | Uncertain Effect | Uncertain Effect | Uncertain Effect | Indirect Effect | Indirect Effect |
| **#4: Markets alone may provide inadequate waste diversion opportunities for some materials** | Indirect Effect | Indirect Effect | Indirect Effect | Direct Effect | Direct Effect |
| **#5: Individual municipal pricing policies have limited effect on goods manufacturers** | No Effect | No Effect | No Effect | No Effect | Direct Effect |
| **#6: Extracting and processing natural resources generate negative environmental externalities further upstream** | Indirect Effect | Indirect Effect | Indirect Effect | Indirect Effect | Indirect Effect |

- Recycling costs (e.g., extent to which available technologies can cost-effectively recycle waste)
- Policy interactions (e.g., extent to which programs overlap with other waste management policies)
- Governance structures (e.g., extent to which producers have flexibility to find low-cost compliance options)[37]
- Materials covered (e.g., extent to which programs cover new materials)
- Transparency and monitoring systems (e.g., extent to which programs require regular reporting and data collection)

## 5.4 SUMMARY

Overall, this section has argued that it is difficult to determine the impacts on system efficiency from complementary policies. The context in each jurisdiction is different, and each policy can be designed in different ways. Moreover, provinces and municipalities need better data to properly assess and isolate policy impacts, which, in many cases, is not publicly available.

We can, however, make several broad conclusions about complementary policies. Table 6 summarizes the extent to which the different policies address the six issues with waste management markets. It includes the three complementary policies from this section, in addition to tipping fees and PAYT programs from Section 3. (Not included in the table, however, is the important role of public education, which we discuss in Box 11.)

The table illustrates that tipping fees and PAYT programs are the only way to directly address issues #1 and #2. These disposal-pricing policies can lead to efficient outcomes, as they allow waste generators to determine the most cost-effective way of managing their waste. Disposal pricing can also help improve waste diversion opportunities, albeit indirectly, by making these options more cost competitive. Lastly, tipping fees and PAYT programs might address the issues associated with porous boundaries but depend on policy design. Municipalities can, for example, adopt two-part tipping fees to address issues with waste exports; they can design PAYT systems to discourage illegal dumping.

After that, however, it gets more complicated. Disposal regulations, for example, can limit what can and cannot be landfilled and, indirectly, drive more waste diversion. Disposal regulations at the provincial level, in particular, can help level the playing field across landfills—public and private—and address the issue of porous boundaries. However, disposal regulations are typically a costlier way to achieve this objective.

[37] See OECD, 2016; Jacobs, 2015.

## Box 11: Public Education and Awareness Can Complement Waste Management Policies

**Enhancing public awareness and education is a longstanding objective of waste management policy. Having knowledge about our local waste management systems is an important factor in our day-to-day decisions on how to sort and manage our solid waste before it enters the waste system (Hasan, 2004; Linder et al., 2018).**

Better awareness of local diversion programs, for example, can help reduce waste disposal by more clearly highlighting the alternatives. Such initiatives can also reduce contamination rates by educating households and businesses on how to properly sort their waste—saving processing costs and increasing the value of recovered material. Broader still, individuals may be more motivated to recycle and compost if they know more about where their waste goes after it enters the waste management system.

Given these potential benefits, many provinces and municipalities employ a wide range of education and marketing campaigns. "Love Food Hate Waste" is one of the largest international education campaigns, designed to help increase awareness about food waste. Started by a non-profit in the U.K., it is now deployed in multiple countries, including Canada. Municipalities are also using phone apps to help improve awareness, such as the BeWasteWise app in St. Albert, Alberta, which helps people sort their recyclables (National Zero Waste Council, 2018; City of St Albert, 2018a).

The effectiveness of public information and awareness does, however, have limits. Information campaigns can be expensive and do not always result in higher uptake of recycling and composting. Campaigns are typically more effective and cost-effective when they have clear objectives and are targeted.

Critically, while improving public education and awareness can help complement waste management policies, it is never a substitute for the more substantive policies assessed in this report (Linder et al., 2018).

At the same time, municipal diversion programs can directly address issue #4 by providing households with an alternative to waste disposal. Recycling and composting programs can cover a wide range of the waste stream, helping municipalities dramatically improve diversion rates and extend the life of existing landfills. Building and operating these programs is costly, however, particularly as municipalities expand the number of materials that they collect and recycle.

Of the three complementary policies, full EPR programs have the greatest potential to improve the efficiency of waste management systems. Providing they are designed, administered, and monitored well, EPR programs are the only policy that can directly address problem #5. Unlike all the other policies assessed in this report, EPR programs can give industry full physical and financial responsibility over the waste from their products.

EPR programs can also directly address issue #4 through improved waste diversion infrastructure. And by requiring manufacturers to recover a higher proportion of waste materials, EPR programs can indirectly address issue #3 by making the boundaries of waste systems less porous. In other words, EPR programs can ensure that fewer materials are landfilled within a given province, reducing the likelihood of waste exports when municipalities charge the full cost of disposal.

Finally, EPR programs can provide manufacturers with continuous, market-based incentives to find the most cost-effective ways to collect and manage the waste from their products. In doing so, these incentives—properly designed—can promote waste prevention by encouraging manufacturers to design their products such that they generate less waste.

# 6 CASE STUDY: WASTE MANAGEMENT IN THE CITY OF CALGARY

**To explore the challenges of waste management in practice, and to illustrate the broader ideas laid out in this report, this section considers the waste management system in one specific municipality: Calgary, Alberta. It considers the progress that Calgary has made so far as well as the policies that Calgary plans to implement in the near future. It also proposes opportunities for further policy, both in Calgary and Alberta.**

## 6.1 THE EARLY DEVELOPMENT OF CALGARY'S WASTE MANAGEMENT SYSTEM (1990s TO EARLY 2000s)

Calgary's waste management system during the 1990s and early 2000s, prior to major policy reforms, provides a baseline for assessing the City's progress over time.

### Calgary's waste management system was characterized by several inefficiencies

Prior to the late 2000s, Calgary's waste management policies were focused primarily on waste disposal (i.e., landfilling). The City's three landfills—owned and operated by the City—accepted most of Calgary's waste with few restrictions on materials.

The City provided limited alternatives to waste disposal for residents during this early period. The City opened a small network of community drop-off recycling centres in 1992 and offered seasonal collection for leaves, pumpkins, and Christmas trees. Meanwhile, the private sector offered recycling services for a narrow range of non-residential waste materials, such as metals and fibres (e.g., corrugated cardboard and boxboard).

Not surprisingly, Calgary landfilled almost all its waste during this early period and had one of the highest rates of waste disposal in the country (Osenton, 2009).

Low tipping fees and a lack of direct pricing for households contributed toward Calgary's reliance on waste disposal. Calgarians paid for waste management services primarily through property taxes, with no connection between how much waste households generated and the amount they paid for the service. Tipping fees at Calgary's landfills were set well below the financial and environmental cost of landfilling (CH2M Hill, 2007).

Provincially, the Alberta government had a narrow set of waste management policies in place during this period. It implemented five product stewardship programs between 1972 and 2004, including programs for electronics, paint, tires, used oil, and beverage containers. But while these programs improved waste diversion for select materials, they did not make producers financially responsible for managing the waste created from their products.[38]

Overall, Calgary's waste management system was relatively inefficient prior to the mid-2000s. Table 7 summarizes Calgary's waste management system with respect to the six key problems from Section 3.

By the mid-2000s, the City of Calgary began to rethink and reprioritize its solid waste management system. The City recognized that relying primarily on landfilling was not sustainable in the long term. Eventually, it would need to build a replacement landfill,

[38] The stewardship programs were (and still are) funded by consumer fees and operated by delegated administrative organizations (arms-length agencies governed by industry and the public).

**Table 7: Extent to Which Calgary and Alberta Government Policies Address the Six Issues with Waste Management Markets (Pre-2008)**

| Key Issues to be Solved | Pre-2008 |
|---|---|
| #1: Calgary households do not pay directly for waste management | |
| #2: Calgary landfills do not charge large generators the full cost of waste disposal | ✓ |
| #3: Porous boundaries of Calgary's solid waste management systems make it difficult to price waste disposal at its full cost | |
| #4: Markets alone may provide inadequate waste diversion opportunities for some materials | ✓ |
| #5: Calgary pricing policies have limited effect on goods manufacturers | |
| #6: Extracting and processing natural resources generate negative externalities further upstream | |

This figure shows the relative progress in addressing the six major problems identified with waste management markets. Prior to 2008, most of the City's residential and non-residential waste during this time was landfilled (City of Calgary, 2018b). Key areas of progress included the City's community recycling drop-off centres and charging tipping fees at its three landfills, even though fees were set below the cost of disposal.

**Zero check marks = problem is not being addressed at all**
**Three check marks = policies comprehensively address the problem**

at a cost to the City—and its taxpayers—of $1.5 billion (City of Calgary, 2017b).

## 6.2 A NEW APPROACH TO WASTE MANAGEMENT (2008 TO 2016)

In 2007, Calgary committed to diverting 80% of its waste by 2020, relative to 2007 levels. To help meet this objective, the City undertook a series of major reforms between 2008 and 2017, many of which improved the efficiency of its waste management system. Specifically, the City bolstered its waste diversion system, changed the ways households paid for waste services, and increased tipping fees to better reflect the cost of waste disposal.

### The City's recycling program provides a viable alternative to waste disposal

Relative to other large municipalities, the City of Calgary was a late adopter of curbside residential recycling. Until the late 2000s, most households and businesses did not have access to recycling services unless they took their materials to a community depot.

After running a pilot project in 2004, Calgary implemented a city-wide curbside recycling program in 2009 to give residents a viable alternative to waste disposal. Calgary now provides curbside collection to every household and transports the materials to a city-contracted, privately owned and operated facility. The materials are then sold on international markets where the revenues help pay for the service (revenues from recyclables comprised 10% of Waste and Recycling Services' total waste management revenues in 2016).

Calgary's curbside recycling program has filled an important gap in waste diversion for residents. The program almost certainly improved the overall efficiency of Calgary's solid waste management system, especially when considering the avoided costs of landfilling (i.e., delaying construction of a new landfill).

### The City shifted how Calgarians pay for curbside waste management services

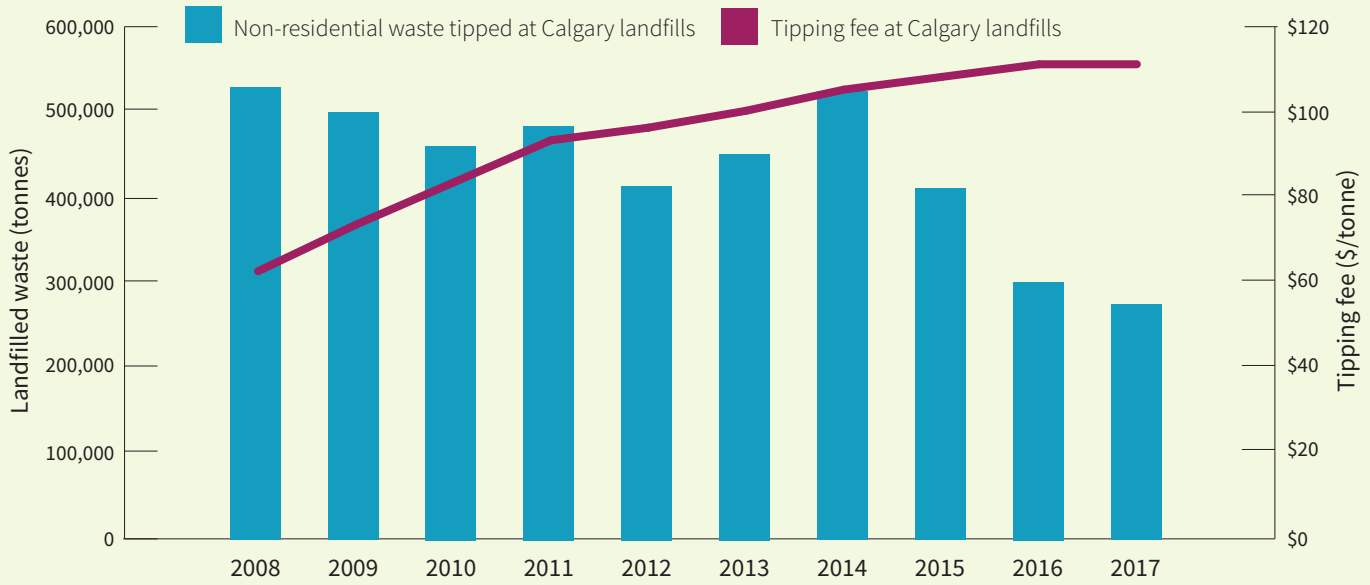
In 2008, Calgary started charging households directly for some waste management services. Households were charged a monthly fee on their utility bill, but the City also reduced property taxes by an equivalent amount. Prior to these changes, property taxes represented nearly half of all waste management revenues in 2006. By 2018, the share of property taxes used for the waste management system was less than 20% of total revenues, while the share of user-fee revenues (i.e., tipping fees plus monthly residential fees) comprised over 70% of total revenues (City of Calgary, 2018a).[39]

Although the shift from property taxes to monthly user fees likely had no impact on the amount of waste generated by each household, it indirectly helped improve the efficiency of the waste management system. By law, the revenues generated from user fees must be earmarked to pay for the service: revenues from waste management charges must go toward paying for garbage collection;

[39] As of January 2019, multi-residential units that receive waste services from the City will pay through user fees instead of through property taxes. Fees will be based on a cost-recovery model and will charge different rates for different buildings, depending on the level of service.

## CASE STUDY: WASTE MANAGEMENT IN THE CITY OF CALGARY

**Figure 9: Tipping Fees ($/tonne) and Landfilled Waste (tonnes) in Calgary, 2008 to 2017**




**This figure shows the tipping fee ($/tonne) at Calgary landfills and the total amount of solid waste (tonnes) tipped at landfills, excluding residential waste (i.e., it includes only the portion of waste directly subject to tipping fees). Tipping fees increased from $64 per tonne in 2008 to $113 per tonne in 2017. Over this period, non-residential landfilled waste decreased by 48%. This data alone does not imply a causal relationship: multiple factors may have contributed to changes in tipped waste, though price was likely one factor.**

Source: City of Calgary, 2018b

the same holds true for recycling fees. User fees therefore created a more stable stream of revenue for the City, ensuring that it can support the infrastructure necessary to provide the service. It also set the stage for further changes in how Calgarians pay for waste management.

### Tipping fees in Calgary have gradually increased over time

Since 2008, the City has nearly doubled its tipping fee rates (see Figure 9). As of 2018, the fee for basic household waste was set at $113 per tonne. Generally, this fee reflects the financial costs associated with operating the landfill and the future capital costs to close and monitor the sites. It also includes costs associated with improved environmental standards, such as required groundwater monitoring and thicker liners.[40]

As Figure 9 illustrates, the gradual rise in tipping fees corresponded with a steep drop in waste disposal in Calgary. Non-residential solid waste intake at the City's landfills dropped by almost one-half between 2008 and 2017.

Importantly, multiple factors underpin the change in commercial waste disposal. The economic slowdown between 2014 and 2017 likely played a role. Further, higher tipping fees likely led to an increase in exports of solid waste to neighbouring jurisdictions. The Coronation landfill located 300 kilometres northeast of Calgary, for example, handled 16,000 tonnes of municipal solid waste in 2007, none of which came from Calgary. By 2016, the amount of municipal solid waste coming from outside the county increased to 343,000 tonnes. Although it is not certain that all this solid waste came from Calgary, it likely comprises a large share (Waste Services Inc., 2008; Platt, 2014; Advisian, 2017).

[40] Calgary's landfills have leachate collection systems and regular groundwater monitoring that reduces the risk of groundwater contamination. Two of the three landfills capture and flare GHG emissions, which significantly reduces them. Each landfill was also built with a buffer zone around its perimeter to reduce the risk of unpleasant odours, litter, and noise for neighbouring residents. Lastly, the City is required to have financial assurance for its landfills to ensure that it has adequate funds when it comes time to close and monitor the landfill (City of Calgary, 2018c).

**Table 8: Extent to Which Calgary and Alberta Government Policies Address the Six Issues with Waste Management Markets (2008 to 2016)**

| Key Issues to be Solved | Pre-2008 | 2008 to 2016 |
|---|---|---|
| #1: Calgary households do not pay directly for waste management | | ✓ |
| #2: Calgary landfills do not charge large generators the full cost of waste disposal | ✓ | ✓✓ |
| #3: Porous boundaries of Calgary's solid waste management systems make it difficult to price waste disposal at its full cost | | |
| #4: Markets alone may provide inadequate waste diversion opportunities for some materials | ✓ | ✓✓ |
| #5: Calgary pricing policies have limited effect on goods manufacturers | | |
| #6: Extracting and processing natural resources generate negative externalities further upstream | | ✓ |

Between 2008 and 2016, the City of Calgary: provided city-wide recycling services to all its residents (issue #4), shifted its funding sources from property taxes to monthly user fees (issue #1), and increased tipping fees to better reflect the costs of disposal (issue #2). While the City's recycling program may have helped reduce the upstream environmental externalities associated with waste management (issue #6), recycling programs do not address the causes of this problem directly.

**Zero check marks = problem is not being addressed at all**
**Three check marks = policies comprehensively address the problem**

### Policies between 2008 and 2016 helped improve the efficiency of Calgary's waste management system, but gaps remained

Overall, the reforms during this period improved Calgary's waste management system, as summarized in Table 8. Between 2008 and 2016, the City's waste disposal rate (residential and non-residential) fell by 36% (from 751 kg per person to 481 kg per person) and its residential diversion rate rose from 16% in 2008 to 21% in 2017. Just as importantly, the prices of waste management became more explicit for waste generators, through monthly user fees and higher tipping fees. The city-wide recycling program also gave residents an accessible alternative to throwing waste in the garbage (City of Calgary, 2018a).

Despite this progress, however, Calgary's waste management system still faced challenges. The City found that reaching its waste diversion target was more difficult than it anticipated. Moreover, higher tipping fees encouraged the private sector to take their waste elsewhere, instead of encouraging them to divert more of their waste in the City.

Considering these challenges, Calgary revised its waste diversion target in 2015, committing to divert 70% of its waste by 2025 instead of 80% by 2020. Yet achieving the new diversion target will still be a formidable task.

## 6.3 EXPANDING AND REFINING POLICIES (2017 TO 2018)

The City of Calgary implemented and expanded two important policies between 2017 and 2018: a city-wide organics collection program and differentiated tipping fees at its landfills. In addition, the City started to explore the idea of introducing a PAYT program for household garbage collection.

### The city-wide organics collection program will dramatically reduce landfilled waste and resulting GHG emissions

The City of Calgary implemented a city-wide food and yard waste collection program in 2017. The City provides weekly organics collection for most residential units and processes the waste at a newly built composting facility. The City also introduced bylaws in 2016 and 2017 requiring all businesses, institutions, and multi-residential buildings to separate recycling and food and yard waste from garbage (City of Calgary, 2018d).

Similar to its recycling program, Calgary's new organics collection program appears to be having a measurable impact on residential waste disposal. In the first six months of operation, for example, the City collected and processed 38,000 tonnes of organic waste, helping reduce its residential garbage by 43%. As residents grow accustomed to the service, even more organics will likely be diverted from landfills.

The extent to which Calgary's organics collection program is improving overall system efficiency, however, requires more analysis.

A key indicator is the net cost per tonne of the organics program, which could be compared to the net cost per tonne of waste disposal. If the net cost of the organics program is less than the net cost of disposal, this would provide strong evidence that the program is improving system efficiency. But even if the net cost of the program is higher than the cost of disposal, it is not necessarily inefficient. Over time, disposal costs will increase as the City's landfills run out of space, whereas the net cost of organics collection could actually decrease if the processing facility becomes more efficient, either by achieving higher economies of scale or by improving the quality of its compost.

### Differentiated tipping fees will strengthen incentives to sort materials and improve waste diversion

In addition to considering a PAYT program, Calgary is expanding its use of differentiated tipping fees for specific materials at its landfills. In 2016, waste generators started paying higher tipping fee for most paper products, such as newspapers, mixed paper, boxboard, and corrugated cardboard. As of October 2018, waste generators will also start paying higher rates for food and yard waste. The fees apply to all waste generators, including industrial, commercial, and institutional users.

Differentiated fees will help efficiently reduce waste disposal in Calgary—and extend the life of its landfills. Waste generators will pay higher prices to dispose of materials that cost more to manage. Diverting organic materials, such as cardboard and paper products, will help reduce landfill methane emissions. For some waste generators, the costs of sorting material (in time and energy) may be greater than paying the additional fee. For others, avoiding the higher tipping fees will be worth the additional effort.

Overall, Calgary's new differentiated tipping fees should play an important role in increasing its diversion rate. The City's recycling and composting programs apply to only residential waste and have no impact on non-residential waste, which represents over one-half its waste. Higher tipping fees that signal the relative costs of managing certain materials provide a clear and cost-effective way to encourage non-residential waste generators to improve source separation and divert more material from the landfill (CH2M Hill, 2007).

### The City is considering a PAYT program for residential garbage

Calgarians currently pay a fixed monthly fee for residential garbage collection, regardless of how much waste they produce. Residents, in other words, have no incentive to dispose of less waste. And those that produce less waste end up paying a disproportionate share of waste management costs relative to larger waste generators.

To address this gap, the City considered a PAYT program for residential garbage collection. In particular, the City explored a bin-based approach, where the cost of waste collection and processing would be linked to the size of each household's garbage bin. Residents would choose between three different bin sizes, with larger bins costing more than smaller bins. The system would be similar to the existing monthly fee for garbage collection except that the fee would depend on the size of household garbage bins (City of Calgary, 2018a).

In 2018, however, Calgary's City Council did not approve this proposal, citing concerns around short-term administrative and service costs. Council is expected to revisit this issue in early 2019. The key to a successful approach might be a PAYT program that creates long-term benefits that more than offset short-term costs. We consider how the City could design a more efficient PAYT, below (City of Calgary, 2018e).

### Calgary's differentiated tipping fees and organics collection program should continue to improve system efficiency, but new challenges have emerged

Table 9 summarizes the expected impact that Calgary's planned policies will have on the overall efficiency of its waste management system. Notably, its organics and recycling programs give residents viable alternatives to waste disposal that will likely become more established over time. Differentiated tipping fees should also make the cost of disposal more explicit for the commercial sector.

Even after these policies are implemented, however, some of the same gaps persist. Perhaps most importantly, the provincial government has not signalled that it will address the issue with upstream goods producers; Alberta remains the only province in Canada without extended producer responsibility programs (EPR Canada, 2017).

## 6.4 PROPOSED POLICY OPTIONS FOR THE FUTURE

Looking at the next few years, Calgary and Alberta governments could implement several policies to help fill the remaining gaps. We assess two additional policies *not* currently being considered that could address remaining issues with Calgary's waste management system.

### Calgary could implement a more sophisticated PAYT program to increase long-term benefits

Implementing the PAYT program based on bin size—as proposed in 2018—would create a relatively weak link between how much garbage households produce and how much they pay. Households that produce a lot of garbage will likely choose a bigger bin, and households that produce less garbage will likely opt for a smaller,

**Table 9: Extent to Which Calgary and Alberta Government Policies Address the Six Issues with Waste Management Markets (2017 to 2018)**

| Key Issues to be Solved | Pre-2008 | 2008 to 2016 | 2017 to 2018 |
|---|---|---|---|
| #1: Calgary households do not pay directly for waste management | | ✓ | ✓✓ |
| #2: Calgary landfills do not charge large generators the full cost of waste disposal | ✓ | ✓✓ | ✓✓✓ |
| #3: Porous boundaries of Calgary's solid waste management systems make it difficult to price waste disposal at its full cost | | | |
| #4: Markets alone may provide inadequate waste diversion opportunities for some materials | ✓ | ✓✓ | ✓✓✓ |
| #5: Calgary pricing policies have limited effect on goods manufacturers | | | |
| #6: Extracting and processing natural resources generate negative externalities further upstream | | ✓ | ✓ |

Between 2017 and 2018, the City's key pricing policy (i.e., differentiated tipping fees at landfills) should strengthen incentives for commercial waste generators and result in less disposal. At the same time, the City's yard and kitchen waste collection program gives residents a viable alternative to putting waste out for disposal. To the extent that these policies divert more waste, they may help reduce environmental externalities associated with extracting and processing natural resources (issue #6). However, these impacts are indirect.

**Zero check marks = problem is not being addressed at all**
**Three check marks = policies comprehensively address the problem**

cheaper bin. Yet regardless of whether a household puts their garbage cart out for collection once each month or four times each month, they would pay the same fixed fee.

To create a stronger financial incentive for reducing waste, the City of Calgary could charge a fixed *and* variable fee for its bin-based program. While all households would still pay a fixed monthly fee, they would only pay the variable fee when they put their garbage carts out for collection.[41] This is the same type of program used in Beaconsfield, Quebec, where households pay an additional 40 cents per pickup for small bins and $1.20 for larger bins.

Charging a variable fee can create potentially large economic benefits. The program in Beaconsfield helped reduce its residential solid waste disposal by one-half.[42] And while the context in Calgary is different, a stronger pricing incentive could have a similar effect, especially considering that the city now has collection programs for recyclables and organics. Over time, reductions in landfilled waste would extend the life of its existing landfills and defer the need to build a new one—creating significant cost savings for taxpayers.

Creating a variable fee may also be a fairer way to charge for waste disposal. Households that generate less waste, would pay less as a result.

### Introducing EPR programs in Alberta would make goods producers more responsible for the waste generated from their products

The summary tables throughout this section show a noticeable gap in Calgary's waste management system: no policies target the upstream production of consumer goods.

Provincial EPR programs help address this problem. In 2009, each province signed onto the Canada-wide Action Plan for Extended Producer Responsibility, organized by the Canadian Council of Ministers of the Environment. This action plan encourages provinces to work toward implementing two phases of EPR programs. The first phase includes packaging and paper products (i.e., curbside recycling materials), electronics, hazardous household solid waste, and automotive waste.

Each province is at a different stage in implementing EPR. Alberta and the Atlantic Provinces, however, have yet to adopt legislated EPR programs and have fallen behind on the commitments made under the Canada-wide Action Plan. Instead, Alberta continues to rely on its five stewardship programs that cover far fewer materials than programs in other jurisdictions and are financed and administered, in large part, by the provincial government. Because

[41] The monthly fee could include one "free" pickup per month to help avoid an increase in illegal dumping.
[42] It is worth noting that Beaconsfield is a small municipality of 20,000 people and comprises mostly of single-detached households.

**Table 10: Extent to Which Calgary and Alberta Government Policies—and Potential Policies—Address the Six Issues with Waste Management Markets (Proposed Policies)**

| Key Issues to be Solved | Pre-2008 | 2008 to 2016 | 2017 to 2018 | Proposed Policies |
|---|---|---|---|---|
| #1: Calgary households do not pay directly for waste management | | ✓ | ✓✓ | ✓✓✓ |
| #2: Calgary landfills do not charge large generators the full cost of waste disposal | ✓ | ✓✓ | ✓✓✓ | ✓✓✓ |
| #3: Porous boundaries of Calgary's solid waste management systems make it difficult to price waste disposal at its full cost | | | | ✓ |
| #4: Markets alone may provide inadequate waste diversion opportunities for some materials | ✓ | ✓✓ | ✓✓✓ | ✓✓✓ |
| #5: Calgary pricing policies have limited effect on goods manufacturers | | | | ✓✓ |
| #6: Extracting and processing natural resources generate negative externalities further upstream | | ✓ | ✓ | ✓✓ |

At the municipal level, implementing a more sophisticated PAYT program could strengthen the link between how much waste households produce and how much they pay for disposal services. At the provincial level, EPR programs could be the missing piece to ensure that upstream producers have more responsibility over the design and disposal of their products. In turn, EPR could indirectly make the boundaries of waste systems in Alberta less porous by levelling the playing field across disposal systems. Lastly, EPR could indirectly address issue #6 by diverting a larger share of materials from the waste stream, thereby decreasing the demand for virgin materials. Other policies in Alberta, such as the province's carbon tax, address issue #6 more directly.

**Zero check marks = problem is not being addressed at all**
**Three check marks = policies comprehensively address the problem**

these programs do not give producers responsibility over the waste from their products, they are less efficient than EPR programs (CCME, 2014a).

Shifting to EPR could have significant benefits in Alberta. It could:

- Increase the quantity and quality of diverted waste—and decrease waste disposal—across the province.
- Reduce costs for municipalities and taxpayers by making manufacturers responsible for operating and financing curbside recycling programs (see Box 10).
- Reduce overall costs by allowing producers to find the most cost-effective ways to manage waste from their products. This could eventually eliminate the need for existing stewardship programs, creating savings for municipalities and taxpayers.

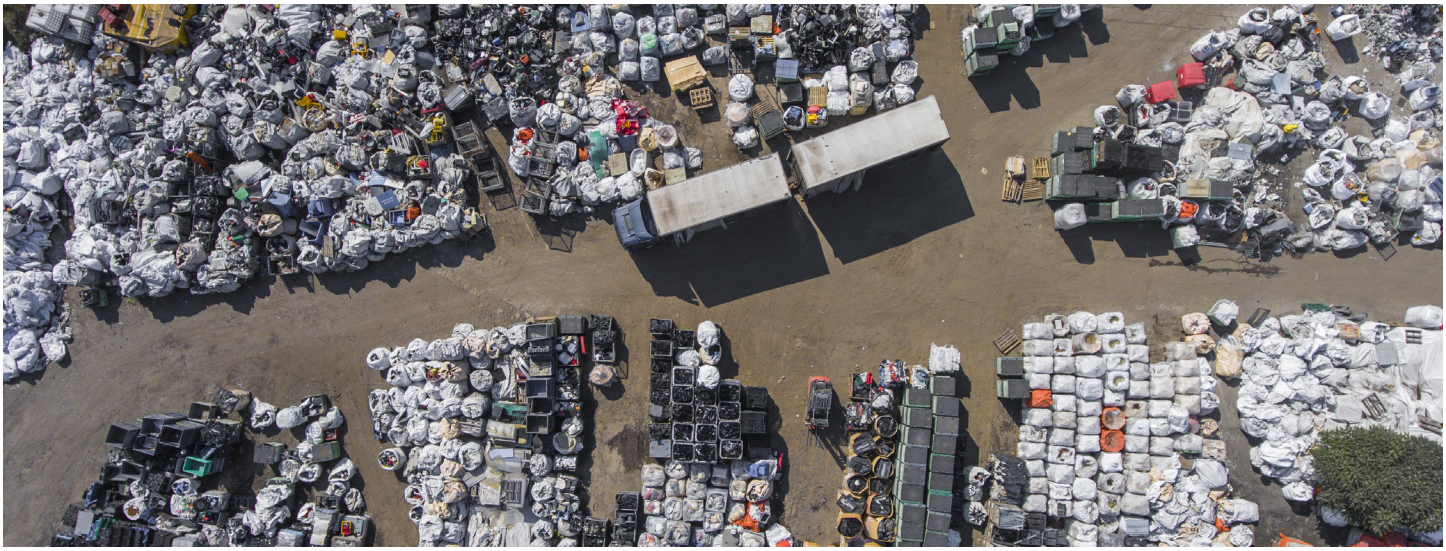
Perhaps most importantly, implementing EPR in Alberta would move Canada closer toward a more harmonized approach to how upstream manufacturers pay for waste management. Because Canada is a small market, harmonization could create a stronger incentive for manufacturers to change the waste profile of their products.

### Our proposed policy options could help fill important gaps

Adopting these two proposed policies—at the municipal and provincial level—could improve the efficiency of Calgary's waste management system, summarized in Table 10. Collectively, they help address the remaining policy gaps.

These policy options, however, are only a starting point for further analysis: a more rigorous analysis of costs and benefits is required before moving ahead. Our analysis throughout this case study was not meant to be comprehensive.

Instead, our goal was to provide a more structured framework for assessing how municipalities can improve the efficiency of their waste management systems. As we illustrate, it starts by identifying the extent to which the six issues with solid waste management markets affect a local community. Using this as the baseline, municipalities can more clearly assess the trade-offs associated with different waste management options to find the policies that most effectively address the problems they face.



# 7 CONCLUSIONS AND RECOMMENDATIONS

**Canadian communities can clearly improve the way they manage their solid waste. On a per capita basis, we generate more solid waste than any other country in the world, most of which is disposed of at landfills. An increasing portion of Canada's waste is diverted through composting and recycling, but diversion levels remain low compared to other high-income countries. At the same time, the costs of managing our solid waste are increasing for governments and taxpayers, businesses, and consumers.**

The case for improving our waste management systems is an economic one. Updates to municipal and provincial solid waste policies can improve the efficiency of our systems, maximizing net benefits for municipalities, taxpayers, and the environment.

To achieve this outcome, we make five recommendations to municipal, provincial, and federal governments:

### RECOMMENDATION #1: Municipalities should charge tipping fees that reflect the full costs of disposal, including environmental costs

Creating more efficient waste management systems starts with smarter disposal pricing. As such, municipalities should charge tipping fees that reflect the full financial and social costs of waste disposal. Tipping fees are a benchmark for the entire waste management system and can change the relative cost of waste diversion and prevention. Correcting price signals at disposal facilities can encourage the private sector to provide innovative and low-cost waste diversion opportunities.

Charging the full cost of waste disposal also requires that municipalities set differential tipping fees. Tipping fees for materials that cost more to manage should be higher. Organics materials, for example, should be charged at a higher rate than inert material to reflect higher methane emissions, contribution to leachate formation, and negative odours for surrounding residents. Municipalities might also charge higher rates (per tonne) for lightweight and voluminous materials, such as polystyrene (i.e., Styrofoam), as these materials take up valuable landfill space.

Setting tipping fees based on the full cost of the service is integral to improving system efficiency, but it can also undermine cost recovery if it encourages haulers to take their waste elsewhere. To address this issue, and to provide space for raising tipping fees, municipalities could consider charging flat (weight-based) fees on all waste generated within a region to help pay for the large fixed costs of disposal systems. Doing so can improve cost recovery and ensure that municipalities have adequate funds to maintain and improve the system.

Provinces have a key role in ensuring that landfills charge tipping fees that reflect the full environmental cost of waste disposal. Regulations and standards can require landfills and incineration operations to manage their environmental impacts, both during

operation and after the site has been closed. Waste disposal sites can then pass on the costs of complying with these policies in the form of tipping fees consistent with the full cost of disposal.

### RECOMMENDATION #2:
### Municipalities should implement PAYT programs and charge households directly for waste disposal

Municipal PAYT programs ensure that households have a continuous incentive to reduce the garbage they produce. To this end, households should pay amounts that vary with the amount of waste they produce.

PAYT programs can be tailored according to the local context. Some communities charge residents for each bag of garbage; others provide residents with different garbage bin sizes and charge higher rates for bigger bins. Municipalities can also choose whether PAYT programs fully recover costs of curbside collection or only partially cover these costs.

Pilot projects can provide opportunities to test and refine new PAYT programs.

### RECOMMENDATION #3:
### Provincial governments should expand, reform, and harmonize extended producer responsibility programs

Disposal pricing—as recommended in the two recommendations above—is a necessary but insufficient step toward efficient waste management systems. Given the set of interrelated challenges described in this report, multiple policies are necessary.

Of the complementary policies we considered, we identified *extended producer responsibility policies* as a key part of efficient waste management systems. They ensure that producers have a clear and direct price incentive to improve the way their goods are managed after their useful life. EPR programs can also be a powerful tool to encourage manufacturers to improve the design of their products and packaging.

Provincial governments are already making good progress on expanding and reforming EPR programs, but more can be done. British Columbia became the first province to have "full EPR" for all of its programs, including its EPR program for residential curbside recycling. Progress in other provinces, however, has been slow. Alberta is the only province without any EPR programs; the Atlantic Provinces have adopted limited EPR programs but have not reached their commitments under the CCME Canada-wide Action Plan for EPR.

Harmonizing EPR programs across provinces should be a long-term objective. EPR programs are administratively complex, especially considering the patchwork of EPR programs across Canada. Streamlining these regulations across Canada can reduce costs, provide a more unified pricing signal for manufacturers, and make these programs more transparent and easier to evaluate.

Not all EPR systems, however, necessarily improve efficiency. For example, EPR programs may not make sense for all material types or sectors. Some materials may be too expensive to recycle due to a lack of technology or limited end markets for the recycled materials. Firms within a given sector may also be too diverse to include under one regulation.

As a result, provincial governments should rigorously analyze the costs and benefits before reforming or expanding EPR programs. Governments should be flexible in their approach depending on the materials covered, industry dynamics, and available technologies to recover the materials.

### RECOMMENDATION #4:
### Provincial and municipal governments should implement policies that improve how organic waste is separated and managed, designed according to their own context

While EPR programs can ensure that manufacturers have incentives to improve how recyclables are managed, extending these programs to organic waste is difficult. As a result, municipalities and provinces may also need policies that specifically target and improve how organics are collected and managed. Generalizing about the best approach to do so, however, is challenging. Specific policies should be chosen according to local context and based on a comprehensive analysis of costs and benefits.

For many municipalities, implementing municipal collection programs for organic waste might be a good starting point. Far fewer Canadians have access to curbside organics collection compared to recycling programs, indicating that more progress could be made. These processing facilities could be built based on the community or region's needs, using technologies that range from sophisticated and capital intensive to basic and lower cost. Still, for smaller communities, limited economies of scale could mean that organic collection programs are too expensive. Other initiatives, such as incentives for backyard composting, may be more appropriate and cost-effective.

Provinces also have a role in ensuring that environmental standards and policies for landfill and incineration facilities are sufficiently stringent. Such standards can ensure that all facilities account for environmental risks from organics, including leachate, greenhouse gases, and odour. Doing so will enable and encourage disposal facilities to charge tipping fees that better reflect the higher financial and social cost of managing active, organic materials. Provinces may also be able to help municipalities improve how

organics are collected and managed. Provinces could, for example, provide targeted and temporary funding for municipal initiatives that cost-effectively divert organics.

### RECOMMENDATION #5:
### To improve the evaluation, assessment, and transparency of waste management policies, federal and provincial governments should expand and standardize data-collection methods and make these data more available to the public

Throughout this report, we have noted a deficiency in data at both the federal and provincial levels. A lack of data on both basic waste management indicators and on specific policies and programs hindered our analysis. Overall, we were unable to answer several fundamental questions, such as:

- How many active and inactive landfills does Canada have?
- What types of environmental protections do Canadian landfills have in place?
- What is the composition of waste being disposed at landfills?
- What is the average tipping fee charged at landfills?
- How many municipalities use PAYT programs?
- What are the economic and environmental impacts of EPR programs, and how do they compare across provinces?

Some provinces are ahead of others on some of these key areas of data collection. However, all governments in Canada can improve, especially when it comes to standardizing methods across jurisdictions.

Improving data access and availability is critical for two reasons. First it allows governments and researchers to assess the extent to which our current systems are efficiently managing waste (or not). Improving data, in other words, can help make our performance on waste management more transparent. Second, it helps evaluate the performance of new policies and approaches over time. It can help policy-makers determine how policy changes have affected waste flows and system efficiency, and subsequently to adjust and adapt policies to further improve performance.

# Appendix A: Waste Management Data in Canada

This appendix provides information on the data used throughout this report. It provides details on how Canadian data are collected and the implications these methods have on our analysis.

Overall, we find significant deficiencies in solid waste management data in Canada. In most cases, Canadian waste management data are several years old and may be outdated. Different provinces and municipalities also use different methodologies to collect and report data, making it difficult (sometimes impossible) to compare progress across jurisdictions. Finally, some waste management indicators are simply difficult to track and measure, particularly for waste diversion and prevention.

All levels of government in Canada can—and should—improve the way data is collected and reported. This includes expanding the coverage and depth of the data collected and making it more readily available. It also includes harmonizing and standardizing methods across jurisdictions. Doing so would allow governments and researchers to better examine waste management trends as they emerge, enabling governments to design policies that make waste management systems more efficient.

## National waste management data are often outdated and inadequate

Most national data on municipal solid waste are collected by Statistics Canada through its Waste Management Industry Survey. This survey includes data from government-owned and -operated facilities as well as facilities and services provided by the private sector. The data includes information on waste management flows (e.g., diverted and disposed materials), financial flows (e.g., waste management expenditures and revenues), and employment statistics (Statistics Canada, 2012).

While the Waste Management Industry Survey is the most comprehensive source of waste management data in the country, it has several limitations.

First, data are often outdated. Aside from waste disposal figures (which are now available for the year 2016), all of Statistics Canada's solid waste management data are from 2014. While recognizing that it takes time to collect, clean, and synthesize these data, having more up-to-date statistics can help policy-makers identify and assess trends as they occur (or soon after they occur).

Second, the coverage of national data are inadequate and do not include key waste management indicators. We were unable to answer basic questions, such as:

- How many active and inactive landfills does Canada have?
- What types of environmental protections do Canadian landfills have in place?
- What is the composition of waste being disposed at landfills?
- What is the average tipping fee charged at landfills?
- How many municipalities use PAYT programs?

Finally, data from the Waste Management Industry Survey are aggregated at a high level, making it difficult to assess local or regional trends. Waste disposal statistics, for example, are available for each province and can be disaggregated by residential and non-residential waste; however, publicly available data does not include the types of materials disposed, nor the quantity disposed in landfills within provinces.

## The availability and quality of provincial and municipal data varies considerably

Provinces and municipalities collect and report waste management data differently. Some provinces, such as Ontario, for example, make residential data collection and reporting mandatory. Ontario publishes useful residential data on waste flows, costs, and key characteristics of landfills. It also includes information on the number of municipal PAYT programs across municipalities.

Data collection and reporting is mandatory in a few other provinces, but only for specific waste management activities. In Quebec and British Columbia, for example, data from the provinces' extended producer responsibility programs are collected and reported annually. These data include volumes of materials collected and the costs associated with managing these materials. Some recycling stewardship programs in Saskatchewan, Manitoba, and the Maritimes are required to publish similar data.

Overall, however, provinces do not collect and report waste management data consistency. In some cases, provinces may collect some of the key data discussed in this Appendix, but do not make it publicly accessible. In others, data are not collected at all. These inconsistencies make it difficult, if not impossible, to accurately track waste management trends in Canada. As a result, assessing problems and identifying solutions is challenging.

Data at the municipal level are even more sparse and varied than at the national and provincial levels. A few municipalities regularly track and report key solid waste management metrics, whereas most municipalities collect (or report) very little.

## Inconsistent methodologies also make it difficult to compare progress

Even when waste management data *are* available, different jurisdictions often use different methodologies to define and collect waste management data. Moreover, some waste management statistics are inherently difficult to track and measure, compounding these provincial differences.

Waste diversion statistics provide the best example of these challenges. The broadly accepted definition of waste diversion includes any materials that "go through any physical transformation, such as composting, separation or sorting in preparation for recycling or reuse" (ECCC, 2016). Yet provinces and municipalities often interpret this definition differently. Some communities, for example, estimate and include backyard composting within their waste diversion data, while others do not. Provinces such as Quebec use perhaps the most expansive definition by including biosolids from wastewater (Government of Quebec, 2017a).

Until Canadian governments standardize terminology, waste diversion data cannot—or should not—be used to make comparisons across jurisdictions. This is a notable problem, given that diversion rates are the most common yardstick to compare progress.

### Waste management statistics underreport waste diversion activity

Some aspects of waste management are simply difficult to track and measure. National and provincial data, for example, only include waste management activity that occurs within the traditional waste management sector. This means any materials that bypass waste management systems, such as waste managed onsite by companies or waste that is transported directly for processing, are excluded. For example, waste that is hauled by general transport companies (instead of using dedicated waste management haulers) is not captured by existing collection methods.

These survey limitations are particularly important for waste diversion statistics. Whereas disposed waste can be taken only to a landfill or incinerator (which are tightly monitored and few in number), diverted waste is far more decentralized. Waste generators have, in other words, more options with how they manage their recyclables and organics, some of which extend beyond the traditional waste management sector. Statistics Canada's diversion data, for example, excludes waste from backyard composting, restaurant food waste collected by farmers, materials that are reused or repaired, and textiles donated to charities. It also excludes waste handled by provincial EPR programs (ECCC, 2016; Statistics Canada, 2012).

Although the exact amount of diverted waste that goes untracked by government is unknown, it likely represents a significant portion of waste flows. It may also explain, for example, why Nova Scotia appears to generate much less waste than other provinces (see Figure 2 in the main text). Nova Scotia was the first province to implement disposal bans for recyclables and organics, leading to a significant shift in how waste was handled in the province. In particular, these policies may have led to a larger portion of the waste stream (particularly diverted waste) to bypass the traditional waste management industry. As a result, data likely underestimates the total amount of waste generated within the province.

Canada is not alone in this measurement problem. Countries such as the U.S. and U.K. also struggle with accurately tracking waste management activities that bypass the traditional system.

### Waste management statistics exclude waste prevention

Most statistics on solid waste cover *disposal* and *diversion*. Data on waste prevention is almost always absent, despite the fact that it is the most preferred option on the waste hierarchy (see Figure 4).

By its very nature, waste prevention is difficult to measure because it reflects something that does not exist. Waste prevention includes the decision of manufacturers to use fewer materials to make and package their products. It also includes consumers choosing to buy products that generate less waste or choosing not to purchase something altogether (Skumatz, 2000). Waste prevention may, however, be indirectly captured through other waste disposal statistics, as it represents a reduction in diverted and disposed waste.

The lack of data on waste prevention remains a significant gap for policy-makers. It has, perhaps indirectly, led to a disproportionate focus on waste diversion as the best (or only) alternative to waste disposal. Reconciling these data collection issues, however, remains a persistent challenge.

# Glossary

**Extended Producer Responsibility (EPR)** is a policy that makes manufacturers financially and physically responsible for managing the waste generated from their products or materials. *Full EPR* programs are financed and operated entirely by producers, while *Partial EPR* programs share responsibility between producers and government. In Canada, EPR policies are implemented by provincial governments.

**Municipal Solid Waste**, also known as downstream solid waste, is the material that remains after goods have been produced and consumed or are of no further use. The primary sources of municipal solid waste are the residential, industrial, commercial, and institutional sectors, along with construction and demolition sites. Municipal solid waste includes everyday items, such as plastics, electronics, paper, steel, glass, wood and food and garden waste.

**Pay-as-You-Throw (PAYT) Programs** are one type of municipal user fee for residential garbage collection and disposal services. Instead of paying for these services solely through property taxes, households under a PAYT program typically pay according to the number of garbage bags put out for disposal, by the size of their garbage bin, or by the frequency that waste bins are placed at curbside for collection.

**System Efficiency** is the extent to which the total net costs of a community's solid waste management system are minimized (or conversely, the extent to which net benefits are maximized). This includes the costs for waste disposal, diversion, and prevention and the benefits of waste management services, including avoided environmental damage.

**Tipping Fees** are a type of user fee levied at the gate of waste disposal facilities (i.e., landfills, waste-to-energy facilities). Fees are typically based on the weight or type of waste being processed.

**Upstream Solid Waste** refers to solid waste not managed by municipal waste systems. It includes waste generated from processing natural resources into consumer goods and materials. This includes waste from the mining, agriculture, oil and gas, and manufacturing sectors.

**Waste Disposal** refers to waste of no further use that is managed at landfills, incinerators, or waste-to-energy facilities.

**Waste Diversion** refers to waste that is managed and eventually utilized through recycling and organics processing facilities. Waste diversion also includes materials that are reused or repurposed, which defers the need for new materials.

**Waste Exports** refers to solid waste that is transported to, and managed in, a different jurisdiction from where the waste was originally generated.

**Waste Prevention** refers to actions that avoid generating waste. It includes manufacturers that reduce the amount of material in a given product or consumers that choose to consume less or purchase products that generate less waste.

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