A CRITICAL REVIEW OF ONTARIO'S BLUE BOX PROGRAM: IDENTIFYING AND TESTING BEST PRACTICES IN PRINTED PAPER AND PACKAGING RECYCLING

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by

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THESIS

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public

Abstract

This dissertation undertook a critical review of four recycling policies used in Ontario which are designed to promote household waste diversion and reduce material management costs. These policies include:

1) Municipal funding should be directly tied to program performance relative to their peer group.

2) All municipalities should make investments in recycling promotion and education, and will be reimbursed $1 per household for all recycling promotion and education expenditures

3) Where possible, municipalities should implement pay as you throw schemes for household waste as a means to minimize the amount of material being disposed of in the waste stream.

4) Where possible, municipalities should opt for single stream collection and processing of household recyclables

Using a combination of recycling data spanning the past 12 years for each of Ontario's 223 obligated municipalities and semi structured interviews with recycling stakeholders, the aforementioned recycling best practices were evaluated using three criteria: 1) the ability to increase waste diversion 2) the ability to contain costs and 3) perception and attitudes among recycling stakeholders (do they think the policy is working).

None of the four recycling best practices tested were able to satisfy all three criteria. Stakeholder perceptions and attitudes towards the best practice policies were mixed. Given that the recycling best practices tested in this study failed to achieve their intended objectives, I then proposed alternative systems that could be characterized as a radical departure from the existing

system. This was done to call into question the appropriateness of having "increased diversion" as the focal point of policy objectives in the province.

In these alternative systems, I propose a "contraction" of the existing Blue Box program – Using a systems based cost model, focus was placed on analyzing whether recycling programs should be offered in rural and northern communities. The results of this analysis demonstrated that eliminating recycling programs in high cost regions significantly decreased system costs without negatively impacting overall recycling rates.

The second alternative system considered in this study examines how changing the mix of materials accepted in Ontario's residential recycling program affects provincial material management costs and recycling rates. The results of the cost model analysis show that removing non-core materials from the Blue Box program significantly decreased system costs without negatively impacting overall recycling rates. Ultimately, it was found that it was possible to increase the provincial recycling rate while simultaneously reducing program costs by targeting specific materials for recovery.

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“Lately it occurs to me: What a long strange trip it’s been” – Grateful Dead

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Dedication

To my family – you are my rhyme and reason. Thank you for your unconditional love and support.

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3Rs – Reduce, Reuse, Recycle

ABC – Activity Based Costing

AMO – Association of Municipalities of Ontario

AMRC – Association of Municipal Recycling Coordinators

CSR – Corporations Supporting Recycling

EPS – Electronics Product Stewardship

HDPE – High Density Polyethylene

HSW – Household Special Waste

IC&I – Industrial, Commercial and Institutional

IFO – Industry Funding Organization

ISP – Industry Stewardship Plans

WDO – Interim Waste Diversion Organization

LDPE – Low Density Polyethylene

MFAM – Municipal Funding Allocation Model

MIPC – Municipal Industry Program Committee

MOE – Ministry of the Environment

MPAC – Materials and Packaging Advisory Committee

MRF – Materials Recovery Facility

MIPC – Municipal Industry Programs Committee

MWIN – Municipal Waste Integration Network

OCC – Old Corrugated Containers

OCNA – Ontario Community Newspapers Association

OMBI – Ontario Municipal Benchmarking Initiative

ONP – Old Newspapers

P&E – Promotion and Education

PET – Polyethylene Terephthalate

PP – Polypropylene

PPEC – Paper and Paperboard Environmental Council

PVC – Polyvinyl Chloride

R&D – Research and Development

RCC – Retail Council of Canada

RCO – Recycling Council of Ontario

WDA – Waste Diversion Act

WDO – Waste Diversion Ontario

Chapter 1: Introduction

The management of municipal solid waste remains at the forefront of policy planning debate and discourse in North America. Increases in urban waste generation, coupled with decreases in available landfill space, necessitate the implementation of comprehensive and cost effective waste diversion programs. However, comprehensiveness and cost effectiveness are not always consistent with one another. Recycling is a costly waste management strategy for municipalities, particularly when compared to conventional land filling options. As such, many jurisdictions have chosen to implement policy measures designed to increase both waste diversion and the operational efficiency of household recycling programs.

While there exists a significant body of research exploring the effectiveness of municipal recycling instruments in promoting waste diversion (see Sidique et al., 2009; Barr et al., 2006; Beatty et al., 2007; Domina, 2002, Hornik et al., 1995), comparatively few have examined how recycling tools affect waste diversion in jurisdictions with mature recycling systems. Traditionally, most studies have tended to focus on areas where household recycling programs were either newly implemented or voluntary. The issue with this is twofold: 1) it is difficult to gauge the efficacy of municipal waste management initiatives when evaluated only in the near term, and 2) The characteristics of both a recycler and a municipality's recycling infrastructure change over time - as do household responses to municipal policy initiatives. The effectiveness of initiatives such as pay as you throw, promotion and education, mandatory recycling etc. will change depending on the characteristics of the system in question. Identifying what policy instruments can be used to increase residential recycling is of critical importance to both private and public stakeholders, who often must work collaboratively to increase recycling rates to meet legal mandates.

Likewise, there is a need to address the long term tenability of recycling initiatives and the notion that “more is better” with respect to waste diversion. While much of the current dialogue surrounding waste management revolves around increasing recycling rates and diversion levels, one must take a step back and ask whether a higher recycling rate should be the focal point of policy objectives. Are there metrics beyond recycling rates that need to be considered when evaluating the long term sustainability of waste management systems? To help understand and potentially answer these questions, let us briefly consider the Ministry of the Environment's (MOE) decision to increase provincial recycling targets for Ontario's residential recycling program (Blue Box). In 2011, the MOE set a provincial recycling rate target of 70% for all residential recyclable material. This move was heralded as a "step in the right direction towards a more sustainable Ontario" and was largely applauded by both municipal officials and the general public (Waste Diversion Ontario, 2011). For the better part of three decades, recycling has been a cornerstone of the province's sustainability platform and is seen as a key driver towards a "closed loop economy". However, the emphasis placed on increasing the provincial recycling rate has come at an enormous financial cost to both municipalities and industry.

In Ontario, the generation of total recyclable material (per annum) has increased from 1,211,000 tonnes to 1,386,000 tonnes between 2002 and 2011 (Waste Diversion Ontario, 2014a). The costs of managing this system have increased by 78% during this same period (Waste Diversion Ontario, 2014a). To use the "low hanging fruit" analogy, the province has already captured most of the easy to recover material (newsprint, cardboard, glass etc.) at an average cost of $178 a tonne. However, the cost associated with collecting and recycling "fringe" materials (mixed plastics, composite packaging etc.) exceeds $878 a tonne (Waste Diversion Ontario, 2014a).

Given that any future increases in the province's recycling rate will most likely come from the recovery of fringe materials, are existing policy approaches that stress the increased recovery of recyclables appropriate in light of rising program costs? At this time, the answer to this question remains unclear. There is little doubt that recycling is a preferred waste management option when compared to the alternatives of landfill disposal and incineration. However, the prospect of increased diversion does little to alleviate the financial burden placed on municipalities that struggle to achieve recycling targets in a cost effective manner.

The careful balancing act between continuous improvement in diversion and cost containment is a topic that requires increased academic attention. Although a relatively large body of research on recycling exists, past studies represent a snapshot of an ever evolving system. What is important is that we constantly strive to better understand what changes need to be made to existing waste management tools to make them more effective (in both economic and environmental terms). If they aren't working, why? If they are, what improvements can be made? It is with this in mind that the current research was conceived.

1.1 Research Goals and Objectives

The goal of this research is to create a better understanding of how recycling policies affect both household and municipal recycling behavior in a mature recycling system. A secondary goal of this study is to develop a framework for evaluating the effectiveness of a given policy (such that changes can be made or alternatives explored). For the purposes of this study, a mature recycling system is characterized as a program that has a) legislatively enforced recycling b) has been in operation for more than 5 years and c) has a household recycling participation rate exceeding 75%.

Drawing upon relevant literatures in integrated resource management, environmental behavior and waste governance, the economic, environmental and policy dimensions of recycling are carefully considered. This was conducted to create a better understanding of the origins, intentions and outcomes of provincial best practices. In this study, I also examine the complex relationships between recycling stakeholders and their respective roles in the development of integrated waste management policy.

Four main objectives guide this research:

1. Explore how Ontario's municipal recycling initiatives affect recycling behavior at both the household and municipal level. With respect to the latter, little is understood about how local governments respond to recycling initiatives. Generally speaking, local governments enact policy initiatives to increase household waste diversion. However, in certain jurisdictions (i.e. Ontario, Manitoba, Quebec), provincial governments implement recycling initiatives that are designed to modify the behavior of local governments (who in turn, implement policies to modify household behavior).

2. Develop and apply an evaluative framework to gauge the effectiveness of Ontario's recycling initiatives. Extending upon the work of Simmons & Widmar (1990), Gamba & Oskamp (1994) and Vining & Ebreo (2002), this study develops metrics and methods to determine whether recycling policies are meeting their intended objectives.

3. Determine whether increasing household recycling rates should continue to be the primary goal of Ontario's waste management initiatives.

4. Explore potential alternatives to the existing system, and put forth recommendations based on feedback from recycling stakeholders and the results of the policy evaluation.

Identifying what does and does not work in promoting residential recycling, as well as who is affected by policy initiative outcomes will be of critical importance in developing an effective and economically viable recycling system in Ontario and other jurisdictions.

1.2 Waste: Issues in integration

The USEPA defines integrated waste management as:

"Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program. An effective ISWM system considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment. (pg.1, 2002)"

Integrated solid waste management is not a new concept –references to the term can be found as early as the 1970s (Marshall, 2013), with many countries now embracing the principles of integrated waste management as a means to promote resource stewardship, conservation and minimize potentially harmful wastes. At its core, ISWM is about evaluating local needs and conditions (with consideration being given to social, economic and environmental factors), and then selecting the most appropriate waste management strategy to meet these conditions (USEPA, 2002). Conceptually, it is difficult to find fault with the tenants of ISWM. In practice, ISWM planning is enormously challenging – largely because of the amorphous quality of waste.

The term waste is neither easy to define nor to delimit in scope. As noted by Zizek (2006) and Moore (2012), waste can be seen as a parallax object, possessing a range of qualities, utility values and attitude attachments depending on one's perspective. Waste is both filthy and valuable, toxic, yet useful - what waste is and how, why and to whom it matters varies greatly (Moore, 2012). Opinions diverge sharply on an appropriate definition of waste, both with respect to legal and operational uses of the term (Smith, 1993). Table 1 below highlights several definitions of waste found within the literature (adapted and expanded from Pongracz et al., 2002):

*Table 1: **Various definitions on the concept of waste***

Author	**Definition**
Baran (1959)	Waste is the difference between the level of output of useful goods and services that would be obtained if all productive factors were allocated to their best and highest uses under rational social order, and the level that is actually obtained
Elwood (1993)	Waste, like beauty, is in the eye of the beholder
EU (1991)	Waste shall mean any substance or object in the categories set out in Annex I, which the holder discards or is required to discard
Gutberlet (2011)	Waste is a potential resource
Hollander (1998)	Waste is something that needs to be expelled in order that the system continues to function
Lox (1994)	Waste is either an output with ('a negative market') 'no economic' value from an industrial system or any substance or object that has 'been used for its intended purpose' (or 'served its intended function') by the consumer and will not be re-used
McKinnie (1986)	Waste is the unnecessary costs that result from inefficient practices, systems or controls
OECD (1994)	Wastes are materials other than radioactive materials intended for Disposal
Pongracz (2002)	Waste is an unwanted, but not avoided output, whence its creation was not avoided either because it was not possible, or because one failed to avoid it
Pongracz (2002)	Waste is a man-made thing that has no purpose; or is not able to perform with respect to its purpose
Tchobanoglous et al. (1993)	Items which have may no immediate use value, but due to their intrinsic properties are often reusable and may be considered a resource in another setting
UNEP (1989)	Wastes are substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law

Table 1 illustrates the non- tractable nature of defining waste, as well as the range of attitudes we as scholars, resource managers and resource users have towards waste. It is these attitudes that shape both our past and present approaches to municipal solid waste management. Given the dualistic properties of both waste as a resource and waste as an unwanted byproduct of consumption, developing an effective integrated waste management framework is both of critical importance, yet rife with challenges. Affected stakeholders have difficulty finding common ground when it comes to how waste is managed, who should manage it, and who ultimately foots the bill.

Creating a system that is sensitive to stakeholder needs and concerns, yet still able to satisfy the environmental and economic objectives of an ISWM system is predicated on effective stakeholder collaboration, supporting legislative and governance frameworks and cooperation across multiple sectors and levels of government. In turn, successfully integrating issues surrounding waste and fully realizing its value as a resource requires an intimate understanding of integrated resource management principles, determinants of environmental and recycling behavior and a thorough knowledge of existing ISWM systems in both developed and developing markets. Understanding what is required to develop a successful ISWM system helped guide the major literature areas reviewed in this thesis.

1.2.1 Recognizing the value of waste as a resource

While waste as a resource is not a new concept, it is a relatively new environmental management strategy (emerging only within the latter half of the century). Historically, people have recycled, repurposed and reused waste during times of increased scarcity (economic depressions, war time etc.) (Hall, 2002). Although resource scarcity also served as the primary impetus for the modern recycling movement, the level of exploitation and environmental degradation that occurred at the time was on a scale never seen before in human history (Melosi, 1981). Policy makers recognized that any potential solution to these problems would have to involve significant changes to both national and local legislation, focusing on resource reuse and recycling to help curb unsustainable extraction rates (Dunson, 1999) . Waste was no longer just a byproduct of resource use, but a resource in and of itself. This reconceptualization of waste was central in the development of modern ISWM systems, and served as the foundation of the integrated solid waste management paradigm (McDougall et al. 2001). The United States pioneered legislation involving waste recovery and recycling in the 1970s, with Canada shortly following suit in the early part of the next decade.

Table 2 summarizes relevant waste management and recycling legislation in both Canada and the United States.

Table 2: ***Relevant waste management legislation***

Act	Purpose
Solid Waste Disposal Act (1965)	Broad attempt to address the solid waste problems confronting the nation through a series of research projects, investigations, experiments, training, demonstrations, surveys, and studies.
Resources Recovery Act (1970)	Established a major research program, run by the EPA, to develop new and innovative ways of dealing with solid waste. Gave the EPA the responsibility of providing state and local governments with technical and financial help in planning and developing resource recovery and waste disposal systems.
Resources Conservation and Recovery Act (1976)	Designed to "promote the protection of health and the environment and to conserve valuable material and energy resources" (USEPA, 1976). The act shifted the emphasis of the national solid waste management initiative to recycling and energy recovery (Melosi, 1981). Furthermore, the act also made state level waste management plans mandatory, transferring both the responsibility and day to day operations of MSWM systems to state and local authorities (Melosi, 1981).
Canadian Environmental Protection Act (1988)	Designed to provide a systematic approach to assess and manage chemical substances in the environment that were not addressed under existing programs. Emphasis on pollution and waste control.
Ontario Environmental Protection Act (1991)	The act grants the Ministry of the Environment broad powers to deal with the discharge of environmental contaminants which cause negative effects. The early and later versions of the Act included regulations on waste and litter disposal.
Canadian Environmental Protection Act (1999)	Extension of CEPA 1988, but with a greater emphasis placed on pollution and waste prevention. Introduced the concept of sustainable development in a Canadian policy context

While the aforementioned legislative changes were certainly critical in helping shape the modern recycling movement, they do not fully explain the adoption of municipal recycling systems across North America. Rising energy costs, a paucity of available landfill space and a decline in the use of refillable beverage containers were important developments in spurring the demand for municipal recycling services (Kollikkathara, 2009).

Prior to the 1970s, little demand existed for recyclable material. The infrastructure simply did not exist to collect, sort and reprocess recyclables as it was often cheaper to produce new goods from virgin material (Hall, 2002). However, a precipitous rise in energy costs and increasing difficulty in procuring scarce primary resources necessitated that manufacturers explore alternative inputs for production, namely recyclables (Hall, 2002). In a report published by the United States Environmental Protection Agency (USEPA, 2010), the energy savings of recycling could be as great as 95% when compared to virgin production. As such, significant investments were made in recycling infrastructure and technology, which ultimately lead to the creation of end markets for recyclable material. Increasing demand for recyclables and the introduction of recycling legislation proved to be quite fortuitous, as the supply of recyclables generated by North American households would increase significantly during this same period.

The switch from refillable to recyclable containers proved to be a pivotal moment in the development of residential recycling in North America. Prior to the mid-1960s, all beverage containers were sold in refillable glass bottles, with producers of the beverage being physically and financially responsible for its end of life management (McRobert, 1994) . However, during the latter half of the decade, beverage brand owners began to introduce non refillable containers, citing increased safety and convenience on behalf of the consumer. Non-refillable containers also proved to be significantly cheaper for the beverage industry and retailers, as they were no longer financially obligated for collecting and processing used containers. By the end of the 1960's, the use of refillable containers had declined to 55% of total beverage sales (McRobert, 1994).

When packaging producers opted to use aluminum, steel and plastic containers in lieu of refillable glass bottles, the corresponding increase in household waste generation placed considerable strain on existing landfill capacity (Melosi, 2000). Increases in public space littering made the issue highly visible to the public, who demanded that measures be taken to preserve the environmental aesthetic (Melosi, 2000). To reconcile the disconnect between the supply of recyclable materials being sent to the landfill and the increasing demand for recyclables from industry, curbside and depot recycling systems became an increasingly popular ISWM strategy across North America (Melosi, 2000).

1.3 Why Ontario?

Ontario, Canada was chosen for the case study in this thesis. Ontario has operated a curbside recycling program (Blue Box) for the better part of three decades, and currently employs a series of recycling "best practices", which refer to: "Waste system practices that affect Blue Box recycling programs and that result in the attainment of provincial and municipal Blue Box material diversion goals in the most cost effective way possible" (Stewardship Ontario, 2007).

While Ontario's best practices cover a variety of areas meant to increase the operational efficiency of the Blue Box program, this study concerned itself only with tools designed to encourage residential recycling and encourage cost containment. Table 3 summarizes the waste management initiatives examined:

Table 3: ***Best practices designed to encourage residential recycling***

(Source: Adapted and expanded from KPMG Blue Box Best Practices Report, 2007)

Tool	Purpose
Municipal Incentivization	When reimbursing municipalities for the cost of managing their recycling system, an incentive system should be used to encourage municipalities to recycle more at a lower cost. All other things being equal, municipalities who recycle more will have a greater percentage of their waste management costs reimbursed than a like municipality who recycles less material (Stewardship Ontario, 2007).
Investments in Promotion and Education	Every municipality should make investments in recycling promotion and education to increase household recycling awareness and participation. Each municipality in the province will be granted a provision of $1 per household to be spent on promotion and educated related expenses (Stewardship Ontario, 2007).
Pay as you Throw Schemes	For municipalities who provide curbside recycling collection, pay as you throw schemes should be implemented to encourage households to source separate recyclables from their waste stream. Fees should be charged for each bag of garbage over and above the baseline limit specified by the municipality (Stewardship Ontario, 2007).
Single Stream Recycling	All new material recycling facilities constructed in the province should be single stream facilities. When possible, municipalities should opt for single stream collection systems.

At this juncture, it seems prudent to identify, examine and test recycling tools that may be used to promote household recycling, particularly the province's "best practices" in Blue Box material recovery. Further to that point, it is crucial that opportunities for improvement be identified with respect to how recycling tools are implemented and evaluated in provincial municipalities.

1.3.1 A note on terminology

Differences between diversion and recycling

This thesis sometimes uses the terms diversion and recycling interchangeably as it pertains to waste management activities in Ontario. The two terms differ in their formal definitions, and understanding when and why to use the terms is of particular importance. The United States

Environmental Protection Agency (USEPA) defines recycling as “Using waste as material to manufacture a new product. Recycling involves altering the physical form of an object or material and making a new object from the altered material.” (2014).Similarly, the USEPA defines diversion as “the combined efforts of waste prevention, reuse, and recycling practices” (2014). All material recycled is by definition, diverted, but not all material diverted is recycled. With that being said, in Ontario, the terms recycling and diversion are, for all intents and purposes, the same for residential Blue Box waste. In order for a packaging product to be classified as diverted, it must be recycled into a new product. Ontario, unlike some other provincial jurisdictions (i.e. Nova Scotia and Quebec) does not recognize incineration as a diversion strategy for packaging waste. Thus, the policy vernacular in Ontario will often use diversion and recycling interchangeably when referring to Blue Box materials. Using these terms as substitutes for one another is not appropriate when discussing waste management activities in other jurisdictions, or when referencing the literature. What is meant by recycling and diversion will depend on site specific contexts and interpretations, and thus, caution should be used when using them.

1.4 Recycling Policy: The Evaluation Imperative

While there is significant evidence from the literature supporting the efficacy of recycling initiatives, there remains a need to develop mechanisms to evaluate specific initiatives in site specific contexts. What has been proven to be successful in other jurisdictions may not work in Ontario (and vice versa). Under conventional recycling schemes, provincial or state actors are accountable for the effectiveness of policy formulation/implementation and efficiency of resource use. However, Ontario’s model of Blue Box recycling shifts many of these responsibilities to local municipalities, which necessitates that clear and prescriptive “benchmarks for success” be developed.

Unfortunately, to date, the process of learning what is and is not working in Ontario's Blue Box remains underdeveloped and poorly understood. The infancy of the province's EPR program, its unique financing arrangements and relative paucity of research into initiatives affecting municipal recycling behavior have all contributed to a general lack of understanding. The difficulties in evaluating municipal recycling policy stem from the complexity and variability of the initiatives themselves. Ultimately, we must ask ourselves, how do we choose to define "success" in recycling initiatives? The answer to this question is not always apparent, and is largely contingent on the interests of both the evaluator and stakeholders.

As proposed by Conlet and Moote (2012), there is a natural inclination to use "improved levels of diversion" as the litmus test for success when evaluating recycling initiatives. While this is indeed a central element to most evaluative models, it ignores the economic and social dimensions of recycling policy. The goals of an evaluation must be clearly defined in order to select appropriate evaluation criteria and guide data collection (Conley et al, 2003). Evaluators must be able to identify the goals of the project, the metrics and indicators used to gauge success (i.e. increased diversion, decreased program costs, increased service area), and be able to prioritize the importance of policy objectives depending on the needs of affected stakeholders. This latter point is of particular importance, in that it highlights the inherently normative nature of evaluating recycling policy initiatives. Some projects may choose to give more weighting to environmental objectives (i.e. diversion), while others may choose to prioritize economic efficiency of program operation. While the criteria used to evaluate each project may be the same, how the evaluator chooses to rank said criteria may change the perceived successes and shortcomings of a given project. As noted by Conley and Moote, "the criteria relevant to a given evaluation will always vary with the reasons for the evaluation, the values and perspectives of the evaluator and the context and characteristics of the collaborative effort being evaluated" (2003: 376)

Despite the potential difficulties in evaluating recycling policy, the "evaluation imperative" stems from the importance of sharing the results, experiences and learnings from each project. Doing so not only adds credibility to specific initiatives, but helps improve future recycling policy in promoting sustainable stewardship (giving consideration to both environmental, economic and social objectives) (Innes, 1999).

This research has chosen to use three criteria to evaluate the effectiveness of recycling policy: 1) Diversion 2) Cost Containment and 3) Stakeholder Perceptions. Both diversion and cost containment are quantitative metrics - either a policy will successfully increase municipal diversion rates, lower program costs, or some combination thereof. Calculating the potentially causal relationships between a given policy and diversion/cost containment is largely an empirical exercise. As discussed in section 3, a series of econometric and quantitative models were employed in this study to quantify the effects of Ontario's recycling best practices on recycling rates and program costs. However, evaluating the merits of a recycling policy based strictly on costs and recycling rates paints an incomplete picture - stakeholder perceptions is a critical component in determining whether a policy is appropriate for a given area. For example, is a policy that increases recycling rates, but results in significant administrative burden for municipalities truly effective? The answer to this isn't necessarily black and white. In direct contrast to diversion and cost containment, stakeholder perceptions is decidedly qualitative. How stakeholders perceive the effectiveness of Ontario's recycling best practices will vary from sector to sector (private companies vs. municipal officials) and even person to person (a municipal official in Toronto may have different attitudes towards recycling policy than one from Kenora). Understanding how stakeholders within the recycling system perceive recycling policy is a central component in evaluating the effectiveness of a given initiative. Feedback from affected stakeholders will ultimately help shape policy direction in the future, deciding whether policies need to be revised or repealed.

1.5 Organization of Dissertation

This thesis is composed of 7 chapters, and is organized in a way that satisfies research objectives while explaining the evolution and rationale of Ontario's Blue Box recycling policy. Chapter 1 provides an introduction to the topic, describing the issues surrounding increased household diversion, the policies currently in place to support provincial recycling goals and the need to evaluate the effectiveness of said policies. Chapter 2 is divided into two sections. The first section undertakes a comprehensive review of the literature relevant to this study. This includes discussion on integrated waste management in a developed world context, determinants of environmental behavior, and by proxy, determinants of recycling behavior. A detailed review of extended producer responsibility schemes, (which is central to the understanding of recycling in Ontario) is also undertaken. This section is then followed by the theoretical framework used in this study, explaining in detail the recycling policy process, integrated waste management and methods for policy evaluation. Chapter 3 provides a general overview of the methods, data sources and methodology utilized in this research project. Chapter 4 provides an overview of recycling in Ontario, which includes a detailed description of recycling in Ontario (including the economics and environmental impacts of recycling), an overview of both the Waste Diversion Act, and Waste Reduction Act, and concludes with a description of study scope (i.e. why am I only looking at Blue Box materials). In Chapter 5, I apply my three factor framework to evaluate the effectiveness of municipal policy initiatives. Using a combination of quantitative and qualitative data, I first determine whether Ontario's recycling best practices lead to increases in municipal recycling rates and encourages cost containment. I then combine these findings with feedback from recycling stakeholders (households, municipal officials and packaging producers), who comment on the effectiveness of existing recycling best practices and the recycling system as a whole. A discussion of these findings is found in Chapter 6. In Chapter 7, I conclude the thesis, providing a summary of research findings, contributions of the research to the broader discourse on recycling and sustainability and providing recommendations moving forward. Statements regarding author contributions and supplementary research documents (consent forms, surveys etc.) are included in appendices A through C respectively.

Chapter 2: Literature Review

2.1 Literature Areas

This project is theoretically informed by several related literatures that form a compelling interdisciplinary intersection. This chapter reviews relevant studies in integrated waste management, environmental and recycling behavior, and extended producer responsibility. This study has drawn from inquiries in each of these areas. This review provides the foundation for the evaluative framework used to test Ontario's recycling best practices, which is presented in Chapter 3.

2.2 Evolution of municipal waste management

Historically, the impetus to manage waste was largely attributed to concerns surrounding sanitation and public health. As noted by Flintoff (1976), improper disposal and management of waste has the potential for significant human harm, attracting vectors for disease such as rats and flies. Tchobanoglous et. al. (1978) have suggested that unregulated and unfettered dumping of waste contributed to the spread of several epidemic diseases in Europe and colonial America between the periods of 1790 and 1900. These problems only became more acute during the industrial revolution, as the rapid expansion of urban areas exacerbated logistic, infrastructural and health concerns for both human and non-human life (Melosi, 1981).

To address these issues, landfilling became an increasingly popular mechanism for coping with increases in waste generation. The "out of sight, out of mind" approach to waste management grew in prominence through much of the 20th century (National Solid Waste Management Association, 2008; Melosi, 1981). While early landfills were characterized by open dumping in unoccupied tracks of lands, urban and municipal engineers recognized the need to develop "sanitary" landfills to help prevent leachate contamination and the propagation of vermin (Melosi, 2000). This was achieved by burying waste in plastic lined trenches, which served to mitigate against soil and ground water contamination (Melosi, 2000). Landfills were placed in remote areas away from major urban centers, minimizing the potential for health and environmental hazards associated with exposure to waste. Furthermore, from a strictly operational standpoint, land filling was a convenient method for collecting and consolidating waste generated by urban and commercial waste streams (National Solid Waste Management Association, 2010). By the 1960s, sanitary landfills had become the dominant method of waste disposal throughout much of North America. As noted by Tarr (1996), sanitary landfills were perceived as an economical and environmentally sound method for managing waste generated by rapidly growing cities.

While landfilling would remain the dominant waste management strategy for much of the 20th century, attitudes towards waste, stewardship and humanity's place within the biophysical environment would change significantly during the 1960s and 70s (Engler, 2009). MSWM was no longer defined by resource use and disposal, and would eventually become part of a larger conversation on sustainable planning and environmental conservation. The catalyst to these changes are largely attributable to the modern environmental movement that characterized much of these two decades (Engler, 2009).

Though the modern environmental movement in North America can trace its roots to as early as 1892 (with the creation of the Sierra Club), it did not gain significant political or public traction until the post war era (Shabecoff, 1993) . Rapid growth of urban areas were accompanied by wide scale environmental degradation and increasing resource scarcity. Several milestone events during the 60s and 70s galvanized the public's attitude towards the environment, forcing substantive changes to environmental policy and legislation. Some of the more salient examples of such events have been highlighted in Table 4 below.

Table 4: ***Milestones in the modern environmental movement (In North America)***

(Events summarized from Shabecoff, 1993) .

Event	Result
Rachel Carson publishes "Silent Spring" (1962)	Increased public concern surrounding pesticide use and pollution and its effect on the environment
Paul Ehrlich publishes "The Population Bomb" (1968)	Raised concerns of resource scarcity and food security in light of rapid increases to population levels and decreasing resource stocks
Santa Barbara oil spill (1969)	• First time American public saw the extent to which oil spills devastate coastal areas and affect both the environment and local economic activity • Creation of the California Coastal Commission
The Cuyahoga River in Cleveland catches fire (1969)	• Impetus for the Clean Water Act, Great Lakes Water Quality Agreement. • Contributed to the formation of the Environmental Protection Agency
Earth Day (1970)	20 million Americans joined together to celebrate the earth and advocate for environmental reform
OPEC announces oil embargo against the United States (1973)	• Significant increase in the price of energy and manufacturing • Increasing emphasis being placed on reuse and recycling

While the above list is hardly exhaustive, it does illustrate three important points: 1) "Environmentalism" became a part of the public lexicon, as citizens were growing increasingly concerned about environmental issues 2) Humans possessed the unique ability to radically and permanently alter their biophysical environment - often to their own detriment and 3) Resources were scarce, and the inability to access said resources (either throw artificial constraints, i.e. OPEC embargo, or declining stocks from overuse) can have significant economic and social consequences.

To help conceptualize these developments, sociologists Catton and Dunlap (1978) developed the New Environmental Paradigm (NEP), a direct critique of the Human Exemptionalism Paradigm (HEP) that dominated the Western world view at the time. Unlike the

HEP which saw humans as being separate and dominant over nature, the NEP recognized that humans were part of the biosphere, affected by the cause, effect and feedback loop of ecosystems (Catton and Dunlap, 1978). Despite the ingenuity and innovative capacity of humans, the NEP stated that both resources and waste repositories are finite, and thus, the biophysical environment imposes constraints on human activity. Humans must place limits on unregulated growth, seeking to preserve the environment through increased stewardship, resource recovery and conservation efforts (Catton and Dunlap, 1978). While Catton and Dunlap faced sharp criticism from proponents of the HEP and technologists in general, the NEP represented a watershed moment with regards to how humans situated themselves relative to the environment (Dunlap & Buttel, 2002). The earth was no longer something to be exploited without consequence, but an intricate system that required careful management to ensure sustained use into the future. The circumstances of the time, namely rising energy costs, increasing resource scarcity and growing concern for environmental issues forced policy planners to re-evaluate approaches to waste and resource management. The 3Rs of "Reduce, Reuse and Recycle" came to define the policy approach taken by resource planners in promoting sustainability and conservation in the following decades (Melosi, 1981).

2.3 Integrated Waste Management

The responsibility of municipalities to collect and dispose of wastes was first introduced in the nineteenth century in response to issues surrounding public health concerns. In many countries, the private sector has recently become more involved in delivering waste management services, but municipalities continue to assume the responsibility to ensure that the service is provided (Wilson, 2007). The change in focus from waste collection to environmentally sound waste management has served as a driver for inter-municipal co-operation to realize economies of scale (Wilson, 2007).

Early models of municipal waste management characterized waste as a nuisance, a byproduct of consumption that needed to be disposed of in a cost effective manner (Buclet, 2002). Waste management was largely seen as an engineering problem with solutions rooted in new technology. Early waste management systems were designed to reflect this simple planning strategy, emphasizing the use of landfills and incinerators to dispose of waste generated from the residential sector. However, driven by a scarcity of available landfill space and an increasing desire to promote sustainable resource use, waste management models have undergone a radical evolution over the past two decades. Increasingly, integrated solid waste management (ISWM) is being promoted as the dominant waste management paradigm (UNEP, 2009).

As per the U.S Environmental Protection Agency (1:2002), Integrated Solid Waste Management can be defined as:

"Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program."

This somewhat vague definition highlights the challenges of ISWM planning. At a very high level, the ISWM model recognizes the value of waste as a resource, necessitating that both public and private waste management systems be substantially modified to promote source reduction, recycling, and reuse of packaging products (McDougall et al. 2001). As a conceptual framework, ISWM attempts to optimize waste management decisions by assessing the collection, disposal and recycling options available to an area to help them meet diversion goals (either self-imposed or legislatively required).

However, the methods to design, implement and manage an ISWM system are highly dependent on a variety of enabling conditions (community type, household attitude towards recycling, adequate waste management infrastructure, etc.). The characteristics of waste management systems vary significantly across regions, and even within the same city, requiring customized waste management solutions (Stewardship Ontario, 2011a)

As noted by McDougall et al. (2001), ISWM planning extends far beyond promoting the 3Rs (Reduce, Reuse and Recycle), and must be tailored to the communities they serve, giving particular consideration to the environmental and social impact of waste management decisions. For example, a decision to implement an extended producer responsibility scheme in an area may force industry to relocate so as to avoid paying for end of life waste management. The net benefit of increased diversion is tempered by decreases in economic activity and employment.

The above issue illustrates that there is no one approach to ISWM. As noted by van de Klundert & Anschuntz (1999) and Kollikkathara et al. (2009), IWSM should consider stakeholder needs, community context, budgetary constraints and available infrastructure and technology. Social and environmental benefits must be weighed against the municipal costs of waste management, which can be quite significant (McDougall et al., 2001)

Despite the rather amorphous guidelines for ISWM as a conceptual framework (differences in terms, objectives and goals of ISWM depend on the author), central themes in ISWM literature can be readily identified. Perhaps the most evident of these themes is the emphasis placed on resource reuse and reduction in waste generation. Largely considered the logical extension of the 3Rs, ISWM can trace its roots to the "waste hierarchy" model, a waste minimization strategy that ranks waste management options in order of their environmental impact (Gertsakis and Lewis, 2003).

Consisting of 5 steps (Avoidance and Minimization, Reuse, Recycling, Recovery & Disposal), in descending order of desirability, the waste hierarchy model suggests that each step be exhausted before moving on to a less desirable waste management strategy. However, while the waste hierarchy serves as a useful guideline when making planning decisions, it should not be used prescriptively (Gertsakis and Lewis, 2003). In many instances, community specific conditions may require "skipping" steps. For example, household hazardous waste (batteries, oil filters, etc.) cannot be recycled in developing countries due to a lack of infrastructure. Given the acute health risks posed to waste workers who collect this material, they may be better served to dispose of the material safely than attempt to reuse/recycle harmful products. Another example where steps might be skipped is in instances where recycling certain packaging types results in a greater environmental burden when compared to the production of virgin material. A recent study by Stewardship Ontario determined that recycling glass cullet resulted in greater GHG emissions relative to the procurement of virgin glass (Stewardship Ontario, 2011b). This is due to the energy intensive nature of melting recycled cullet, and the distance traveled to end markets for the recycled product.

Despite the variation in ISWM planning and design, at its core, ISWM is about safely and sustainably managing waste through its entire life cycle (Sachs, 2006). Sachs argues that a reduction in consumption coupled with the utilization of discarded products within the production system can lead to reduced end-of-cycle waste generation. Thus, less efforts and resources will be required for the final disposal of the waste (Sachs, 2006).

2.3.1 Challenges of integrated waste management

While there have been numerous demonstrable successes in integrated resource management, it is not without its challenges, particularly in the context of waste management. The very nature of integration in waste - which requires collaboration among a diverse group of sectors, industries and institutions - may result in conflict, communication externalities and stakeholder fatigue. To help frame some of the challenges of collaborative policy research and implementation, I draw on the work of Public Choice theorist, William Niskanen.

In 1971, Niskanen published a seminal work in economics, “Bureaucracy and Representative Government”. While the work's central focus is on the interaction and inefficiency of government agencies, Niskanen's findings can be readily transposed to a resource management context. Government agencies are insular in nature, and rarely interact in a collaborative fashion with other departments. In fact, agencies and departments will often compete with one another for a larger share of a finite budgetary pie (Niskanen, 1971). When issues arise that require inter-agency cooperation, competing interests and mandates may result in a communication externality. A communication externality is a cost (not necessarily monetary) incurred by all affected parties that is attributable to lapses in communication (Niskanen, 1971).

Niskanen highlighted three primary contributors to communication externalities:

1. The greater the number of participants in the negotiative process, the greater the communication externality. Thus, for integrative issues that require the input of multiple actors, the greater the “cost” (Niskanen, 1971).

2. The further you go outside of the central or lead agency, the greater the communication externality. For example, if an issue requires input from individuals outside of the government, the greater the cost (Niskanen, 1971).

3. If there is unequal bargaining power among members involved in the negotiative process, the greater the communication externality. Disparities in the power structure in integrative collaboration may render stakeholders either too dominant or too ineffectual (Niskanen, 1971).

Ultimately, communication externalities and conflict among affected stakeholders may be sufficient to deter cooperation all together, negating the integrative process. These issues have actually lead to integrative failure in the Blue Box system, wherein packaging producers, municipalities and the provincial government were forced to enter arbitration regarding levels of municipal funding in 2014. Despite the best efforts of all parties to arrive at a mutually agreeable outcome, competing interests, and a perceived lack of fairness with respect to the funding model subsequently resulted in forced mediation (which as of time of thesis preparation, is still ongoing)

2.3.2 Application to research

For this research, integrated solid waste management (and by proxy, integrated resource management as a whole) is seen as a valuable concept that helps us better understand the challenges with managing a resource as contentious as waste. ISWM emphasizes the importance of appropriately identifying issues, developing solutions that take into account site specific needs/concerns, and encouraging integration and collaboration across affected stakeholders.

2.4 Determinants of environmental behavior

Environmental behavior literature is a complex and rich subfield that can trace its conceptual roots to psychology, environmental science and economic theory. At its core, environmental behavior examines relationships between human behavior and the natural and built environment. As noted by the keystone journal, *Environment and Behavior*, the field explores research topics that include environmental experiences (e.g., restorativeness, place attachment/identity, environmental perception/cognition); environmental outcomes (e.g., pro-environmental behaviors such as recycling; health-supportive environments; design preferences); and processes linking environments and behaviors that support human well-being.

Studies by Blake (1999) and Seligman (1985) note that there is a marked disconnect between what people say and what people do with respect to environmental behavior. Despite strong evidence to suggest that household concern and awareness regarding environmental issues is growing, few people take steps to alter their environmental behavior in day to day life (Blake, 1999). This discrepancy between intent and action is often referred to as the "Value-Action" gap (Kollmuss & Agyeman, 2002). This idea illustrates that environmental attitudes and knowledge are poor predictors of individual behavior, and represent only one dimension of what motivates people to act a certain way (Pelletier et al. (1998).

Factors underlying environmental behavior have been studied from different theoretical perspectives. Contemporary literature examining individual motivations to engage in environmental behavior can largely be divided into three major areas: 1) perceived costs and benefits, 2) moral and normative concerns, and 3) habitual behavior.

2.4.1 Perceived Costs and Benefits

Various studies on environmental behavior operate under the assumption that individuals make rational choices and choose alternatives with highest benefits against the lowest costs (expressed in terms of money, effort and/or social approval) (Steg and Vlek, 2008). An influential framework that is predicated on the cost/benefit assumption is the theory of planned behavior (TPB), the conceptual extension to the theory of reasoned action (Ajzen and Fishbein, 1975) and the theory of self-efficacy (Bandura, 1977). TPB states that attitude toward behavior, subjective norms, and perceived behavioral control, together shape an individual's intentions and behaviors (Ajzen, 1985).

While TPB was originally conceptualized as a predictive persuasion model, the underlying intuition can (and has) been readily applied to issues related to environmental behavior. Studies by Nigbur et al (2010), Han et al (2010), and Biel and Thogerson (2006) have all used TPB to explain individual action (or inaction) towards environmental issues such as recycling and energy conservation. Their findings are consistent with the TPB model, in that favorable intent or positive attitude towards a given issue is insufficient for inducing behavioral change. An individual must feel that their behavior will a) make a material difference in contributing towards a social good, and b) be relatively easy to perform, before they are likely to act.

2.4.2 Moral and normative concerns

A number of studies have focused on the role of moral and normative concerns underlying environmental behavior from different theoretical perspectives (Steg and Vlek, 2008). Research examining the value basis of environmental behavior and beliefs (see De Groot and Steg, 2007, 2008; Nordlund & Garvill, 2002; Schultz and Zelezny, 1999) suggest that the more strongly individuals subscribe to values beyond their immediate own interests (e.g. pro social, altruistic, biospheric etc.), the more likely they are to engage in pro environmental behavior.

Studies focused on the role of environmental concern (i.e. Dunlap and Van Liere, 1978; Dunlap et al., 2000) have mostly been measured by the New Environmental Paradigm scale. These studies revealed that higher levels of expressed environmental concern are associated with acting more pro environmentally. However, as noted by Steg and Vlek (1994) and Vining and Ebreo (1992), this relationship is generally not very strong. A third line of research examining moral and normative concerns focuses on moral obligations to act pro environmentally. These studies are based on the norm-activation model (Shwartz, 1977) and the value belief norm model (Stern, 2000). Each of these models has been successful in explaining low cost environmental behavior and "good intentions" such as willingness to change behavior, political behavior and environmental citizenship (Steg and Vlek, 2009). However, they have far less explanatory power in situations characterized by high behavioral costs or strong constraints on behavior (Steg and Vlek, 2008). In these instances, the theory of planned behavior has been more successful in explaining pro environmental behavior, as the TPB model accounts for external influences.

2.4.3 Habitual Behavior

Unlike the theoretical frameworks examining perceived costs and benefits and moral and normative concerns, some researchers argue that behavior is habitual and guided by automated cognitive processes, rather than being preceded by reasoned choices (Aarts et al, 1998).

Aarts et al,. (1998) defined three characteristics of habitual behavior:

1) Habits require a goal to be achieved

2) The same course of action is likely to be repeated when outcomes are generally satisfactory

3) Habitual responses are mediated by mental processes. When people frequently act in the same way in a particular situation, that situation will be mentally associated with the relevant goal directed behavior

As noted by Steg and Vlek (2008), habits refer to the way behavioral choices are made, and not to the frequency of the behavior. Aarts and Dijksterhuis (2000), Klockner et al. (2003) and Fuji (2003) have successfully employed habitual measures in explaining pro environmental behavior. Significant academic attention is now being paid to methods to modify behavior that has undesirable environmental consequences (Bamberg and Schmidt, 1999)

2.4.4 Determinants of Recycling Behavior

The discourse surrounding household recycling and determinants of consumer recycling behavior can largely be divided into four broad categories 1) external incentives, 2)internal motivators, 3) external facilitators, and 4) internal facilitators (Hornik et al, 1995).

Early literature on understanding recycling motives emphasized the role of external incentives in encouraging consumer recycling. Economic theory assumes that consumers are utility maximizers who base their decisions on a rational assessment of costs and benefits. As such, environmentally desired behavior can be achieved via mechanisms that reduce the relative costs of the behavior, such that the perceived benefit yields the individual a net increase in utility (Kinnaman & Fullerton, 2000). Studies by Geller, Winett, & Everett (1982), McNeely (1988) and Ackerman (1988) have demonstrated that monetary incentives are generally successful in promoting a desired behavior. More recent research examining the role of market incentives in encouraging recycling via "Pay as you Throw" systems have shown that the demand for household recycling is elastic to changes in the cost of waste diversion (Thogerson, 2003). If consumers are obligated to pay fees in proportion to the weight of material disposed in the residential waste stream, the relative cost of recycling is reduced, thereby incentivizing source separation. While regulation by means of economic incentive is gaining traction in environmental policy, critics of this approach question the merits of incentive systems in promoting an enduring change in consumer behavior (Thogerson, 2003). Studies by Pardini & Katzev (1984) & Curlee, (1986) argue that a desired behavior would persist only for as long as the incentive was made available. In the absence of said incentive, it is assumed that the marginal cost of recycling (expressed as time and effort on the part of the consumer) would be sufficiently high to deter the act of recycling itself.

However, subsequent research by Simmons & Widmar (1990), Gamba & Oskamp (1994) and Vining & Ebreo (1990) points to evidence that a consumer's propensity to recycle may be attributable to internal motivators that are non-remunerative in nature. Thogerson (2003) states that conventional economic reasoning assumes that a consumer's preferences are given, independent of relative pricing and unaffected by policy regulation. Behavioral scientists argue that this may not be the case, as economic regulation may interact with an individual's intrinsic values and personal motives for partaking in the desired behavior. This suggests that the research surrounding determinants of recycling behavior should be expanded to include drivers of recycling that are rooted in social and moral norms.

Studies by Pieters (1991), De Young (1986), Ajen & Fishbein (1980) and Thogerson (1996) describe intrinsic motivators for recycling that include personal satisfaction in promoting sustainability and stewardship. Some consumers derive utility from participating in an activity that is perceived to be environmentally and socially beneficial. Ackerman (1997) characterizes this behavior as being driven by intrinsic or altruistic motives. Some researchers have questioned whether the term intrinsic is appropriate, as pro-social behavior is generally a function of injunctive norms prescribed by the community (Cialdini, Kallgren, & Reno, 1991). If there is an expectation that consumers should recycle, the decision to participate in the activity may be indirectly coerced as opposed to internally motivated. However, as evidenced by McCarty & Shrum (2001), it is often difficult to delineate between intrinsic motives and social norms, as the two determinants are a function of one another, i.e. intrinsic motives may lead to social norms, and social norms reinforce intrinsic motives. Thus, the demand function for recycling is expanded to include non-quantitative variables that capture a consumer’s attitudes towards recycling, the environment and their community. The personal satisfaction derived from recycling may be enough to offset the costs incurred, or complement existing external incentives. While there is increasing evidence to suggest that a consumer's concern for the environment, and by proxy desire to recycle, is growing, current diversion and recycling rates remain low. This points to barriers to recycling that may lie outside a consumer's own behavior, and towards external factors that indirectly affect a consumer's recycling demand function.

Internal and external facilitators of recycling behavior refer to conditions, attitudes, actions or policies that enable consumers to recycle. Hornik et al (1995) have characterized internal facilitators as cognitive variables that include a consumer's awareness of recycling initiatives and the importance of recycling as a whole. One of the primary barriers to increased waste diversion is ignorance on the part of the consumer regarding what constitutes recyclable material. In the absence of explicit or prescriptive disposal guidelines, households are more likely to dispose of printed paper and packaging in the residential waste stream (Stewardship Ontario, 2011). The transaction/information costs incurred on behalf of the consumer in increasing internal facilitators may be sufficient to discourage recycling. Research by Callan and Thomas (2006) observed that municipalities that invest directly in recycling promotion and education have managed to successfully increase waste diversion. By reducing consumer transaction costs in recycling awareness, people are more likely to participate in a cause that they are familiar with. However, neither recycling awareness nor desire to recycle are sufficient to encourage a meaningful change in recycling behavior. As noted by Lansana (1992) and McCarty and Shrum (2001) recycling must be made convenient for the consumer.

External facilitators refer to exogenous conditions that encourage consumers to recycle by reducing the time costs associated with recycling. Domina (2002) noted that household participation in a recycling program is largely contingent on convenience - if recycling requires a significant time or monetary investment on the part of the consumer, they will be less inclined to participate. Empirical evidence suggests that a consumer's recycling demand function is highly elastic to changes in level of convenience (Nyamwange, 1996). Methods to increase external facilitators include weekly or bi-weekly curbside recyclable collection, the provision of designated recycling containers and depot stations for MHSW (Material Hazardous Solid Waste) and WEEE (Waste Electrical and Electronics) materials. Work by Berger (1997) suggests that municipalities offering household recyclable collection achieved higher recycling rates than those implementing voluntary "bring" systems. Further research examining differences in single and muti-family recycling have also shown that convenience is a primary determinant in a consumer's recycling proclivity (Stewardship Ontario, 2010).

2.4.5 Application to Research

An understanding of why people recycle is critical in developing policy initiatives designed to increase household diversion. However (as noted above), the motivations and cognitive antecedents to recycling behavior are complex, interconnected and sometimes, not readily apparent. While chapter 5 will further explore the linkages between policy intent and stakeholder action, it's important to note that why a person recycles is dependent on personal attitude attachments, social norms and site-specific enabling factors.

2.5 Recycling policy literature

This section reviews the literature specific to each of the recycling best practices that are evaluated in this thesis. Broadly speaking, a review of recycling promotion and education, pay as you throw and singe/multi stream recycling literature has been conducted. Of note, literature on municipal incentivization and transfer payments has been excluded from this discussion - at the time of thesis preparation, no studies existed that specifically examined the effects of incentivization targeted towards municipalities. However, a discussion on recycling motives, including the roles of incentives in affecting behavioral change, is included in section 2.4.4. An additional literature area on the economics of recycling also accompanies the following discussion. Understanding the economics of packaging waste recovery (the opportunities, challenges and practical considerations) is crucial in gauging whether diversion should remain a focal point of policy in Ontario.

2.5.1 Recycling Promotion and Education

An integral component for the proper functioning of a municipal recycling system is ensuring public approval and participation (Jurczak et al., 2006; Simmons and Widmar, 1990; Reams and Ray, 1993; Tucker, 1999; Mee et al., 2004). The efficacy of the recycling system will largely be determined by a household's ability to properly recognize recyclable material, what to do with recyclables separated from the waste stream, and the importance of recycling activity as a whole (McDonald and Ball, 1998; Evison, 1998; Evison and Read; 2001). A popular tool employed by municipalities in raising levels of household awareness and participation in recycling initiatives is the use of promotion and education (P&E) campaigns. While P&E campaigns vary depending on the intended message and the target audience involved, there is a consensus that communications should clearly specify: 1) why consumers should recycle, including the environmental, economic and community benefits, and 2) how consumers should recycle, including all of the relevant details (what, where, and how) of the program (McKenzie-Mohr, 1995).

Table 5 below summarizes the types of P&E initiatives that can be used by municipalities.

Table 5: ***Types of P&E Initiatives***

Type	Purpose
Leaflets, Pamphlets and Flyers	Raise levels of consumer recycling awareness. Could be used in very general terms (i.e. promoting the importance of recycling, or be tailored to the specific characteristics of a given community)
Radio, Web and Television Advertisements	Raise levels of consumer recycling awareness. Could be used in very general terms (i.e. promoting the importance of recycling, or be tailored to the specific characteristics of a given community)
Door to Door Campaigns	Informs consumers about recycling initiatives at a local level
Product Labeling	Indicates the recyclability of a particular product
Bin Advertisements	Informs consumers about what materials belong/do not belong in recycling bins. Generally used in public spaces (i.e. parks, malls etc)

Historically, little data has been made available regarding the use of P&E initiatives at the local level (Jurckzak et al., 2006). In many instances, municipalities outside of Ontario fail to make provisions for investments in recycling P&E due to budgetary constraints or low policy prioritization. Despite this paucity of data, studies by Callan and Thomas (2006), Sidique et al. (2009), Read (1999a, 1999b, 2003), Mee et al. (2004) and Jurckzak et al (2002) have pioneered research into quantifying the effects of P&E on waste diversion.

To date, the majority of the research in this area suggests that investments in P&E are effective in encouraging household participation in recycling. Reed's study of household recycling in Chelsea, England, found that conventional approaches to P&E (i.e. leaflets, advertisements etc) were successful in fostering enduring changes in consumer awareness (1998). Further to this finding, Reed (1999a) observed that door to door P&E campaigns increased total waste diversion by 23% relative to baseline measurements. Building on Reed's work, Jurckzak et al. (2002) observed that P&E campaigns adopted in Jaslo, Poland resulted in both an increase in the total tonnes of material recovered from households, as well as a broader range of materials recycled. Sidique et al. (2009) and Callan and Thomas (2006) noted similar results in Minnesota counties and Massachusetts respectively. With respect to these findings, researchers found that the effectiveness of P&E campaigns is largely rooted in its ability to act as both an internal and external facilitator of recycling. However, as noted by Read (1999a), P&E initiatives are successful in changing "one time public behaviors" (i.e. changing attitudes about recycling from negative to positive, consumer purchasing habits, etc). As such, P&E initiatives are most effective when levels of recycling awareness are low, generally when a recycling program has been newly implemented. However, are P&E campaigns likely to be as effective in jurisdictions with mature recycling systems?

Thus far, there is no literature to support the efficacy of P&E campaigns in areas with high levels of recycling awareness, no research has been conducted in this field. This is a topic that necessitates further academic investigation, particularly in jurisdictions such as Ontario which has operated a curbside recycling program since the early 1980s.

2.5.2 Pay as you throw (PAYT)

The effect of municipal user pay systems on waste and recycling activity is a topic that has generated significant attention from a multitude of researchers. Early literature on the topic sought to develop a household demand function for waste services, exploring the effects of PAYT on household waste generation. Such studies include seminal pieces by McFarland et al, (1972), Wertz (1976), Jenkins (1991) and Repetto et.al (1992). Subsequent studies by Ebreo et al. posited that households may reduce quantities of waste disposed under a variable fee system, opting to reuse items and/or change purchasing behaviour (i.e. buying durable instead of one time use items etc.) (1999). While changes in consumer purchasing behaviour and waste generation are largely dependent on the magnitude of the PAYT price signal (the penalty for excess garbage must be sufficient to induce behavioural change), there is empirical evidence linking PAYT policy to reduced household generation rates and changes in household consumption. A Belgian study on the effects of PAYT schemes found that household waste generation decreased by 9.1% over a ten year period (Flemish Waste Institute, 2013). Similar results were observed in a review of PAYT schemes in 27 European Union states - Austria, Germany, Finland and Ireland all reported decreases in household generation and an increase in the proportion of material recycled post implementation of PAYT policy (BIOS, 2012).

Tangent to this line of inquiry, an increasing number of researchers have expanded the household waste demand function to include recycling, attempting to determine the effects of PAYT on overall waste diversion (Fullerton and Kinnaman, 1997, 2000; Hong, 1999; Allers and Hoebin, 2009; Sidique et al., 2009). The general argument in favour of unit based pricing (eg. Dijkgraaf and Gradius, 2008; Callan and Thomas, 2006) is that such schemes promote the efficient use of waste management resources. Households are given an incentive to generate less waste if they are forced to pay for the management of additional material.

As demonstrated by Podolski and Siegel (1998) and Jenkins (1993), these studies find statistical support for the negative relationship between the price paid per bag and the quantity demanded of disposal services. In a study using community level data for 149 New Jersey municipalities, pay as you throw schemes were found to significantly reduce the amount of solid waste disposed by households, while increasing the amount of material recycled (Podolski and Spiegel, 1998). Kinnaman and Fullerton (2000) derive a similar conclusion by analyzing cross-section data of more than 900 U.S. communities. Consumers will also be less likely to dispose of items such as white goods (fridges, microwaves), waste electronics and yard waste in the residential waste stream when PAYT systems are implemented.

Brown and Johnstone (2014) also found that there is public support for garbage bag limits/unit based pricing among residents living in PAYT communities. In an analysis of environmental taxes (expressed as PAYT fees) in communities across four countries, it was found that household support for PAYT schemes was a direct function of exposure to such systems. Opposition and/or resistance to PAYT policy was observed to decrease over time, a finding that was supported by other studies examining similar forms of environmental taxation (see Schuitema et al., 2010; Dunne et al., 2008) . Of note, Brown and Johnstone (2014) found an inverse relationship between support for PAYT schemes and levels of household waste generation (households with higher rates of waste generation expressed lower levels of support for PAYT policy). This result is consistent with our understanding surrounding how PAYT policies affect behaviour - those most affected by garbage bag limits/unit based pricing are most likely to be opposed to its implementation. What is unknown is whether "high generation" households modified consumption and disposal behaviour in response to PAYT policy over time.

Despite the extensive empirical evidence supporting the use of PAYT systems in increasing waste diversion, there remains considerable debate as to whether they benefit the community as a whole. As noted by Kinnaman (2006, 2008) and Allers et al (2009), PAYT systems may give rise to illegal dumping and in fact, may be more costly for municipalities to implement relative to a fixed fee scheme. The administrative challenges of measuring and billing individual households may be sufficient to offset any benefits from diverting material from the residential waste stream. To date, there is little consensus regarding the long term efficacy of PAYT schemes despite an increasing trend to adopt such systems in North American cities (USEPA, 2007).

2.5.3 Single vs. Multi Stream Recycling

At this time, there is a paucity of academic literature that specifically examines the effectiveness of single and multi-stream recycling. What little work has been done in this area has generally been "grey literature" - consulting reports, trade magazine articles, technical papers etc. - carried out by local governments. Much of the information that is currently available comparing multi and single stream programs has reflected either local circumstances that can differ substantially from one area to the next and/or has reflected a particular focus or interest of the author. As a result, this research attempted to expand the research focus to the greatest extent possible to include system performance documented both inside and outside Ontario, and to identify the specific rationale supporting the findings regarding system performance.

There is a general consensus in the available literature that single stream recycling offers potential for more efficient collection and reduced collection costs. In 2007, the Solid Waste Association of North America (SWANA) observed that collection savings from single stream systems ranged from $10 to $20 per tonne. Similar findings were observed by The Solid Waste Hazardous Waste Education Centre at the University of Wisconsin, which reported that the potential savings associated with single stream collection can vary from 5% to 25%. In contrast to these findings, an examination of the collection costs by Cascades/Metro Waste concluded that the savings from single stream collection was much lower, with estimates ranging from $0 to $3 a tonne (2008)

While single stream collection costs are presumed to be lower than multi stream systems, it is generally accepted and demonstrated that the capital and operating costs for single stream processing are more expensive. In a study by the University of Wisconsin, processing costs for single stream systems were 10% higher on average when compared to multi stream systems (2005). These findings were echoed in studies by Waukesha County (2007) and Escambria County (2008), which observed differences in processing costs ranging from 7% to 50% (with single stream systems being more expensive). However, there have been some studies that have estimated that the annual operating cost for single stream facilities could be lower than a multi stream facility when operating at the same throughput. A study undertaken by consulting firm Stantec Ltd., it was estimated that the costs for a hypothetical facility with a throughput of 14 tonnes per hour would be $107/tonne for a single stream system and $116/tonne for a multi stream system (2012).

Reports evaluating the effectiveness of single stream recycling systems have also found that the commodities recovered from single stream programs are of lower quality than those recovered from multi stream systems. This results in decreased value and/or difficulties in finding end-markets. In a study conducted by Morawski (2010), it was found that single stream systems had eight times the yield loss compared to multi stream systems for paper fibers collected curbside.

Plastics processors reported that material from single stream MRFs had a yield rate 10% lower than multi stream MRFs (Morawski, 2010).

2.5.4 Economics of Recycling

As noted by Lavee (2007), there is a general consensus in the literature that the direct costs of recycling exceed the costs of disposal. Work by Bohm et al. (2010), Staudt (1993) and Ready (1994) all note that reported municipal recycling costs for household waste are greater than the costs of disposal. However, there are two issues with this claim: 1) When externalities are factored into the cost of recycling (relative to the costs of disposal), there is significant evidence that suggests recycling is economically and environmentally preferable (Brisson, 1997) and 2) The costs of recycling can be reduced through policies such as unit based pricing on garbage disposal (see works by Podolski & Siegel (1998), Jenkins (1993), Kinnaman (2006, 2008) and Allers et. al., (2009)), economic incentivization (Palatnik et. al., (2005) & Lakhan (2015d)), and policies to encourage cost containment (Lakhan (2014b), Stewardship Ontario (2011)). In several instances, reductions in the cost of recycling make it a cost competitive alternative to disposal (Miranda et al., (1994) & Harder et al., (2006))

The consideration of externalities (both economic and environmental) is critical when evaluating the merits of recycling initiatives. Most of the literature in favor of recycling cite the benefits of reducing the need to procure material from virgin sources (USEPA, 2013). This has obvious environmental benefits, in that depending on the material being recovered, recycling can reduce emissions output by a factor of 10x (USEPA (2013), Stewardship Ontario (2012)). Furthermore, recycling is seen as promoting resource stewardship and helps preserve declining resource stocks. Increased recycling also reduces the quantities of material being sent to landfills, reducing the strain on landfill capacity and the need to site new landfills (which is becoming increasingly difficult in urban areas). Highfill and McAsey (1997) even argue that the cost of recycling decreases relative to disposal over time, as landfill costs will increase as available capacity decreases.

Studies conducted by the Conference Board of Canada (2014), the National Recycling Coalition (2001) and the USEPA (2011) also find that recycling activity contributes to job creation (recycling creates 7x more jobs when compared to disposal), gross domestic product and value added measures. Even when the jobs displaced from recycling activity are accounted for, recycling positively impacts employment levels and the economy as a whole.

Given the extensive evidence in favor of recycling, why do municipalities struggle with rising material management costs? As noted by Munger (2007), few (if any) recycling systems for household packaging waste are self sustaining (where the economic benefits of recycling activity offset the cost incurred for material management at the municipal level). Critics of recycling often claim that recycling is an inefficient activity, as it generally costs more to use recycled material relative to procuring virgin material (Munger, 2007). While this assessment of recycling fails to take into accounts its non pecuniary value , it does highlight a critical issue when evaluating the impacts of recycling - who are the winners/losers of recycling activity? In the majority of instances, municipalities are responsible for delivering recycling services to residents - they incur the costs associated with material management. These costs may be recovered through property taxes, extended producer responsibility schemes, or some combination thereof. However, the benefits of recycling - reduced emissions, job creation etc., are generally accrued by parties external of the municipality. The jobs created by recycling generally occur "downstream" from the point of collection - at processing plants that are sometimes located in other provinces, states and even countries. The emissions savings from recycling occur at the point of virgin material displacement, once again, rarely does this occur at the municipal level (Stewardship Ontario, 2012). Essentially, municipalities bare the cost of recycling for the benefit of others - on a system wide level recycling is seen as a net social good, but individually, municipalities may not benefit. Tangent to this point, there is considerable debate as to whether the external benefits of recycling can be quantified in any credible way. Pollin & Peltier (2009) found that the methodologies used to estimate job creation, emissions savings etc. vary from study to study, and it remains unclear as to whether these numbers are accurate.

2.5.5 Recycling and Sustainability

The concept of sustainable development was originally defined as « meeting the needs of the present generation without compromising the ability of future generations to meet their needs » (United Nations Brundtland Commision, 1987). Following this definition, something is either sustainable or not sustainable; sustainability cannot be "improved" or "worsened" (or it is merely the time before depletion that changes) (Leonard, 2010). Society is faced with the issue of sustainable living because we live in a finite world, with constraints on the amount of resources we depend on. When waste is condemned to a landfill for disposal, we often condemn a potentially reusable material to idleness, further exacerbating the need to extract and exploit raw materials (Unruh, 2010).

Recycling, as broadly defined in section 1, means reusing raw material that has already been extracted (normally after these materials have been collected, sorted and reprocessed in the post consumption stage of the product's life cycle). This in turn reduces the need to procure virgin materials, resulting in various degrees of energy savings (depending on the material in question) and preserving resource stocks by reducing the rate of extraction.

Recycling is seen as a potentially significant means to reduce carbon emissions impacts, promote resource stewardship and conservation and encourage a broader movement towards "sustainable living" (Unruh, 2010). However, as noted throughout this thesis, participation in recycling initiatives remains low. It is estimated that while more than 75% of post-consumer waste can be recycled, only 30% of it actually is (Conference Board of Canada, 2014). Canada as a whole and Ontario in particular do a particularly poor job with respect to recycling – the country ranks last in a list of OECD countries with respect to overall waste diversion, while Ontario is among the worst performing provinces in the country (with overall diversion rates of approximately 12%) (Conference Board of Canada, 2014). This represents a significant opportunity for the nation's waste management sector – even incremental improvements in overall diversion levels will have potentially significant impacts on various sustainability metrics (emissions impacts etc.)

However, the nature of recycling reprocessing has an inherent drawback – in virtually all instances, products made from recycled materials are often of lesser quality than the object for which the material was previously used. This process, called downcycling, suggests that raw material cannot be reused indefinitely due to properties intrinsic to recycling. With the exception of metals, recycling, at best, can delay the need to procure virgin materials, but cannot replace the need to do so (Leonard, 2010). Also, recycling may be seen as an unsustainable activity if it engenders the excessive use of other resources (e.g. Oil for transportation, or energy for transformation). This may occur for certain materials that are shipped overseas to be managed in developing countries at a lower cost.

With this in mind, proponents of recycling activity often cite its practice as being an effective method for reducing the demand for raw products and energy (Unruh, 2010). This is especially true when the recycled objects are made from substances that pose significant environmental harm (i.e. petroleum-based plastics, aluminum).

For recycling to be unquestionably sustainable, it is necessary to review the way the material is transformed and re-processed. For this reason, it is recommended that the first two tenets of the waste management hierarchy (avoidance and reuse) be promoted as a preferred solution relative to recycling when attempting to promote sustainability.

2.6 Extended Producer Responsibility: Experiences from within Canada and abroad

2.6.1 Pre amble

This section engages in an in depth overview of extended producer responsibility, discussing its many forms, the advantages and disadvantages of the approach and experiences/key learnings from other jurisdictions. While this section is included in the literature review, it is not (at least in the strictest sense) compiled from the broader academic literature. Extended producer responsibility has received relatively little attention from the research community – while studies on EPR do exist (Mayers, 2008; Walls, 2007; Gottberg et al, 2005), very rarely do these studies delve deeply into the topic (as it is not in their scope to do so). While EPR as a concept has existed for more than two decades, it is a topic that is very much in its conceptual infancy (at least in a North American context). As such, the information included in this section has drawn on a variety of sources: industry and consulting reports, conversations with packaging producers and recycling stakeholders, and not least, my personal experiences as both a consultant and policy planner working in this space.

2.6.2 What is extended producer responsibility?

Extended producer responsibility is becoming a favored public policy approach to manage post-consumption waste in most developed economies. Generally speaking, EPR shifts the financial (and sometimes physical) responsibility for the end-of-life (EOL) management of used packaging from consumers to the producer of the original packaging (Lindhqvist, 2000). Producer, in this case, is commonly defined as the brand owner of the packaged product or the first importer into a specific jurisdiction (typically the distributor or retailer who first receives the product in that jurisdiction). While the packaging manufacturer or the packaging material supplier is sometimes included under shared producer responsibility regulations, this is the exception and not the norm. The brand owner makes decisions as to which packaging materials will be supplied in a given market and, therefore, bears the ultimate responsibility for its end-of-life management.

EPR is the most commonly used term for this broad policy approach. Other terms that are commonly used include product stewardship and the polluter pays principle. EPR for packaging should be viewed as a subset of the broader global trend towards the adoption of sustainability thinking.

Table 6 below describes product currently being managed through EPR programs.

Table 6: Products being managed through EPR programs

(Source: Adapted from StewardEdge (2010))

	Short-life Consumables	**Durable Products**	**Hazardous Components**
Common Examples	• Packaging • Used motor oil and filters • Paints and coatings • Small quantity hazardous or special wastes such as cleaners, solvents • Pharmaceuticals • Single-use batteries • Plastic bags	• Electrical and electronic equipment • Propane tanks and cylinders • Tires • Rechargeable batteries • Thermometers • Fluorescent bulbs and tubes • Automobiles	• Mercury switches • Sharps • Residual flammables • Additives • Cold cathode fluorescent tubes
Emerging Initiatives	• Branded organics • Littered items	• Carpets • Mattresses • Construction and demolition wastes	• Irritants, corrosives

EPR is itself a subset of a broader effort underway to identify and assign costs to key environmental and social impacts.

2.6.3 Underpinning policy rationale

Although EPR policy formulation and programs for used packaging have been around for 20 years, EPR thinking is still in its infancy: The ever-widening range of government initiatives, program implementation models and new enterprises forming in response to these changes highlight the relative immaturity of the field. As a result, program costs vary widely.

The primary reason for adopting EPR policies, to date, has been the relatively narrow issue of post-consumer waste management. While grounded within the broader sustainability framework, most program initiatives have focused on the collection and diversion of designated wastes from disposal, with increasing attention being paid to waste reduction and product/packaging design (Tojo, 2001).

Primary public policy arguments for implementing EPR for packaging include (Mayers, 2008):

1. To transfer the costs of managing packaging waste from the local tax base to the producer and user of the product.
2. To provide a direct economic incentive for the producer of the package to reduce packaging materials and design packaging for improved recyclability.
3. To bring the expertise and resources of industry to bear for the design and ongoing management of comprehensive materials management systems (as opposed to local waste management systems).
4. As an initial step towards the development of a circular materials economy – where waste materials serve as feedstock for new processes (as opposed to the current norm: a linear extraction/production/consumption/disposal economic system).
5. To make the producer and consumer of the packaging fully responsible for the environmental impacts of it production, use and end-of-life management.

Notably absent in most EPR practices, to date, has been the ability to design and implement a program based upon a broader product and packaging lifecycle assessment. This will likely change in the future to include consideration of greenhouse gas (GHGs) emissions, water impacts, hazardous materials and use of renewable materials and renewable energy.

Consideration of these impacts will be driven by:

- Rising global concern with reducing GHG emissions, combined with evolving markets for trading GHG reduction credits;
- Regional water supply and quality issues and a greater understanding of the water intensity of some production processes;

- Public policies that favour the use of renewable energy and materials;
- Development of lower-cost, open-source, linked data tools for completing lifecycle assessments;
- Higher customer and public awareness of the environmental impacts of alternative packaging (and products) choices resulting from awareness of and access to verified, comparative data to produce scorecards; and
- Lobbying by competing materials and packaging suppliers to shape EPR policies to favour their products.

This section briefly summarizes experience gained from the adoption of EPR for packaging in a range of jurisdictions internationally.

2.6.4 Alternative EPR Implementation Models

A wide range of policy alternatives are included under the broad category of EPR, and each differs in the manner and in the extent to which it may align with the spirit and principles of EPR. Table 7 below describes commonly used EPR implementation models.

Table 7: EPR implementation models

(Source: Adapted from Steward Edge, 2010)

Approach	**Overview**	**Examples**	**EPR Policy Fit**
Leasing products	Ownership remains with the manufacturer who organizes the end-of-life (EOL) management to highest value use.	• Computer equipment • Carpets • Vehicles	**High** – All costs internalized to the producer and user.
Voluntary Deposits	A redeemable deposit reflecting the actual or enhanced value of the product returned *in its original form.*	• Refillable beverage containers • Lead acid batteries • Pressurized containers • Shipping pallets and totes	**High** – Provides an economic incentive for the user or other economic actors at a level required to return product.

Approach	Overview	Examples	EPR Policy Fit
Mandatory Deposits	A regulated redeemable deposit system; with mandated return-to-retail or licensed return centres; and fixed system-wide handling fees; sometimes with restrictions on container types.	• National beverage container deposit schemes in Europe • State and provincial beverage container deposit schemes in North America	**Case specific** – Parallel recycling systems can increase environmental burdens; can lead to cross-subsidization of container types; deposit funds can be seized for other unrelated services; can be a profit centre for system owners if return performance is low.
Individual Producer Responsibility	Individual brand owner/manufacturer responsible for EOL management.	Can take the form of: • Direct management as with collecting used appliances, mattresses upon delivery of new ones • Contracting with service providers to manage EOL products on their behalf • Return share allocation of costs based upon brand identification • Price support as required to incentivise entrepreneurs to collect used products	**Medium to High** – High if product returned directly to the producer Adherence to EPR principles reduced if costs incurred by collective scheme allocated by current market share and where costs of unidentifiable, orphaned and obsolete products are high and allocated by current market share (e.g., computers).
Competing Producer Responsibility Schemes	Groups of producers, individual industry sectors or service providers organize competing schemes and compete for customers.	• Packaging schemes in Germany, Poland, UK • WEEE schemes in France, Spain, USA, Austria, UK,	**Case specific** – Competitive forces can lead to unlevel playing field, inappropriate EOL management services, and reduction in recycling rates/volumes.
Tradable Credits Schemes	Obligated producers purchase evidence of recycling of quantities of packaging sufficient to meet their obligations.	• UK national packaging compliance scheme	**Low to Medium –** Internalizes only the incremental costs of recycling additional quantities of packaging.
Monopoly Producer Responsibility Schemes	Obligated producers form a single compliance scheme to discharge all companies' obligations.	• National programs in Belgium, France, Portugal • Provincial programs in Canada	**Case Specific** – Low where fee rates do not reflect true cost to manage individual packaging types. Higher where materials are appropriately disaggregated and assigned true costs to manage.
Packaging Taxes	Sales based, unit or material specific tax applied by government.	• National programs Netherlands, Hungary	**Low** – No direct incentive to producers; funds usually go to general revenue rather than ring fenced for EOL management; tax rates may be arbitrary; linked to government revenue needs.

2.6.5 Approaches to EPR Being Adopted in OECD Countries

The Organization for Economic Cooperation and Development (OECD) includes many of the most developed economies in the world, including the United States. Most OECD countries have adopted one or more of these EPR approaches for end-of-life product management and packaging. Approximately 61 percent of the OECD population currently has EPR policies for packaging in place. The significant majority of the remainder not covered is the United States (27 percent) (Mayers, 2008).

Initial packaging EPR program models were predominately based upon the creation of a single national packaging compliance scheme. More recent EPR policy trends have focused on assigning the legal responsibility for EOL management of packaging waste to individual producers; and allowing each producer, operating individually (as part of a group or as a member of a producer responsibility organization) to discharge their legal obligation. In most cases, EPR programs for non-packaging products and wastes require the producer to pay 100 percent of the program costs. A notable exception was the EU EPR legislation for the management of waste electronics which made the producers responsible for program costs only from the point of aggregation within municipal programs. Existing EPR programs for used packaging assign partial or full financial responsibility to producers, but there is a clear trend in Europe and Canada to assigning the full program costs to producers.

Under full producer responsibility models:

- Obligated companies pay 100 percent of packaging recovery costs
- In Europe, this includes mechanical recycling, chemical recycling and some processing for energy recovery.

- Individual company responsibility or discharge obligation through approved compliance scheme.
- Compliance schemes define and implement best practices
- Collection and intermediate processing are contracted to municipal or industry service providers through competitive tenders or payment to best practice standards.
- Take-back guarantees come from material suppliers and/or direct investment in market development activities.

Producers or groups of producers can apply to the government for approval of a program plan to recover used packaging to meet their legal obligation to achieve minimum recycling and recovery quotas. A producer responsibility organization takes on the legal responsibility for meeting the collective obligation of its members and directly contracts with municipalities and other service providers to collect, sort and recycle sufficient used packaging to meet the collective quotas. In what is often referred to as the “dual approach,” producers assume direct financial and operational responsibility for organizing the packaging recovery system.

Under shared producer responsibility models, obligated companies pay a portion of packaging recycling costs through an approved compliance scheme. This includes:

- A defined share of recycling costs incurred by municipalities; and
- In some cases, the cost to manage packaging disposed as waste.
- Legal obligation is transferred to an approved compliance scheme. Compliance schemes use various mechanisms to promote best practices and control costs, including:
- Technical support; cost negotiations, promotion and education; research and development; and market development.

- In some cases, these schemes may apply to best practice costs only,

Table 8 below summarize EPR trends in European countries

Table 8 European Union Programs Summary

(Source: Adapted and expanded from Mayers, 2008)**Approach**	**Countries**	**Trends**
Producers pay 100% of costs	15	Move towards competing compliance schemes
Producers pay shared costs	10	Move to increasing industry cost share + costs of disposal for packaging not recycled
Tradable credits schemes	2	Provides only indirect price support for municipal recycling; focus on transport packaging
Packaging taxes	2	Add carbon costs as well as recycling costs; new government revenue source

Consumer packaging companies currently have the option of implementing EPR programs for used packaging on a voluntary basis. However, few producers today are willing to step up to this challenge. In cases where broad industry-led, voluntary schemes have launched in developed economies, results have been modest. The European Recovery & Recycling Organization (ERRA) launched packaging recycling pilots across Europe to demonstrate effective and efficient approaches to package recycling (Pro Europe, 2012). ERRA supported European-wide packaging legislation to stimulate wider adoption of packaging recycling schemes and minimize trade distortions in the common market. In Canada, major brand owners and grocery retailers have promoted voluntary approaches to recycling through Corporations Supporting Recycling for more than a decade. A lack of financial resources and the proliferation of provincial packaging regulations led CSR to advocate for EPR programs for used packaging. In the United States, voluntary industry efforts have tended to be single-material or packaging- specific approaches, and the overall recycling rate for used packaging has remained relatively flat over the last decade.

The remainder of this chapter will explore options for managing used packaging under regulated EPR programs.

2.6.6 Legislative Approaches

In general, national legislation is a preferred option. However, the regulatory authority for packaging waste issues may rest at the sub-national level (state, province, canton, etc.). Two current broad approaches to EPR legislation that address used packaging include “packaging-specific legislation” and “framework EPR legislation.” (StewardEdge, 2010)

EPR legislation was first implemented in Europe (Mayers, 2008), starting with used packaging before expanding to a wide range of product and waste categories, including end-of-life vehicles, WEEE (waste electronics), batteries, etc. In some European countries, regulated packaging recovery schemes are limited to managing specific packaging sub-sets (such as household packaging) and may be explicitly prohibited from managing other types of wastes. While packaging-specific compliance schemes are expected to continue for some time to come, two new trends suggest that the original model of focusing on managing packaging wastes in isolation may be open to change. Some packaging waste management schemes have expanded their operations (where permitted by law) to include the management of other designated wastes.

Commercial drivers for this change include requests from existing client companies obligated for both packaging and other waste streams (i.e. WEEE, batteries) or a desire to generate new revenue streams and lower overhead costs associated with packaging wastes (StewardEdge, 2010).

The European Union (EU) has also initiated several comprehensive waste management and environmental policy reviews which call into question the original single material/single medium focus of the original packaging waste legislation, including (Pro Europe, 2012):

- *Sustainable materials management policies (SMM),* which promote the efficient and environmentally responsible use of raw materials, products or waste. SMM takes a lifecycle approach as its basic premise and includes sustainable extraction, ecological design, eco-efficient production, sustainable consumption, and sustainable waste management. SMM aims to reduce the negative environmental impacts of materials use and preserve natural capital along the whole chain. SMM takes into account ecological, economic and social gains (Pro Europe, 2012).
- *Integrated product policies (IPP),* which seek to minimize environmental degradation by looking at all phases of a product's lifecycle and taking action where it is most effective (Pro Europe, 2012);
- *Sustainable consumption and production policy action plans,* which seek to improve the environmental performance of products and stimulate demand for more sustainable goods and production technologies (Pro Europe, 2012).

2.6.7 Framework EPR Legislation

Some EPR policy thinking and legislation in North America has modified the EU single product grouping focus to introduce the concept of "framework EPR legislation." In essence, rather than developing legislation for each individual product grouping or waste stream, this approach creates place legislation outlining requirements for implementing an EPR program for any designated product or waste stream. Table 9 below compares the advantages and disadvantages of each different types of EPR legislation.

Table 9: Comparison of material specific vs. framework legislation

(Source: Adapted and expanded from Stephenson (2010))

	Advantages	**Disadvantages**
Packaging specific	• Considerable CPG company experience in Canada and Europe. • Proven models in place applicable to U.S. market. • Model state legislation approach may support greater national harmonization. • Limits cost exposure for CPG companies.	• Reinforces disproportionate attention to packaging in isolation. • Tendency for governments to set high recycling targets and performance requirements linked to deposit systems for beverage containers. • May lead to multiple producer responsibility organizations for packaging, components and for products (i.e. WEEE, batteries).
Framework approach	• Reflects emerging public policy thinking. • Government may establish minimum common requirements for all materials rather than stricter minimum requirements for individual material streams. • May accelerate move towards broader LCA thinking. • Addresses much larger range of products and hazardous material. • Allows for longer term planning for all affected industries.	• Affects a much wider range of industries. • Fewer examples of working models in place. • CPG companies may face additional requirements and costs related to products.

As noted by Stephenson (2010), effective EPR legislation is contingent on a variety of enabling factors, and should include/address (StewardEdge, 2010; ProEurope, 2012):

- Establish clear public policy goals;
- Focus on outcomes and not pre-determine how industry must achieve these;
- Clearly identify the legally responsible producer under the legislation;
- Provide for a de minimis exemption provision to be set, as appropriate, for the designated material type;

- Establish clear consequences for failure to meet the requirements of the legislation;
- Include a practical enforcement mechanism and provide sufficient resources to ensure enforcement action will be taken;
- Allow a producer to discharge their legal obligations operating individually, as part of a group of producers, or through a single-producer responsibility organization established for that purpose;
- Include minimum waste diversion targets to be met by a combination of materials recycling, composting and energy recovery;
- Establish minimum requirements for approval of EPR program plans developed under the legislation;
- Ensure that any funds raised by the EPR program are directly controlled and managed by affected producers and not by government;
- Leave the determination of the most appropriate program funding mechanism to the affected producers, as long as all obligated materials are treated in a fair, transparent manner and pay their fair share of costs;
- Consider a broader range of environmental impacts rather than limited considerations to waste management impacts in isolation;
- Include a requirement for consumer incentives to participate in recycling programs (such as mandatory recycling, bans from disposal, pay-as-you-throw); and
- Ensure transparency and public accountability.

The legislative approach outlined above provides the greatest flexibility for producers to discharge their obligations in an economically and environmentally efficient manner. Once legislation is in place, producers are left with the responsibility to design detailed program plans for discharging their obligations. As outlined above, there are numerous alternative approaches for doing so (StewardEdge, 2010). The remainder of this section highlights some of the major issues to be addressed in EPR policy planning work.

2.6.8 Materials to be included under EPR programs for packaging

Programs including only household packaging directly address the most obvious case where EOL costs are not the responsibility of the generator or the producer. Rather these costs tend to be paid indirectly through municipal taxes or waste management service fees (StewardEdge, 2010) .

Household packaging wastes are widely dispersed and are often the most expensive types of used packaging to collect, process and recycle. Compliance programs are also challenged with accurately tracking quantities sold into and generated by households, adding complexity to the administration process (StewardEdge, 2010) . Including all primary or consumer packaging, regardless of where it is sold or generated, reduces administrative complexity but expands the scope and cost of the program. Since most secondary packaging and some primary packaging types (in particular, used beverage containers) are generated in large quantities outside of the home, achieving packaging recycling rates of 60 percent or more will be difficult without including all primary packaging under the recovery program(StewardEdge, 2010) .

Secondary packaging

This is generally considered to include both transport and display packaging. With the exception of small generators in urban areas, the cost of managing these materials is usually paid for directly by the generator. While this might be considered grounds for excluding these from the program, they are often the most cost-effective packaging materials to recycle; have well-established markets; and may already have recycling rates higher than for similar packaging materials found in household wastes.

Printed Papers

When EPR programs were first initiated in Europe for packaging, many policymakers assumed that recycling rates and markets for printed papers were already well established. However, prices paid for these materials are also subject to swings in global commodity prices and collection, processing, transport and recycling costs often exceed the revenues from sale of these EOL materials. Additionally, as much as two-thirds of materials (by weight) collected in household recycling programs are printed papers (newspapers, catalogues, flyers, unaddressed mail, home office papers, etc.). Not including these materials under regulated EPR programs can lead to cost- and fee-setting distortions as stakeholders are incented to assign costs to those materials from which they can generate EPR payments (StewardEdge, 2010).

Table 10 below summarizes a list of advantages and disadvantages of the options described above.

Table 10: Pros and Cons of Including Various Materials in EPR Programs

(Source: Adapted from StewardEdge (2010))

Materials Included	Pros	Cons
Household Packaging Only	• Limits the scope of obligation. • Highest public/political profile.	• Most expensive packaging to manage in isolation. • Administrative difficulty of calculating and reporting on sales to households only. • Does not address high profile of packaging improperly disposed in public spaces. • For some packaging types as much as 40 percent is not consumed in the home; recycling rates may be under-reported.
All Primary Packaging	• Easier to monitor and report sales data. • For some packaging types as much as 40 percent. not generated in the home • Program can address recycling of all packaging regardless of where generated. • Some economies of scale possible in high generation locations (i.e. restaurants and bars, offices, schools). • Addresses packaging recycling in high profile public spaces.	• Increase scope of the program (collection from industrial, commercial and institutional generators; litter control). • Some quantity of this material already recycled under existing commercial arrangements.
Secondary Packaging	• Generally lower cost material to recycle. • Large concentrations already under the control of obligated producers. • Some materials (i.e. old corrugated cartons) already have high recycling rates in some jurisdictions. • Comprehensive approach may reduce per ton operating costs and improve overall recycling rates.	• Significant quantities of this material already recycled under existing commercial arrangements. • Lack of detailed planning data on existing generation and composition.
Printed Papers	• Common practice to collect both packaging and printed paper in households and offices. • Relatively low cost material to recycle; improves program economies of scale. • Increases total waste diversion and environmental impacts of the overall program.	• Newspaper publishers have not embraced EPR and have strong political influence.

2.6.9 Allowable recovery options

EPR programs for packaging should promote the most cost-effective and environmentally sound diversion programs suitable for a specific jurisdiction, including materials recycling, composting and energy recovery. This requires a clear, consistent definition of “recycling” (which generally refers to various forms of recovering materials from collected recyclables for use in the manufacture of another product) and “recovery” (which generally includes the recovery of materials, the recovery of embodied energy value and chemical recycling).EU member countries with long-running EPR programs for used packaging have evolved from setting common but arbitrary material-specific recycling rates for all member states, to establishing minimum and maximum material-specific recycling and recovery targets. This approach gives producers greater flexibility to meet their waste diversion obligations through a combination of methods best suited to a region’s existing waste management infrastructure and prevailing market forces.

Packaging recovery targets

There is no consistent methodology used to calculate packaging recovery rates under existing EPR programs for packaging. Nor is there any consistency in recovery targets included in legislation (though the EU has adopted a common range for recycling and diversion targets for its 27 members) (ProEurope, 2012).

Key lessons learned to date include:

Data available for establishing total quantities of obligated packaging supplied into the market and quantities of each packaging material type currently recovered at the start of the program will be imperfect but will improve in each program year to follow. Consideration should be given to a transition phase during which producers are required to calculate and report the quantities of obligated materials supplied before setting fee rates or recovery targets. Furthermore, recovery targets should be set and reviewed for increments of three to five years to allow for reasonable program and investment planning horizons.

2.6.10 The Cost of EPR Programs for Used Packaging

The costs of managing packaging under an EPR program are influenced by a wide range of local variables including (ProEurope, 2012):

- Mix of packaging materials used in that market;
- Size, geographic characteristics and population density of the market;
- Local markets and export opportunities for recyclable materials;
- Requirements of local legislation (including whether producers have shared or full responsibility for program costs);
- Allowable options for management of recovered materials (including materials recycling, energy-from-waste and composting);
- Waste management infrastructure that was in place when the program was initiated;
- Recovery rates achieved for designated materials;
- Level of investment required to change consumer behaviour to sort recyclable materials from waste and to maintain their participation in the program;
- Maturity of the program; and
- Program design and related administration costs.

It is not possible to simply project the costs of recycling from one jurisdiction to another given key differences in such factors as established consumer habits, logistics networks, existing waste management and recycling infrastructure, all of which can significantly alter the price/recovery matrix. For initial discussion purposes only, Table 8 below shows a rough continuum of the range of per-capita costs for 2014 with current currency exchange rate of 1€ = $1.81 (CAD.) experienced for comprehensive packaging recycling programs in place today across a range of mature program jurisdictions. It is important to note, however, that in some jurisdictions there may be other additional or hidden costs incurred by consumers and industry related to managing specific sub-elements of packaging in addition to the comprehensive EPR program for packaging. This would include mandatory deposits on beverage containers that operate in parallel with household packaging collection schemes (e.g. Germany, Ontario, Quebec) or packaging taxes (Belgium, Netherlands). While these costs are not quantified in this section, they are significant. Table 11 below compares program costs across jurisdictions.

Table 11: ***Comparison of program costs across jurisdictions***

(Source: Adapted from StewardEdge (2010) and ProEurope (2012))

Highest Costs ($US)	**Why?**	**Lower Costs Europe ($US)**	**Why?**	**Lowest Costs**	**Why?**
Netherlands $30	Tax solution imposed based on claimed waste and CO2 costs	France $9.00	Industry led plan to pay only incremental costs of recycling; estimated industry share of costs approx. 60%.	Ontario $5.50 (+ beverage container deposit costs)	Payment of 50% of net costs only; packaging & printed paper; based upon industry design and aggressive advocacy

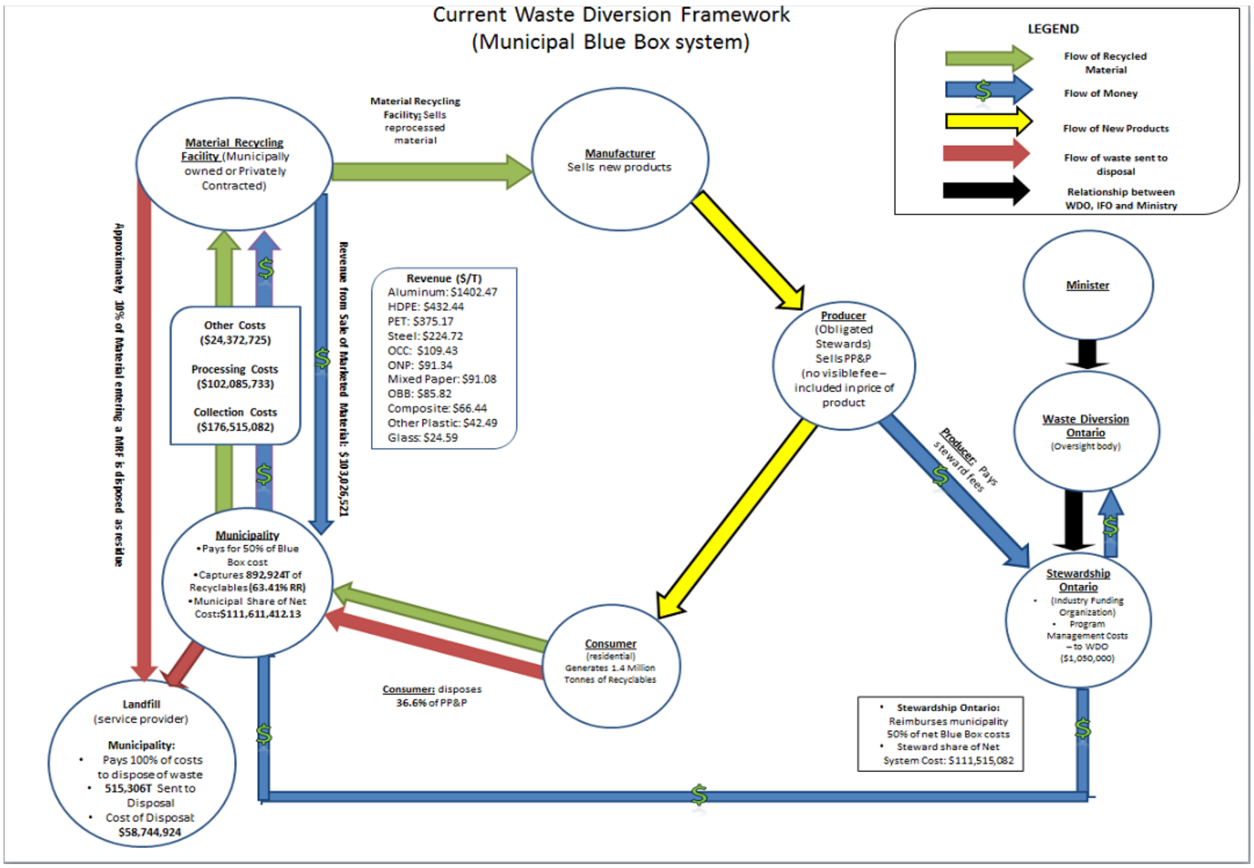
As noted by Stephenson (2010), the design of an EPR model for packaging should be supported by legislation. Industry must be obligated to maintain control of and directly manage the program funds outside of government. There is also a need to establish a *de minimis* exemption such that administration costs do not exceed compliance costs. Generally speaking, commercially enforceable agreements are more effective than relying on government enforcement action over the long term. Producers must be allowed alternative options by which they can discharge their legal obligations operating individually, as part of a group of producers, or through a single producer responsibility organization established for that purpose. Governments should leave the determination of the most appropriate program funding mechanism to the obligated producers, so long as all obligated materials are treated in a fair and transparent manner. Fee rates should also take into consideration the value of the recycled material. An optimal system should ensure transparency and public accountability through proper governance and public reporting. Programs should also build on the experience gained from implementing programs in other jurisdictions, rather than reinventing the wheel, subsequently reducing program risks.

2.7 Theoretical framework for evaluation

An understanding of who are the relevant stakeholders, the relationships between them, and how policy decisions are made was a critical first step in undertaking this research. With this in mind, governance theory seemed like an appropriate starting point to help guide the discussion. An understanding of governance theory is critical in our understanding of the Blue Box program, which involves complex financial and regulatory relationships between a multitude of actors from both public and private spheres. Figure 1 below visually summarizes the governance framework of the Blue Box system.

Figure 1: ***Governance Framework of Blue Box System***

(Source: Adapted from Stewardship Ontario (2014), Waste Diversion Ontario (2014) and Lakhan (2014))



The Ontario Blue Box governance structure is unlike any of the other provincial industry funded organizations (IFOs) (waste electronics, household hazardous waste and used tires), as it is the municipality that is the primary service provider. They assume control of material for collection and processing, and are the sole recipient of revenues received from the sale of marketed material. Furthermore, the Blue Box system is the only program mandated under the provincial Waste Diversion Act that requires producers to partially reimburse municipalities for the costs associated with end of life material management. Under Ontario's waste electronics, household hazardous waste and used tires program, producers provide incentives to non- municipal service providers to collect and process end of life material, but do not reimburse them for the actual costs of material management.

While Chapter 4 will discuss the financial and legislative arrangements between municipalities and producers in greater detail, Figure 1 highlights the importance of using governance theory for helping understand the process of governing and decision making among recycling stakeholders. Adapting Stoker's (1998) five propositions of governance theory, this study uses governance theory to:

1) Identify the institutions and actors involved in decision making processes that reside both within and beyond governmental boundaries.
2) Explain the shift in financial and physical responsibilities of managing and diverting residential waste.
3) Identify the power dependencies involved in the relationships between affected recycling stakeholders (provincial government, municipalities, packaging producers and households).
4) Explain and understand the process of self governing among recycling stakeholders in negotiating best practice system costs, municipal reimbursements and packaging fee rates.
5) Define the role of government in developing legislative requirements and policy objectives and recognize their role as facilitators in ensuring that the Blue Box program is implemented effectively and efficiently.

With the above in mind, governance theory is useful as an organizing framework. As noted by Judge et al (1995), the utility of governance theory rests on its capacity to provide a framework for understanding changing processes in governing. What it does not do is explain causal relationships, behavioral intent or action among stakeholders. Given that this research includes a phenomenological and behavioral component (understanding how recycling policies affect household and municipal recycling behavior), I also required a theoretical framework that could help guide my inquiry in these areas. Azjen's theory of planned behavior (TPB) was used as the theoretical framework for this section of my research.

The TPB provides a framework for systematically investigating the factors which influence behavioral choices. Ajzen (1985) put forward the theory of planned behavior, the conceptual extension to the theory of reasoned action (Ajzen and Fishbein, 1975) and the theory of self efficacy (Bandura, 1977), to fully explain the linkages between belief and behavior. TPB states that attitude toward behavior, subjective norms and perceived behavioral control, together shape an individual's intentions and behaviors (Ajzen, 1985).

Figure 2 illustrates the connections between behavior and behavioral antecedents as described by the TPB model.

Figure 2: ***Visual diagram of the theory of planned behavior***

(Adapted from Ajzen, 1985)

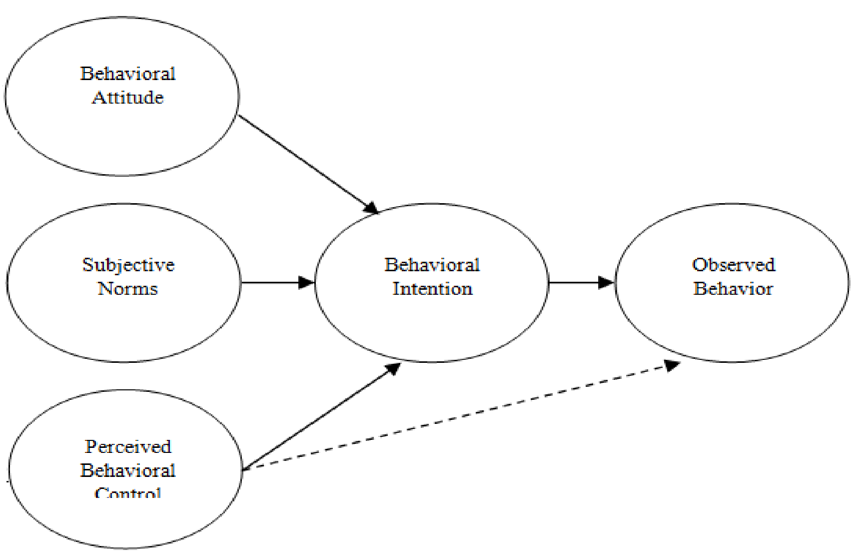


Table 12 below describes each of the components of the TPB model in detail.

Table 12: ***Components of the TPB model (Adapted from Ajzen, 1985)***

Component	Description
Behavioral Attitude	Consists of two components: 1) An individual's belief about the consequences of a particular behavior (based on a subjective assessment about whether one's actions produces a desired outcome) and 2) An individual's attitude towards a given behavior (the degree to which performance of the behavior is positively or negatively valued)
Normative beliefs	Refers to an individual's perception of normative pressures about whether one should subscribe to a particular belief or behavior. An individual's beliefs may also be affected by subjective norms, which is influenced by the judgment of significant others (e.g. parents, spouse, friends etc.)
Perceived behavioral control (PBC)	Refers to an individual's assessment of the level of difficulty in performing a particular behavior. PBC is conceptually related to individual self-efficacy described by Bandura (1975). PBC also takes into account control beliefs about the presence of conditions that may facilitate or impede performance of the behavior
Behavioral intention	A measure of an individual's readiness to perform a given behavior. Intent is seen as the immediate antecedent to behavioral action (Ajzen, 2002). Behavioral intention is a function of behavioral attitude, subjective norms and perceived behavioral control
Behavior	An individual's observable response to a given situation with respect to a given issue. As noted by Ajzen, behavior is a function of both an individual's intentions and perceived level of behavioral control, where PBC is expected to moderate the effect of intent on behavior. An individual is likely to perform a certain behavior when favorable intent is accompanied by high levels of perceived behavioral control

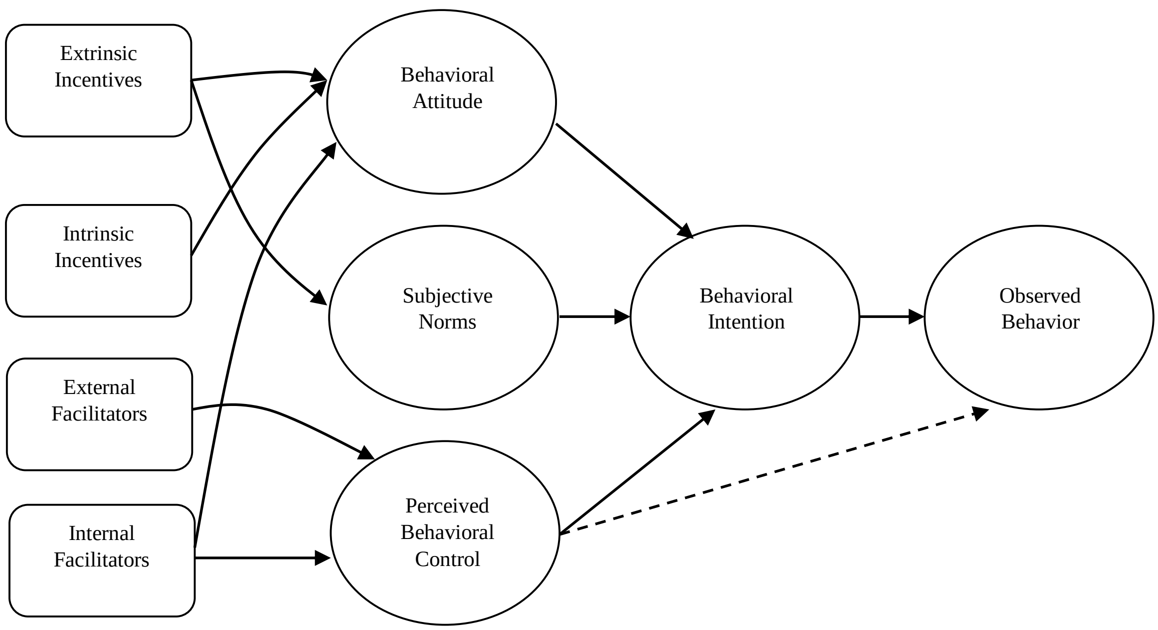
With specific regards to recycling, TPB provides a theoretical framework for systematically identifying the factors which influence recycling decisions (Tonglet et al, 2004). The decision to recycle is likely to be complex, as recycling is a behavior that involves considerable effort on the part of the consumer. Several studies have confirmed the utility of TPB when investigating the determinants of recycling behavior (Tonglet et al, 2004; Boldero, 1995; Chan, 1998; Taylor and Todd, 1995).

Though critics of TPB cite that the model does little to accommodate for exogenous factors that influence behavior (personality, past experience etc), Ajzen and Fishbein (1980) maintain that this influence is indirect, mediated through the components of the model.

2.7.1 Putting it all together, understanding how waste management tools affect the TPB

Figure 3 illustrates the interactive affects between waste management tools and an individual's behavioral process.

Figure 3: ***Interactive affects between waste management tools and an individual's behavioral process***



As illustrated above, the tools designed to encourage household waste diversion serve to enhance the antecedents to recycling behavior, albeit in different ways. Table 13 below summarizes how each of the broader motivational categories are intended to affect the various components of the TPB model (Adapted and expanded from Hopper and Nielson (1991)).

Table 13: ***Motivational categories affect the various components of the TBC model***

Motivational Category	**Affect on behavioral antecedents**
Extrinsic Incentives (i.e. PAYT schemes)	Directly incent people to participate in recycling activity. The relative costs of recycling relative to other waste management alternatives (i.e. disposal) are reduced. If recycling becomes an economically desirable alternative to waste disposal, households will feel more positively towards recycling and be more likely to participate in the activity.
Intrinsic Incentives (i.e. promotion and education)	Increase an individual's awareness regarding recycling initiatives, including the importance of recycling as a pro environmental behavior. Likely to positively influence a person's attitude towards recycling. People feel good about participating in an "eco-friendly" and sustainable activity.
External Facilitators (i.e. curbside recyclable collection)	Enhance an individual's perceived behavioral control. Increased levels of recycling convenience are likely to decrease an individual's perceived level of difficulty in performing the behavior (recycling). If that person feels positively towards recycling and is compelled to recycle due to social pressures, there is a strong likely hood that they will participate in a curbside recycling program.
Internal Facilitators (i.e. promotion and education, recycling legislation)	Enhances an individual's perceived behavioral control and attitudes towards recycling. Increased levels of awareness regarding recycling programs decreases the amount of time spent on determining the what, when and where of recycling (increased perceived behavioral control). As noted above, knowing more about a recycling program, including why a person should recycle, may positively affect a person's attitude towards recycling.

The TPB provides a useful conceptual model for understanding how recycling tools affect the factors that influence behavioral intent and action. While there is significant empirical evidence to support the use of recycling tools in affecting household recycling behavior, additional research needs to be done in jurisdictions with mature recycling systems. Tools which may be effective during a program's inception and early implementation may diminish in their effectiveness over time, or require adjustments/refinements.

2.8 Chapter Summary

The literature areas summarized in this chapter provide the theoretical and conceptual foundation to understand and identify issues in integrated solid waste management. For example, issues in ISWM often require extensive stakeholder collaboration and integration across multiple agencies and sectors. Understanding both the advantages and impediments to the integrative process is critical in developing appropriate solutions to achieve desired outcomes (changes in consumer recycling behaviour etc). However, developing an effective solution, or even identifying what the desired goal should be, is much easier said than done. Recycling stakeholders have competing interests and objectives, and (as discussed in greater detail in Chapter 4) the risk for integrative failure is acute. A review of the literature allows us to learn from past experiences, identifying what tools we have at our disposal to help overcome the challenges associated with integration. The extensive literature on the antecedents to recycling behaviour help inform what policies should aim to do with respect to overcoming the barriers to recycling. For example, if recycling awareness is low, promotion and education (P&E) campaigns might be an effective strategy. Conversely, if perceived levels of self-efficacy are low (low recycling convenience, lack of accessibility to recycling services etc), investments in infrastructure would be more appropriate than P&E.

A review of the literature also helps identify the "research gaps" in the existing discourse on recycling policy and behaviour. The analysis in this study builds upon existing research, shifting the research focus away from individual consumers and households to municipalities. To date, no study has evaluated how policies such as incentivization at the municipal level affects recycling rates. The distinction between this study and those that preceded it is that this research explores incentives being provided *to* municipalities and not incentives being provided *by* municipalities. A further unique aspect of this study is the emphasis placed on examining the effectiveness of recycling policies in a mature recycling system - most research in this area tends to focus on areas where recycling systems are newly implemented or voluntary. A full discussion on the contributions of this study to recycling research can be found in Chapter 7. In this section, I also briefly discussed how governance theory and the theory of planned behavior help frame the conceptual and theoretical inquires of this research project.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter provides a comprehensive overview of the methodological approaches and methods used in this study. I begin by first describing my general research philosophy, briefly highlighting the ontological, epistemological and methodological perspectives that serve as the foundation of this thesis. I then provide the rationale for selecting Ontario, Canada as my case study site. This is followed by a detailed discussion of the data used in this study, including sections on data sources, collection techniques and interpretive methods. This chapter concludes with an acknowledgement of the data and methodological limitations.

3.2 Research Philosophy

From an ontological perspective, this research project largely follows an objectivist approach. Objectivism is the philosophical position which holds that social entities exist in reality external to social actors. However, elements of subjectivism can be found throughout (Where the subjectivist view is that social phenomena are created from the perceptions and consequent actions of social actors). While there are varying degrees of objectivism as it relates to research philosophy (See Burrell and Mogan's continuum of philosophical perspectives), the objectivist's goals are to identify causal explanations and fundamental laws that explain regularities in human social behavior (Easterby-Smith et al. 1991). Objectivists believe in causality, where independent causes lead to an observed effect, and researchers must formulate a hypothesis based on their conceptualization of a particular phenomenon (Remenyi et al. 1998). To achieve this end, results are generalized from a sufficiently large sample size utilizing the hypothetico-deductive process (Holden and Lynch, 2000). The hypothetico-deductive approach involves the quantitative operationalization of concepts, employing reductionism to reduce a problem into its smallest elements. Objectivists believe that a problem is better understood when it is reduced to its smallest parts.

From an epistemological perspective, objectivists subscribe to the positivistic philosophical position (Moses et al, 2012). Positivism in general refers to a perspective that emphasizes empirical data and scientific methods. The positivist position holds that the world consists of regularities, and that these regularities are detectable, and thus, the researcher can infer knowledge about the real world by observing it (Moses et al, 2012). Every rationally justifiable assertion can be scientifically verified or is capable of logical or mathematical proof, and the only authentic knowledge is scientific knowledge. Positivists assert that such knowledge can only come from positive affirmation of theories through strict scientific methods (Moses et al, 2012).

From a methodological perspective, objectivists subscribe to the nomothetic approach (Burrel and Morgan, 1979). The nomothetic method is used by researchers who seek to learn something about social regularities – things that apply to people in general (Hughes and Sharrock, 1997). Nomothetic research attempts to discover the laws and principles that govern aspects of reality. In contrast to an ideographic approach (which studies a single person, event or situation in detail), nomothetic research cannot depend on information that describes a single individual. It needs information that describes enough cases so that general patterns or relationships can be established (Hughes and Sharrock, 1997). The development and testing of hypotheses based on a series of data observations underscores the majority of the analysis in this research project.

It is important to note that this project followed a moderate objectivist approach. From a methodological perspective, the research position utilized was not strictly objectivist, allowing room for interpretivism in both study design and data analysis. A phenomenological component was also included in this study through surveys and interviews with recycling stakeholders. There is a desire to explore the subjectivities and lived experiences of recycling stakeholders and their attitudes towards recycling, sustainability and the environment. While the primary goal of this project was to develop a series of hypotheses evaluating the perceived efficacy of recycling best practices, interviews and open ended surveys add context and color to the empirical analysis. As discussed in greater detail in section 3.4, integrating objectivist (quantitative) and subjectivist (qualitative) approaches is becoming increasingly common in social sciences.

3.3 Types of evaluative models used in recycling research

The methods employed to evaluate recycling policy initiatives vary greatly, and differ depending on the questions being asked, the scale of the evaluation and the resources available to conduct an evaluation (Conley et al, 2003). While experimental methods and multivariate correlation analysis have historically been used to establish cause and effect relationships between initiative characteristics and outcomes, there is an increasing emphasis being placed on qualitative models of evaluation (Patton, 1986, Leach 2000).

The following section describes several of the predominant models used to evaluate recycling policy initiatives.

3.3.1 Multivariate Correlation Analysis

Multivariate correlation analysis (within the context of recycling policy) aims to establish causal relationships between the outcomes of a particular initiative with individual project characteristics. This is largely a quantitative exercise, using statistical techniques such as regression and log linear analysis to calculate the strength of the relationship between the dependent (i.e diversion/recycling rates) and independent (i.e. promotion and education rates, curbside collection etc) variables. While this technique remains extremely popular in disciplines such as economics and ecology, its applicability as a standalone measure to issues related to recycling is debated.

One of the primary challenges of correlation analysis is a paucity of reliable data. Such methods require sufficiently large sample sizes to draw statistically meaningful conclusions, and often have difficulty accommodating the complex and dynamic nature of recycling initiatives (Sidique et al, 2010). When multivariate approaches are employed, it is usually based on structured surveys and/or province/state wide data on household recycling activity. Several researchers (see Chen, Rossi, 1987) have been critical of this approach, as there is a propensity to lose sight of "contextual factors and circumstances" when analyzing empirical data (Chen et al, 1987). Conversely, one could contend that quantifiable measures of a project's success/failure provide objective and easily communicable results. While it is important to recognize the shortcomings of a multi-variate approach, we must be cautious of dismissing it all together. Such techniques have an extremely long history in issues related to resource management, and as such, must remain in our "tool box" of evaluative strategies.

3.3.2 Participatory Approaches to Recycling Policy

Participatory evaluative models of recycling initiatives directly engage recycling stakeholders, soliciting input as to the perceived successes, failures and experiences of a given project. Typically, respondents are asked to participate in surveys or interviews to assess a project's outcomes, the factors that led to those outcomes, and the appropriateness of the processes used (Lee, 2011). Participatory models may also be used to glean information about stakeholder attitudes, opinions and relationships. Mendoza and Prabhu (2002) have noted that the strength of participatory evaluative models can be attributed to:

1. Participatory models are useful in capturing behavioural patterns and change among stakeholders
2. Participatory models are effective at capturing people's perceptions, particularly those that are difficult to quantify
3. Participatory models are generally more accommodating and less intimidating to stakeholders

While participatory modelling is decidedly qualitative in its approach, survey responses can be used to help inform quantitative methods such as multivariate correlation analysis (described above).

As discussed by House (1999), the subjective nature of participant perceptions and values may subvert the credibility of a participatory approach. Though the approach is often lauded for capturing the full range of stakeholder experiences, it is seen as a less appropriate mechanism for measuring tangible outcomes (Mendoza et al, 2002). Furthermore, participatory models of evaluation are often resource and time intensive. Depending on the scope of a recycling initiative, it may be difficult to gather responses from a meaningful sample of participants (Conley et al, 2003). With that being said, participatory evaluative models are gaining traction as a preferred approach in assessing the efficacy of recycling initiatives, as they provide greater insights into the opinions and perspectives of recycling stakeholders.

3.3.3 Measuring Tangible Outcomes

Outcome evaluation is often predicated on comparing observed outcomes with desired objectives. As noted by Conley and Moote (2003), outcome evaluation can be applied when outcomes of a given initiative are readily quantified, and where there is sufficient baseline information to allow reliable comparisons over time and between cases. Within the context of recycling initiatives, some quantifiable metrics include:

- Municipal diversion levels
- Recycling program costs
- Access to recycling services
- Household recycling participation rates

Assuming that sufficient baseline data has been collected, two relative system states can be compared (pre and post recycling initiative) to evaluate the efficacy of a given initiative. Outcome evaluations are often seen as more objective than participatory evaluative models, as it is generally not prone to issues of stakeholder bias, values and perceptions. However, critics of outcome based evaluations often question the "black box" nature of the approach (Patton, 1986). Unlike multivariate correlation analysis, outcome-based approaches do not explore the relationship between project outcomes and characteristics (Patton, 1986). As such, evaluators are unable to determine which variable (project characteristic) leads to a given outcome. Relationships under an outcome based approach are inferred, perhaps even erroneously. Furthermore, outcome based approaches give little insight into perceptual factors, like mutual learning among stakeholders, perceived fairness of the process, or outcome and conflict abatement (Conley et al, 2003) . Despite these criticisms, outcome based evaluation remains a popular evaluative approach.

3.3.4 Hybrid Approaches

Reconciling two or more evaluative models may be seen as a potential strategy for overcoming some of the methodological shortcomings described above. The intersection of empirical and ethnographic approaches (such as multi-variate and participatory modeling), captures both the nuances and complexity of stakeholder experiences with the empirical rigor of conventional multi-variate analysis (Mendoza et al, 2002). Hybrid approaches attempt to overcome the methodological pitfalls attributable to any one approach. Multivariate correlation analysis is employed to check for the relationships among policy characteristics, while oral interviews establish a contextual narrative among affected stakeholders. Furthermore, incongruences between survey responses and stated experiences (via interviews) can be readily identified and examined further.

While the benefits of a hybrid approach are readily apparent, there remain practical impediments to applying such a model to all recycling policy initiatives. The foremost of these challenges is the cost of undertaking this approach. A combination of both participatory and multivariate models are both resource and time intensive, often requiring a longitudinal approach that may not be feasible for the purposes of informing decision making (Innes, 1999). As such, one must carefully consider the intended purpose and timescale of the evaluation before employing a hybrid evaluative model. I was able to overcome the resource/data gathering challenges traditionally associated with the hybrid model by partnering with Waste Diversion Ontario, who graciously provided me with access to data from the municipal data call. This not only greatly reduced the time and resource burden of acquiring data, but provided me with access to Canada's largest and oldest database related to municipal waste management.

3.4 Developing an evaluative framework

With the above in mind, this study utilized the hybrid approach to evaluate the efficacy of municipal policy initiatives. This particular approach was taken due to its ability to capture both cause and effect relationships between policy initiatives and recycling rates, as well as qualitative dimensions that provide context and color to the empirical analysis (through interviews and surveys with recycling stakeholders). However, identifying the criteria that would be used in the evaluation proved challenging. Diversion/recycling was an obvious choice - most of the current literature tends to use diversion/recycling as the primary metric when evaluating the effectiveness of a recycling policy (see studies by Simmons & Widmar (1990), Gamba & Oskamp (1994), Vining & Ebreo (1990), Thogerson (2003)). However, a focus only on recycling rates paints an incomplete picture of whether a recycling policy is successful. As discussed in chapter 6, policies that increase diversion may come at an enormous cost to both municipalities and industry, which begs the question as to whether they are truly tenable in the long term. As such, cost is another factor that is of critical importance when examining the effectiveness of a given policy. There are comparatively fewer studies that have investigated the effect of recycling policies on municipal costs (see studies by Bohm et al. (2010), Staudt (1993) and Ready (1994)). This may be attributed to the fact that many municipalities do not (or are not required to) provide data on material management costs. In Canada, only Manitoba, Quebec, Ontario and British Columbia track municipal recycling costs and make that data available to the public.

While diversion and cost are certainly important considerations when gauging the effectiveness of a given policy, input from stakeholders that the policies are designed to affect may be the best indicator of whether they are successful or not. However, unlike diversion and cost which are decidedly quantitative metrics, stakeholder perceptions/attitudes is somewhat vague and more difficult to define. First and foremost, different stakeholders will have different opinions about what constitutes "success" for a given policy. Recycling in Ontario is a particularly contentious issue, in that municipalities and packaging producers are fundamentally at odds with one another. Industry chooses to prioritize cost containment above all else (as they are financially obligated to fund 50% of the Blue Box program), while municipalities will often focus on diversion goals (they receive a greater proportion of funding if they recycle greater quantities of material). Households generally have little concern for either of these metrics, and generally tend to be more focused on accessibility, convenience and uniform enforcement of policies. Given these diverging opinions and perspectives, how then do you develop a set of benchmarks to determine policy effectiveness? To help address this issue, I first made the decision that the perception and attitudes of households should be addressed separately from those of either municipal or private actors. Households occupy a completely different role in the recycling system - they are neither responsible for program delivery or are financially obligated to directly fund the program (although property taxes are used to fund, in part, waste and recycling collection) . Secondly, households are not affected by all of the best practice policies being tested - for example, municipal incentivization has no direct bearing on household recycling behavior (nor are consumers expected to be aware that these policies exist). Asking for household feedback on such policies would not be particularly useful or provide any meaningful insights. With this in mind, household surveys and interviews were conducted to receive feedback on the effectiveness of PAYT and recycling P&E policy. Households were asked to comment on: 1) Perceived awareness of the recycling policy (did they know it exists) 2) Perceived convenience of the recycling policy (how easy is it for them to conform to the policy) 3) Perceived accessibility of recycling services (how easy is it for them to recycle), and 4) Perceived success of recycling policy (do they think the policy is working or not).

Open ended questions were also given to household respondents, where they were asked to provide general comments on recycling in general and attitudes towards the environment.

As noted in Chapter 3, semi structured surveys and open ended interviews were conducted with both municipal waste managers and packaging producers. Unlike household surveys, the focus of the interview/survey questions surrounded 1) Perceived fairness of existing policies, 2) Perceived success of existing policies, and 3) Changes they would like made to existing policies. Open ended questions were also provided where respondents were asked to provide feedback on the state of the existing recycling system, the proposed waste reduction act and the future of the Blue Box program.

The feedback provided by all recycling stakeholders (households, municipal waste managers and packaging producers) was then coded and categorized, and accompanied the results from the regression models.

Of note, the results from both the regression modeling and stakeholder interviews/surveys could not be used to definitely say whether a policy was successful or not. I did not attempt to provide any sort of quantitative score regarding the efficacy of a given policy (i.e. providing an aggregate score based on diversion, cost and stakeholder feedback). At best, I could only provide a qualitative assessment of how policies might be working, what might be affecting their performance, and salient considerations moving forward. The evaluative framework developed in this chapter should be seen more as a guidance tool than an actual benchmark. It is meant to illustrate that there are multiple dimensions - and multiple perspectives - when considering the efficacy of recycling policy.

3.5 Interpreting the Data: Combined Qualitative and Quantitative methods

As noted by Bryman (2006), there is little doubt that research involving the integration of quantitative and qualitative research is becoming increasingly common. Unfortunately, few examples of multi-method research can be found in the discourse on household recycling. Generally speaking, studies have been decidedly either quantitative (Sidique et al, 2008;Sidique et al, 2009; Timlet and Williams, 2007;Williams and Wilson, 2008; Callan and Thomas, 2006; Abbott et al, 2011) or qualitative (Read, 1999; Barr et al, 2003; (Reis et al, 2004, Nixon and Saphores, 2008) in nature.

The decision about which research approach to employ (within the context of recycling research) is largely contingent on the question being asked. Identifying determinants of recycling behavior can be evaluated from the perspective of potential demographic drivers (e.g. age, income, gender, etc.) or attitudinal drivers (e.g. normative pressures, perception of self-efficacy etc.). Studies examining demographic antecedents to recycling behavior (see work by Yang and Innes, 2007; Saltzman et al.,1993; Callan and Thomas, 2007) have all employed various quantitative methods in their analysis (mainly pooled ordinary least squares regression or panel regression). Conversely, attitudinal research (Nixon and Saphores, 2008; Vining and Ebreo, 1990) tends to focus on qualitative techniques to elucidate the why and how of recycling behavior. These include methods such as participant observation, non-participant observation, field notes, reflexive journals, structured interviews, semi-structured interviews, unstructured interviews, and analysis of documents and materials.

The most popular method of interpreting qualitative data in recycling research is the use of coding, an interpretive technique that both organizes the data and provides a means to introduce the interpretations of said data into certain quantitative methods (Hay, 2005). Studies by Read

(1999) and Barr et al (2003) have both used coding as a means to interpret survey and interview data on household recycling habits. Other methods of qualitative interpretation include recursive abstraction and content analysis, as seen in the meta analysis study by Hornik et al (1995).

Given that this study conducts multi-method research, consideration must be given to the following:

1. Are the quantitative and qualitative data collected simultaneously or sequentially? (Morgan, 1998)
2. Which has priority, the quantitative or qualitative data? (Morgan, 1998; Morse, 1991)
3. What is the function of the integration - for example, triangulation, explanation or exploration (Creswell, 2003)
4. At what stage(s) in the research process does multi-strategy research occur? (Tashakkori and Teddlie, 1998). It may be at stages of research question formulation, data collection, data analysis, or data interpretation (Bryman, 2006).
5. Is there more than one data strand? (Tashakkori and Teddlie, 2003). With a multi-strand study, there is more than one research method and hence source of data. With a mono-strand study, there is one research method and hence one source of data.

A multi-strand, mixed methods research approach was utilized in this study, combining both quantitative and qualitative analysis in an attempt to gauge the effectiveness of Ontario's best practice policies. This study used a combination of panel data from 223 Ontario municipalities over a 10 year period, and survey/interview data from recycling stakeholders (including municipal officials, households, packaging producers and government officials).

The purpose of the multi method approach was twofold: 1) quantitative analysis modeled the relationship between recycling rates and municipal policy initiatives, and 2) qualitative research gauged the attitudes and opinions of various stakeholders within the recycling system. The qualitative analysis was used to complement the empirical component of this study, providing additional context and color to the data being examined.

This study used a two stage research approach. The first stage involved analyzing the data provided by Waste Diversion and Stewardship Ontario to determine the general relationship between best practice policies, municipal recycling rates and program costs. Based on these findings, semi structured surveys and interviews were developed and disseminated to recycling stake holders to determine the following:

1) Reactions to the effectiveness of current Blue Box best practices

2) Identify the challenges and primary issues facing the existing Blue Box system

3) Give consideration to the future direction of the Blue Box program, and propose a series of recommendations to improve diversion and/or encourage cost containment.

3.6 Why Ontario?

There is a significant body of research exploring the efficacy of municipal recycling tools in promoting waste diversion (see Sidique et al., 2009; Barr et al., 2006; Beatty et al., 2007; Domina, 2002, Hornik et al., 1995). Tools such as pay as you throw schemes, promotion and education initiatives, etc. have all been examined and assessed in detail, achieving varying levels of success in jurisdictions across North America and Europe. Given the extensive attention that these topics have already received, what merit is there in revisiting the effectiveness of recycling tools in an Ontario context? Table 14 below highlights the unique attributes of Ontario that make it an ideal subject for further academic inquiry.

Table 14: ***Unique recycling characteristics of Ontario***

Attribute	**Rationale for further inquiry**
Maturity of Recycling System	Ontario has had a curbside recycling system for more than 30 years. Recycling awareness and participation is already extremely high relative to other jurisdictions. Previous studies examining the efficacy of P&E and PAYT initiatives were in areas where recycling systems had been recently adopted with voluntary household participation
Extended Producer Responsibility and Eco Fees	Ontario is one of only three provinces to adopt an EPR scheme, and the only jurisdiction in Canada to implement an incentive based method for calculating eco fees and municipal payments. No study to date has investigated the efficacy of Ontario's eco fees or municipal transfer payments in increasing household recycling.
Geographic Variation	The province of Ontario spans 1,076,000 square kilometers, with population densities ranging from 945 persons/km^2 to 0.1/km^2 (Statistics Canada, 2011). The characteristics of municipal waste diversion programs in the densely populated southern regions of the province are radically different than those in rural northern communities. This begs the question as to whether a "one size fits all" approach to recycling policy is appropriate given regional differences in demography and access to recycling services.
Use of Recycling Best Practices	In Ontario, a set of recycling "best practices" are used to enhance the operational efficiency and performance of the province's Blue Box recycling system (Stewardship Ontario, 2007). These best practices were formulated in a 2006 report commissioned by Stewardship Ontario to address the following issues: • There was a lack of understanding and consensus among stakeholders regarding what constitutes best practices in municipal recycling • Municipalities were seeking guidance on how to employ best practices in order to increase diversion and lower program costs. Ontario's best practices underscore all recycling policy decisions made in the province (regarding the Blue Box program). Due to their perceived efficacy, provinces such as Manitoba, Saskatchewan and British Columbia are looking to adopt similar practices.

Ontario's residential recycling program is largely seen as a leader in recycling initiatives and many of the policies and regulations in place for other waste programs are the result of experiences gleaned from the Blue Box system. Other waste programs (and in some instances, other jurisdictions) look to the Blue Box program to set the tone for policy direction, cost recovery mechanisms and best practice initiatives. As an example, the cost recovery methodology used in the Blue Box program (to allocate fees to packaging producers) was replicated for the WEEE and MHSW programs due to its perceived success. Both Manitoba and British Columbia have adopted Ontario's municipal incentivization methodology for provincial EPR programs. With regards to Ontario's review of industrial, commercial and institutional recycling, policy planners are looking to adapt and implement policies from the Blue Box program to help increase sector diversion (i.e. investments in promotion and education). However, as noted in Chapter 1, the effectiveness of Blue Box best practices have yet to be evaluated in any meaningful way. Policy planning decisions have been made predicated on the assumption that the Blue Box policy initiatives are demonstrably successful in improving diversion. With this in mind, it seemed critical that these assumptions be tested, such that any policies stemming from the Blue Box program are consistent with the objectives of the Waste Diversion Act (increased diversion, while minimizing costs)

3.7 Personal Perspectives

While this project was originally conceptualized to advance our understanding of waste management and recycling in a mature recycling system, it was also born out of self interest. Over the duration of my relatively brief career, I have worked as both a steward representative and policy planner, as well as a private consultant for a range of municipalities. – I am, and have been, a stakeholder that has advocated for the interests of packaging producers and government (both local and provincial). Based on these experiences, having personally been privy to the antagonism and issues that plague the system, I thought it would be prudent to test and challenge some of the assumptions and policies on which the recycling system is predicated. The policies examined in this dissertation are not only assumed to be best practices, but also, in some instances, appear to be the source of conflict among stakeholder (i.e. municipal incentivization)

3.8 Data Collection

Data for this study was obtained from four primary sources: 1) Waste Diversion Ontario Municipal Data Call 2) Stewardship Ontario Pay in Model 3) Statistics Canada and 4) Surveys & Interviews with recycling stakeholders.

3.8.1 Describing the WDO Data Call

Data for Ontario's residential recycling system was obtained from the Waste Diversion Ontario (WDO) municipal data call. Each year, the WDO requests that every municipality within Ontario report detailed recycling and cost information regarding the management of their waste diversion programs (Waste Diversion Ontario, 2012a). Municipalities are required to log into the Waste Diversion Ontario web site and fill out a 41 page electronic questionnaire that solicits information on municipal contact information, Blue Box best practice activities, total number of households serviced, quantities of material recovered, the types of material recovered and the operating and capital costs associated with the management and collection of recyclables.

Figures 4 through 6 are screen shots of a sample data call questionnaire.

Figure 4: ***Sample Screen Shot 1***

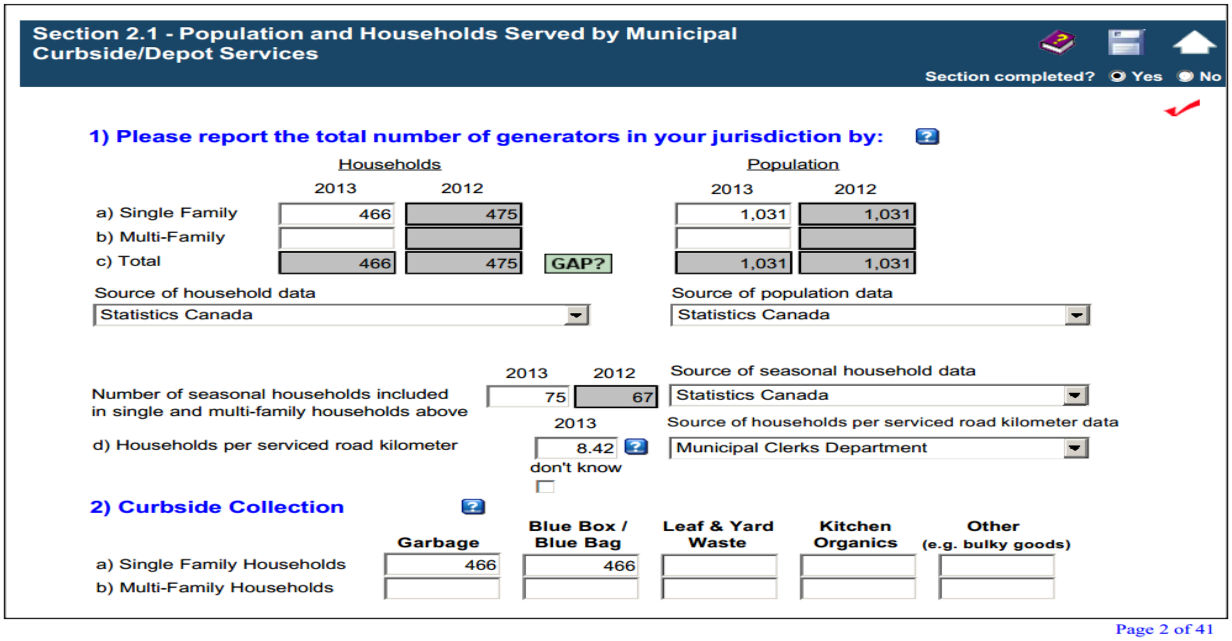


Figure 5: ***Sample Screen Shot 2***

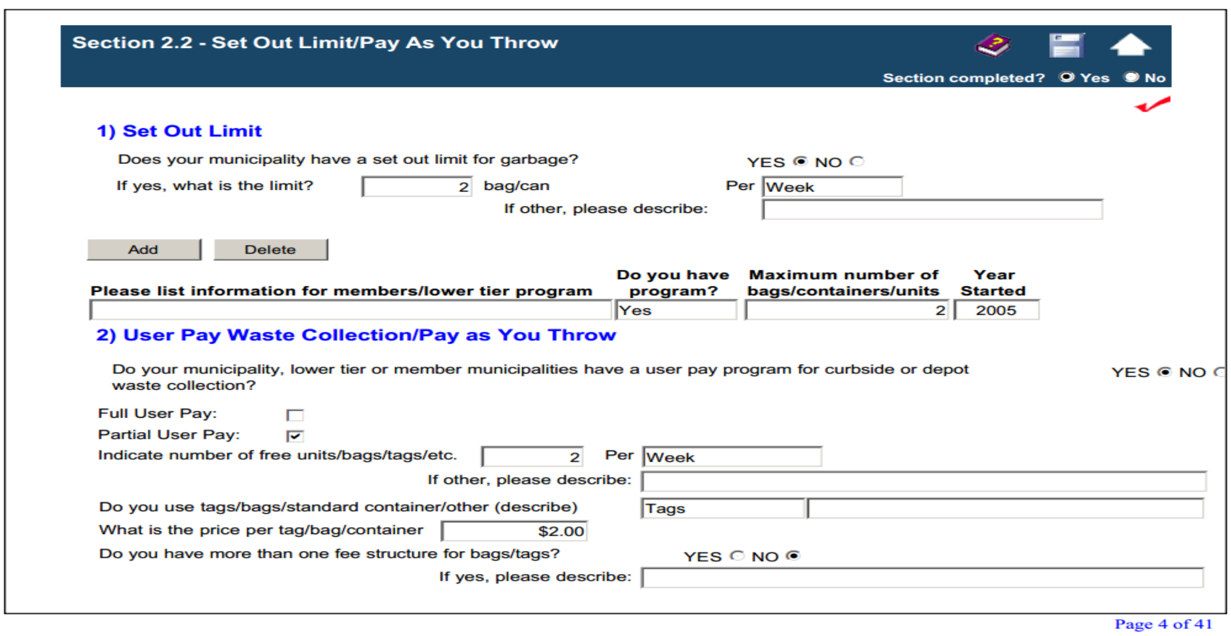


*Figure 6: **Sample Screen Shot 3***

Section 2.4 - Blue Box Best Practice Activities

Section completed? Yes No

PRINCE, TOWNSHIP OF WDO Program: 562 WDO Group: 6

MODULE 1 - PLANNING AND MONITORING

Objective #1 - Program Performance Projections and Analysis (20%)

Please complete the following chart, where possible, and provide any comments on 2013 performance and projected performance for 2014. Data for '2013 Actual' will be automatically updated as the 2013 Datacall is completed.

Use Datacall Values

	2011	2012	2013 Projected	2013 Actual	2014 Projection
Gross Collection ($)	29,959.27	30,390.67	0.00	31,800.53	32,000.00
Gross Depot/Tx ($)	5,586.34	5,907.63	0.00	1,410.24	5,810.00
Gross Processing ($)	3,394.19	3,926.86	0.00	3,754.43	3,800.00
Revenue ($)	0.00	0.00	0.00	0.00	0.00
Marketed Tonnes	132.00	78.00	0.00	0.00	0.00
Net Cost	42,532.86	42,599.16	0.00	40,004.60	41,000.00
Households	466.00	475.00	0.00	466.00	466.00
Net Cost/Tonne	322.22	546.14	0.00	0.00	0.00
Net Cost/HH	91.27	89.68	0.00	85.85	87.98
kg/HH Recovered	283.26	164.21	0.00	0.00	0.00
Analysis of 2013 Performance					
Rationale for 2014 Projection					

[1] It is recognized that not all programs report revenues. Please provide this information if available.
[2] Includes calculated administration costs and interest on capital.

Objective #2 - Efficiency Assessments (10%)

Formal efficiency assessments are a good way to measure the overall success of a program. Does your municipality perform efficiency assessments on a regular basis? Please complete the following chart and summarize the most recent assessment

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3.8.2 Summarizing and Analyzing the Data Call

The way in which municipalities submit survey data into the WDO data call makes it difficult to interpret and analyze the information quickly. Each survey response has to be summarized and organized into the appropriate categories using the database program Microsoft Access and enterprise software SAP. WDO and Stewardship Ontario staff are responsible for creating summary files that query the data call database and retrieve information on municipal tonnages, costs etc.

Figures 7 and 8 are screen shots taken from the WDO summary files to illustrate how data is organized from the WDO data call. Any potentially sensitive or proprietary data has been removed from the screenshots.

Figure 7: Sample Screenshot from WDO Data Call (financial)

2012 Blue Box Financial Details - Based on WDO 2012 Blue Box Financial Details

Municipal Grouping	Program Code	Program Name	Marketed or Calculated Marketed Tonnes	Single Stream	Residential Collection Costs	Residential Processing Costs	Residential Depot/Transfer Costs	Residential Promotion & Education Costs	Interest on Municipal Capital	Adminstration Costs	Administration Factor (Calculated)	Calculated Administration[1] and Interest on Municipal Capital[2]	Gross Costs
1	1	HALTON, REGIONAL MUNICIPALITY OF	41,299 T	Y	$5,130,396	$3,219,576	$48,120	$200,372	$21,475	$310,534	3.60%	$332,009	$8,930,472
1	172	HAMILTON, CITY OF	38,422 T	N	$7,922,612	$3,479,645	$124,144	$145,502	$173,054	$394,519	3.33%	$567,573	$12,239,476
1	50	LONDON, CITY OF	26,670 T	N	$5,084,528	$4,153,376	$66,046	$228,338	$268,181	$332,513	3.39%	$600,694	$10,132,982
1	270	PEEL, REGIONAL MUNICIPALITY OF	86,950 T	Y	$19,937,202	$14,095,723	$286,940	$673,488	$943,556	$1,242,239	3.46%	$2,185,794	$37,179,148
1	20	TORONTO, CITY OF	156,465 T	Y	$33,215,934	$22,397,574	$7,232,374	$1,806,726	$1,578,718	$2,811,316	4.24%	$4,390,034	$69,042,641
1	97	YORK, REGIONAL MUNICIPALITY OF	76,737 T	Y	$9,252,970	$11,149,291	$2,826,032	$347,096	$783,978	$832,345	3.42%	$1,616,324	$25,191,713
		Group 1 Totals	**426,542.74**		**$188.83**	**$137.14**	**$24.81**	**$7.97**	**$8.84**	**$13.89**		**$22.72**	**$381.48**
2	6	DURHAM, REGIONAL MUNICIPALITY OF	44,429 T	N	$9,578,932	$5,314,155	$241,957	$469,394	$474,426	$556,716	3.46%	$1,031,142	$16,635,581
2	18	ESSEX-WINDSOR SOLID WASTE AUTHORITY	24,918 T	N	$3,756,911	$2,850,965	$10,046	$189,890	$239,425	$254,075	3.61%	$493,500	$7,301,311
2	357	NIAGARA, REGIONAL MUNICIPALITY OF	39,465 T	N	$6,658,375	$4,066,967	$162,199	$434,787	$352,507	$423,127	3.62%	$775,634	$12,097,961
2	441	OTTAWA, CITY OF	60,886 T	N	$12,603,399	$5,575,973	$0	$59,444	$132,805	$608,305	3.31%	$741,110	$18,979,926
2	335	SIMCOE, COUNTY OF	25,511 T	N	$5,836,447	$756,104	$162,361	$264,061	$19,750	$239,741	3.41%	$259,491	$7,278,464
2	53	WATERLOO, REGIONAL MUNICIPALITY OF	34,534 T	N	$6,866,744	$3,657,465	$27,571	$158,226	$149,070	$364,596	3.36%	$513,666	$11,223,671
		Group 2 Totals	**229,743.24**		**$197.18**	**$96.72**	**$2.63**	**$6.86**	**$5.95**	**$10.65**		**$16.60**	**$320.00**
3	14	BARRIE, CITY OF	11,590 T	N	$1,532,833	$0	$111,555	$143,656	$4,549	$60,807	3.39%	$65,356	$1,853,400
3	179	BRANTFORD, CITY OF	6,607 T	N	$1,715,468	$603,431	$20,187	$55,410	$1,794	$73,958	3.09%	$75,751	$2,470,247
3	36	GUELPH, CITY OF	8,416 T	Y	$1,098,724	$2,211,511	$73,434	$72,650	$163,030	$180,967	5.00%	$343,997	$3,800,316
3	293	PETERBOROUGH, CITY OF	8,518 T	N	$1,161,008	$647,210	$54,145	$39,440	$1,718	$58,988	3.10%	$60,706	$1,962,509
3	103	SARNIA, CITY OF	3,873 T	Y	$737,101	$414,562	$0	$6,923	$0	$36,349	3.14%	$36,349	$1,194,934
3	55	SAULT STE. MARIE, CITY OF	6,014 T	N	$851,172	$459,483	$69,912	$6,305	$0	$43,079	3.11%	$43,079	$1,429,951
3	123	THUNDER BAY, CITY OF	6,213 T	N	$290,269	$263,717	$207,097	$67,369	$5,015	$27,696	3.32%	$32,711	$861,162
		Group 3 Totals	**51,230.34**		**$144.18**	**$89.79**	**$10.47**	**$7.65**	**$3.44**	**$9.41**		**$12.84**	**$264.93**
4	186	BLUEWATER RECYCLING ASSOCIATION	11,868 T	Y	$3,528,378	$1,765,599	$20,269	$54,847	$219,766	$278,846	4.99%	$498,612	$5,867,704
4	190	BRUCE AREA SOLID WASTE RECYCLING	4,360 T	N	$815,056	$491,212	$134,479	$26,714	$30,919	$74,919	5.00%	$105,838	$1,573,299
4	429	CHATHAM-KENT, MUNICIPALITY OF	4,232 T	N	$842,300	$0	$272,868	$14,199	$2,526	$38,661	3.42%	$41,187	$1,170,553
4	183	GREATER SUDBURY, CITY OF	13,311 T	Y	$2,921,753	$1,756,373	$170,156	$43,496	$12,067	$156,889	3.20%	$168,956	$5,060,734
4	601	KAWARTHA LAKES, CITY OF	5,857 T	N	$1,586,532	$134,781	$640,587	$94,088	$13,271	$83,812	3.39%	$97,083	$2,553,072
4	324	KINGSTON, CITY OF	9,280 T	N	$1,944,213	$1,402,234	$0	$40,699	$26,236	$136,388	4.00%	$162,624	$3,549,770
4	89	MUSKOKA, DISTRICT MUNICIPALITY OF	5,844 T	N	$1,549,704	$871,321	$779,794	$46,988	$1,845	$104,754	3.22%	$106,599	$3,354,405
4	34	NORFOLK, COUNTY OF	4,677 T	N	$1,466,156	$719,069	$0	$56,429	$14,456	$71,647	3.18%	$86,102	$2,327,757
4	143	NORTH BAY, CITY OF	3,896 T	N	$758,595	$184,152	$50,968	$36,280	$10,166	$36,963	3.55%	$47,129	$1,077,124
4	12	NORTHUMBERLAND, COUNTY OF	5,461 T	Y	$964,185	$1,609,198	$48,213	$95,559	$72,138	$120,721	4.33%	$192,859	$2,910,014
4	878	OXFORD, RESTRUCTURED COUNTY OF	7,147 T	N	$1,322,873	$722,557	$133,252	$45,011	$3,022	$77,057	3.46%	$80,079	$2,303,772
4	88	PETERBOROUGH, COUNTY OF	4,707 T	N	$1,048,946	$513,344	$188,630	$52,630	$288	$56,637	3.14%	$56,925	$1,860,475
4	87	QUINTE WASTE SOLUTIONS	10,751 T	N	$2,347,903	$883,843	$34,069	$51,639	$11,993	$109,856	3.30%	$121,849	$3,439,302
4	21	WELLINGTON, COUNTY OF	5,000 T	N	$1,266,435	$485,333	$294,823	$54,718	$9,947	$73,983	3.50%	$83,930	$2,185,239
		Group 4 Totals	**96,390.62**		**$232.00**	**$119.71**	**$28.72**	**$7.40**	**$4.45**	**$14.74**		**$19.19**	**$407.02**
5	524	ARNPRIOR, TOWN OF	642 T	N	$147,448	$4,874	$0	$1,209	$0	$4,630	3.02%	$4,630	$158,161
5	427	AYLMER, TOWN OF	383 T	Y	$118,235	$41,133	$0	$6,296	$0	$5,183	3.13%	$5,183	$170,846
5	67	BROCKVILLE, CITY OF	1,376 T	Y	$199,680	$0	$0	$9,669	$0	$6,474	3.09%	$6,474	$215,823
5	731	CARLETON PLACE, TOWN OF	623 T	N	$254,123	$54,027	$0	$608	$0	$9,275	3.00%	$9,275	$318,032
5	732	CASSELMAN, VILLAGE OF	235 T	Y	$48,494	$16,724	$0	$2,688	$0	$2,091	3.08%	$2,091	$69,996
5	214	CORNWALL, CITY OF	2,599 T	Y	$762,793	$508,746	$40,782	$14,255	$339	$42,161	3.18%	$42,500	$1,369,077

Figure 8: Sample screen shot from WDO Data Call (tonnage)

Group	PC	Municipality	Total Households Served	TOTAL Reported and/or Calculated Marketed Tonnes[1]	Paper (tonnes): Printed Paper Reported and/or Calculated Marketed[2]	Paper (tonnes): OCC/OBB Reported and/or Calculated Marketed[3]	Paper (tonnes): Mixed Paper Reported and/or Calculated Marketed[4]	Paper (tonnes): Polycoat Reported and/or Calculated Marketed[5]	Plastic (tonnes): PET Reported and/or Calculated Marketed	Plastic (tonnes): HDPE Reported and/or Calculated Marketed	Plastic (tonnes): Plastic Film Reported and/or Calculated Marketed	Plastic (tonnes): Tubs and Lids Reported and/or Calculated Marketed	Plastic (tonnes): Polystyrene Reported and/or Calculated Marketed	Plastic (tonnes): Mixed Plastic Reported and/or Calculated Marketed[6]	Metal (tonnes): Steel Reported and/or Calculated Marketed	Metal (tonnes): Aluminum Reported and/or Calculated Marketed
			5,192,895 HH	**892,924**	**493,966**	**169,413**	**22,998**	**5,657**	**32,234**	**15,768**	**4,894**	**2,901**	**180**	**15,657**	**30,825**	**11,208**
1	1	HALTON, REGIONAL MUNICIPALITY OF	183,677 HH	41,299	26,871	5,924	241	186	1,301	615	1	183	0	326	1,197	502
1	20	TORONTO, CITY OF	1,000,936 HH	156,465	92,437	34,540	-	809	3,802	2,318	267	304	57	752	4,003	1,105
1	50	LONDON, CITY OF	168,568 HH	26,670	13,684	5,743	692	231	1,260	496	182	-	-	573	1,012	379
1	97	YORK, REGIONAL MUNICIPALITY OF	332,788 HH	76,737	49,053	9,462	-	382	2,576	1,423	-	-	13	640	2,170	708
1	172	HAMILTON, CITY OF	215,733 HH	38,422	19,448	9,479	-	177	1,380	627	488	-	17	960	1,478	527
1	270	PEEL, REGIONAL MUNICIPALITY OF	416,500 HH	86,950	55,949	14,791	-	547	2,132	1,278	853	239	-	72	2,228	784
2	6	DURHAM, REGIONAL MUNICIPALITY OF	213,317 HH	44,429	25,353	4,948	3,296	449	2,066	810	-	494	-	70	1,668	691
2	18	ESSEX-WINDSOR SOLID WASTE AUTHORITY	164,356 HH	24,918	14,789	4,988	-	55	875	460	-	-	-	492	949	318
2	53	WATERLOO, REGIONAL MUNICIPALITY OF	199,450 HH	34,534	23,772	2,919	-	387	1,612	664	-	-	-	1,154	1,110	506
2	335	SIMCOE, COUNTY OF	131,150 HH	25,511	2,919	3,915	9,714	153	1,295	677	77	770	3	47	1,215	560
2	357	NIAGARA, REGIONAL MUNICIPALITY OF	190,710 HH	39,465	21,238	6,542	-	138	1,090	298	860	3	0	3,880	1,454	400
2	441	OTTAWA, CITY OF	387,732 HH	60,886	32,434	14,949	-	415	2,253	780	-	-	-	1,095	2,418	571
3	14	BARRIE, CITY OF	56,292 HH	11,590	8,032	284	-	147	610	427	0	0	0	662	389	275
3	36	GUELPH, CITY OF	49,482 HH	8,416	4,505	1,211	-	59	455	200	-	-	-	244	501	179
3	55	SAULT STE. MARIE, CITY OF	32,517 HH	6,014	4,375	120	-	-	234	136	-	-	-	160	309	112
3	103	SARNIA, CITY OF	39,326 HH	3,873	2,038	991	-	38	173	113	-	52	-	6	125	76
3	123	THUNDER BAY, CITY OF	46,945 HH	6,213	3,023	2,481	-	112	170	87	24	-	-	6	229	79
3	179	BRANTFORD, CITY OF	37,874 HH	6,607	2,877	2,209	-	80	341	185	-	102	-	141	180	130
3	293	PETERBOROUGH, CITY OF	36,465 HH	8,518	4,800	1,794	-	73	370	181	56	33	2	15	279	101
4	12	NORTHUMBERLAND, COUNTY OF	37,657 HH	5,461	2,543	1,569	-	19	184	76	181	-	-	117	198	102
4	21	WELLINGTON, COUNTY OF	32,142 HH	5,000	1,841	1,530	-	8	362	177	-	-	-	172	269	133
4	34	NORFOLK, COUNTY OF	28,581 HH	4,677	2,636	985	-	40	203	99	31	18	1	8	153	56
4	87	QUINTE WASTE SOLUTIONS	63,996 HH	10,751	4,309	3,384	216	38	363	137	268	188	5	569	536	130
4	88	PETERBOROUGH, COUNTY OF	32,975 HH	4,707	2,563	958	-	39	229	112	35	21	1	9	173	63
4	89	MUSKOKA, DISTRICT MUNICIPALITY OF	47,996 HH	5,844	3,713	633	-	56	245	117	234	-	-	225	307	82
4	143	NORTH BAY, CITY OF	23,977 HH	3,896	1,459	1,632	-	-	148	67	-	-	-	80	175	41
4	183	GREATER SUDBURY, CITY OF	74,235 HH	13,311	8,482	1,596	-	60	259	172	96	-	-	952	427	98
4	186	BLUEWATER RECYCLING ASSOCIATION	72,685 HH	11,868	1,843	2,043	5,304	16	459	188	82	-	-	247	504	186
4	190	BRUCE AREA SOLID WASTE RECYCLING	33,197 HH	4,360	1,494	1,601	-	-	225	143	-	-	-	119	248	87
4	324	KINGSTON, CITY OF	53,160 HH	9,280	5,083	1,809	-	87	345	124	132	-	31	401	295	151
4	429	CHATHAM-KENT, MUNICIPALITY OF	47,303 HH	4,232	2,385	891	-	36	184	90	28	17	1	7	138	50
4	601	KAWARTHA LAKES, CITY OF	39,445 HH	5,857	3,774	478	-	31	212	107	55	-	-	66	328	107
4	878	OXFORD, RESTRUCTURED COUNTY OF	49,192 HH	7,147	2,898	2,203	-	52	277	103	54	0	18	201	298	116
5	8	STRATFORD, CITY OF	13,750 HH	2,265	948	683	162	14	90	47	15	9	1	5	68	27
5	41	OWEN SOUND, CITY OF	9,605 HH	2,068	1,102	668	-	-	91	35	-	33	3	3	54	36
5	56	ORILLIA, CITY OF	14,600 HH	2,948	1,662	621	-	25	128	63	19	12	1	5	96	35
5	67	BROCKVILLE, CITY OF	10,689 HH	1,376	723	270	-	11	74	36	11	7	0	3	56	20
5	75	ORANGEVILLE, TOWN OF	10,303 HH	3,606	2,032	759	-	31	156	77	24	14	1	6	118	43

3.8.3 Access to the WDO Data call

All necessary authentication credentials were provided by Waste Diversion Ontario, subject to the data usage agreement (found in Appendix D). Tables were exported for manipulation and analysis in Microsoft Excel and Stata 13.

3.8.4 Stewardship Ontario Pay in Model

The information collected by the WDO is used to calculate material specific costs by Stewardship Ontario using a "Pay in Model" (PIM) (2013). The Stewardship Ontario pay in model allocates municipal recycling costs to individual materials using a three step process.

These include:

1. Determine Blue Box Program Costs
2. Allocate Costs to Individual Materials
3. Determine Fee Rates

Each year, representatives from Stewardship Ontario, the Association of Municipalities of Ontario (AMO) and the City of Toronto meet to review the costs submitted by municipalities and together determine a "Best Practice" cost, which is used to negotiate producer obligations to municipalities for their share of the cost for running the Blue Box program. In 2013, the net cost for managing the residential Blue Box program was approximately $197 million dollars (Stewardship Ontario, 2014). These costs are allocated to individual materials based on activity based costing principles and a distribution of common costs. These costs are distributed on the basis that a material specific net cost reflects the costs of collecting, processing and providing administrative support for that material. The PIM model then calculates material specific fee rates for packaging producers using a three-factor formula based on the net cost of material management, material specific recycling rates, and an equalization payment, where (Stewardship Ontario, 2014):

1. 40 per cent of the cost of the program is assigned to each material category based on how much it costs net to manage each material in the system,
2. 35 per cent of the cost of the program is assigned based on the recovery rate achieved by that material,
3. 25 per cent of the cost of the program is assigned based on how much it would cost to manage the material if it were recovered at a rate of 60 per cent (only applies to materials achieving less than 60 per cent target rate) (Stewardship Ontario, 2014)

For the purposes of this study, the PIM model was only used to calculate material specific generation, recovery and cost data.

Data used in this study pertains to packaging materials found in the residential recycling stream. This includes the following materials:

- Newsprint
- Magazines and Catalogs
- Telephone Books
- Other Printed Paper (eg. Office paper)
- Corrugated Cardboard
- Boxboard

- Gabletop Cartons (e.g milk and orange juice containers)
- Aseptic Containers (e.g. juice boxes)
- Paper Laminants (e.g. coffee cups)
- PET Bottles (eg. water bottles)
- HDPE Bottles (eg. laundry detergent)
- Plastic Film (e.g. grocery bags)
- Plastic Laminants (e.g chip bags)
- Polystyrene
- Other Plastics (e.g. margarine tubs and lids)
- Steel Food and Beverage Cans
- Steel Aerosols
- Steel Paint Cans
- Aluminum Food and Beverage Cans
- Other Aluminum Packaging
- Clear Glass
- Colored Glass

Figure 9 provides a screen shot of the Stewardship Ontario PIM model. Where appropriate, sensitive information was removed.

*Figure 9: **Screenshot of Stewardship Ontario PIM model***

Table 2: Gross and Net Costs (full-year obligation)

Assumed Recovery Rate 60%

			Gross Cost		Revenues		Net Cost of Current System					Net Cost to Achieve 60% Diversion Rate			
Category	Material	Quantity Recovered	Per-tonne	Total Cost	Per-tonne	Total Revenue	Per-tonne	Total Net Cost	%'age of Net $	%'age of Printed Cost	%'age of Pckg Cost	Cost to Manage Rest of 60%	%'age Cost of Tonnes to 60%	%'age of Printed Cost	%'age of Pckg Cost
PRINTED PAPER															
Printed Paper	Newsprint - CNA/OCNA	202,416	$ 175.49	$ 35,521,908	$ 91.34	$ 18,489,571	$ 84.15	$ 17,032,337	8.6%	40.4%		$ -	0.0%	0.0%	
	Newsprint - Non-CNA/OCNA	138,193	$ 175.49	$ 24,251,394	$ 91.34	$ 12,623,136	$ 84.15	$ 11,628,258	5.9%	27.6%		$ -	0.0%	0.0%	
	Magazines and Catalogues	74,738	$ 175.49	$ 13,115,839	$ 91.34	$ 6,826,949	$ 84.15	$ 6,288,890	3.2%	14.9%		$ -	0.0%	0.0%	
	Telephone Books	8,523	$ 226.68	$ 1,932,060	$ 90.12	$ 768,104	$ 136.56	$ 1,163,956	0.6%	2.8%		$ -	0.0%	0.0%	
	Other Printed Paper	63,890	$ 186.09	$ 11,889,274	$ 91.08	$ 5,819,364	$ 95.00	$ 6,069,911	3.1%	14.4%		$ 1,080,185	0.6%	100.0%	
Printed Paper Total		**487,760**	**$ 177.80**	**$ 86,710,475**	**$ 91.29**	**$ 44,527,124**	**$ 86.48**	**$ 42,183,351**	**21.4%**	**100.0%**		**$ 1,080,185**	**0.6%**	**100.0%**	
PACKAGING															
Paper Based Packaging	Corrugated Cardboard	148,703	$ 479.71	$ 71,334,511	$ 109.43	$ 16,272,651	$ 370.28	$ 55,061,860	27.9%		35.6%	$ -	0.0%		0.0%
	Boxboard	66,790	$ 281.55	$ 18,804,859	$ 85.82	$ 5,731,890	$ 195.73	$ 13,072,968	6.6%		8.4%	$ 5,388,524	2.9%		2.9%
	Gable Top Cartons	4,568	$ 1,121.98	$ 5,125,592	$ 89.86	$ 410,498	$ 1,032.12	$ 4,715,094	2.4%		3.0%	$ 4,091,681	2.2%		2.2%
	Paper Laminants	384	$ 882.05	$ 338,468	$ -	$ -	$ 882.05	$ 338,468	0.2%		0.2%	$ 21,806,777	11.6%		11.7%
	Aseptic Containers	476	$ 882.05	$ 419,938	$ 90.09	$ 42,893	$ 791.96	$ 377,045	0.2%		0.2%	$ 1,989,708	1.1%		1.1%
Paper Pack'g Total		**220,922**	**$ 434.60**	**$ 96,023,367**	**$ 101.66**	**$ 22,457,933**	**$ 332.99**	**$ 73,565,435**	**37.3%**		**47.5%**	**$ 33,276,690**	**17.7%**		**17.8%**
Plastic Packaging	PET Bottles	29,321	$ 1,287.22	$ 37,742,557	$ 375.17	$ 11,000,340	$ 912.05	$ 26,742,217	13.6%		17.3%	$ 4,121,933	2.2%		2.2%
	HDPE Bottles	16,134	$ 1,202.61	$ 19,402,803	$ 432.44	$ 6,977,025	$ 770.16	$ 12,425,777	6.3%		8.0%	$ 464,186	0.2%		0.2%
	Plastic Film	4,392	$ 1,904.61	$ 8,364,627	$ 28.08	$ 123,308	$ 1,876.54	$ 8,241,319	4.2%		5.3%	$ 50,306,616	26.7%		26.9%
	Plastic Laminants	350	$ 1,904.61	$ 665,739	$ -	$ -	$ 1,904.61	$ 665,739	0.3%		0.4%	$ 39,278,628	20.9%		21.0%
	Polystyrene	1,018	$ 2,304.04	$ 2,346,557	$ 51.65	$ 52,604	$ 2,252.39	$ 2,293,953	1.2%		1.5%	$ 26,923,413	14.3%		14.4%
	Other Plastics	15,505	$ 1,395.07	$ 21,630,878	$ 90.24	$ 1,399,249	$ 1,304.83	$ 20,231,629	10.3%		13.1%	$ 32,326,563	17.2%		17.3%
Plastics Total		**66,720**	**$ 1,351.20**	**$ 90,153,161**	**$ 293.05**	**$ 19,552,526**	**$ 1,058.17**	**$ 70,600,635**	**35.8%**		**45.6%**	**$ 153,421,340**	**81.5%**		**82.0%**
Steel Packaging	Steel Food & Beverage Cans	28,727	$ 353.99	$ 10,168,936	$ 224.72	$ 6,455,420	$ 129.27	$ 3,713,516	1.9%		2.4%	$ -	0.0%		0.0%
	Steel Aerosols	1,151	$ 353.99	$ 407,395	$ 224.72	$ 258,621	$ 129.27	$ 148,773	0.1%		0.1%	$ 184,912	0.1%		0.1%
	Steel Paint Cans	922	$ 353.99	$ 326,433	$ 224.72	$ 207,226	$ 129.27	$ 119,208	0.1%		0.1%	$ 262,261	0.1%		0.1%
Steel Total		**30,800**	**$ 354.00**	**$ 10,902,764**	**$ 224.72**	**$ 6,921,267**	**$ 129.27**	**$ 3,981,497**	**2.0%**		**2.6%**	**$ 447,173**	**0.2%**		**0.2%**
Aluminum Packaging	Aluminum Food & Beverage Cans	9,994	$ 1,120.16	$ 11,194,631	$ 1,402.47	$ 14,015,921	$ (282.30)	$ (2,821,289)	-1.4%		-1.8%	$ -	0.0%		0.0%
	Other Aluminum Packaging	320	$ 1,120.16	$ 358,665	$ 1,402.47	$ 449,056	$ (282.30)	$ (90,391)	0.0%		-0.1%	$ -	0.0%		0.0%
Aluminum Total		**10,314**	**$ 1,120.20**	**$ 11,553,296**	**$ 1,402.47**	**$ 14,464,977**	**$ (282.30)**	**$ (2,911,681)**	**-1.5%**		**-1.9%**	**$ -**	**0.0%**		**0.0%**
Glass Packaging	Clear Glass	71,466	$ 136.70	$ 9,769,407	$ 27.19	$ 1,943,384	$ 109.51	$ 7,826,023	4.0%		5.1%	$ -	0.0%		0.0%
	Coloured Glass	16,869	$ 126.08	$ 2,126,845	$ 21.98	$ 370,743	$ 104.10	$ 1,756,102	0.9%		1.1%	$ -	0.0%		0.0%
Glass Total		**88,335**	**$ 134.70**	**$ 11,896,253**	**$ 26.20**	**$ 2,314,128**	**$ 108.47**	**$ 9,582,125**	**4.9%**		**6.2%**	**$ -**	**0.0%**		**0.0%**
PACKAGING TOTAL		**417,090**	**$ 528.70**	**$ 220,528,841**	**$ 157.55**	**$ 65,710,831**	**$ 371.19**	**$ 154,818,011**	**78.6%**		**100.0%**	**$ 187,145,204**			
TOTALS		**904,850**	**$ 339.50**	**$ 307,239,316**	**$ 121.83**	**$ 110,237,954**	**$ 217.72**	**$ 197,001,362**	**100.0%**			**$ 188,225,389**	**100.0%**		**100.0%**

3.8.5 Combining Historical Data Entries

Given that this study analyzed the effects of municipal recycling initiatives over time, data from both the WDO data call and Stewardship Ontario PIM model needed to be combined into one dataset. This required that data from both sources be downloaded and organized using Microsoft Access and Microsoft Excel. Historical data between the periods of 2002 and 2013 were aggregated into "summary" files that were used as the base panel data for all subsequent econometric analysis. All efforts were made to maintain the integrity of the original data set - data manipulation was kept to a minimum, and was only done to organize the data in a way that facilitated program and group comparisons.

3.8.6 Statistics Canada

This study also relied heavily on data provided by Statistics Data. Data pertaining to population size, population density, median age, and education levels were obtained from the Statistics Canada 2006 and 2011 census (Statistics Canada, 2006, 2011). All data was in Microsoft Excel format. When performing the statistical regressions, the data was imported into Stata 12 for analysis.

3.8.7 Survey and Interview Data

All survey and interview data was collected over a 6 month period between December 2013 and April 2014. Surveys and interviews were later archived and transcribed electronically

As noted earlier, qualitative surveys and interviews were conducted to create a more complete understanding of recycling in Ontario. A combination of generic/pragmatic and grounded theory methods were used to best collect, synthesize and analyze the data. Appendix C provides a copy of the survey and interview questions.

The qualitative component of this study was divided into two main areas: 1) Semi-structured surveys and interviews with households, and 2) Semi-structured surveys and interviews with municipal waste managers and packaging producers.

3.8.8 Household Survey and Interviews

9 geographical regions were targeted to complete questionnaires pertaining to daily household recycling activity.

1) Large Urban (Peel Region, Toronto, North York)

2) Urban Regional (Windsor)

3) Medium Urban (Barrie)

4) Rural Regional (Peterborough)

5) Small Urban (Orangeville)

6) Rural Collection - North (Timmins)

7) Rural Collection - South (North Glengarry)

8) Urban Depot - North

9) Urban Depot - South

These groups were selected on the basis that they adequately represent the geographic/demographic differences in the province.

Municipal groups are classified using two primary and two secondary criteria. Primary criteria includes a municipalities' population and population density. Secondary criteria include a municipalities' location (north or south) and type of service (curbside or depot). For programs with populations less than 50,000 and a population density less than 4, the municipal groups have been further subdivided based on geographic location into 'north' and 'south')as defined by O. Reg. 101/94); and type of service (which may also include depot). Using the aforementioned criteria, provincial municipalities are classified as follows in the WDO Data Call (Adapted and expanded from the WDO Data Call Municipal Classification Criteria, 2011):

Table 15: ***Description of WDO Municipal Groups***

Municipal Group	Description
Large Urban (Group 1) (6 Municipalities)	• Population greater than 250,000 • Population density greater than 4 residents per square km
Urban Regional (Group 2) (6 Municipalities)	• Population greater than 250,000 • Population density less than 4 residents per square km
Medium Urban (Group 3) (7 Municipalities)	• Population between 50,000 and 250,000 • Population density greater than 3 residents per square km
Rural Regional (Group 4) (14 Municipalities)	• Population between 50,000 and 250,000 • Population density less than 3 residents per square km
Small Urban (Group 5) (23 Municipalities)	• Population less than 50,000 • Population density greater than 4 residents per square km
Rural Collection South (Group 6) (32 Municipalities)	• Population less than 50,000 • Population density less than 4 residents per square km • Located in the "South" as defined by O. Reg. 101/94 • Provide curbside collection service of Blue Box materials to at least 30% of households
Rural Depot South (Group 7) (63 Municipalities)	• Population less than 50,000 • Population density less than 4 residents per square km

	• Located in the "South" as defined by O. Reg. 101/94 • Provide only depot collection service or a combination of depot and curbside collection with less than 30% of households receiving curbside collection of Blue Box materials
Rural Collection North (Group 8) (46 Municipalities)	• Population less than 50,000 • Population density less than 4 residents per square km • Located in the "North" as defined by O. Reg. 101/94 • Provide curbside collection service of Blue Box materials to at least 30% of households
Rural Depot North (Group 9) (33 Municipalities)	• Population less than 50,000 • Population density less than 4 residents per square km • Located in the "North" as defined by O. Reg. 101/94 • Provide only depot collection service or a combination of depot and curbside collection with less than 30% of households receiving curbside collection of Blue Box materials

Survey questions were organized into five main areas: 1) Willingness to participate in recycling activity, 2) Perceived levels of convenience surrounding existing waste management services, 3) Perceived level of awareness and attitudes towards existing waste management initiatives, 4) Experience and attitudes towards recycling, and 5) Demographic information related to race, ethnicity, education and income.

Questionnaires were pre-tested and refined prior to conducting the official survey. The pre-test allowed for wording refinements and changes to the ordering of the questions. The finalized survey was conducted over a six week period beginning in December 2013 and running through January 2014. Teams of two enumerators and one site supervisor were sent to each municipality for a period of three days each, spending four hours at each survey site. Enumerators were retained from the environmental consulting agency "Environmental Alliance" and provided in-kind renumeration for their work. Enumerators were required to successfully complete the Tri-Council ethics certification prior to their participation in the study. I served as the site supervisor for all survey work conducted.

Questionnaire "booths" were set up in spaces with high foot traffic (namely malls, arenas and public commons areas). Enumerators were asked to approach members of the public, explain who they were and the purpose of the study, and request approximately 10-15 minutes of the participant's time to complete the survey. Survey responses were recorded by hand and by tape recorder by the enumerator, and later electronically archived and analyzed using Provalis Word Stat, Microsoft Excel and Microsoft Word. Word Stat was used to code, summarize and categorize interview responses. Microsoft Excel and Microsoft Word were used to record Likert scale values and record frequency counts and percentage distribution of responses.

Respondents were asked to answer questions using a combination of Likert scales, dichotomous selection (yes or no) and open ended statements. Respondents were read questions and asked to mark their responses on the survey with the assistance of the enumerator. Upon completion of the written survey, respondents were asked a series of open ended questions related to their attitudes towards garbage bag limits and recycling behavior.

The interview was recorded and later transcribed in full. Teams of two enumerators would administer the survey, one tasked with taking interview/field notes and the other working with respondents to complete the survey.

Enumerators were proficient in several languages (including Hindi, Punjabi, Farsi, Spanish and French), allowing the survey to be administered in the language respondents were most comfortable with (in most instances). A total of 613 people were approached and asked to participate in completing the survey. Of those approached, enumerators managed to successfully complete 228 of the surveys, for a response rate of 37.19%. Table 16 and 17 below provide detailed information on the number of survey responses by region and the summary statistics of survey participants

Table 16: ***Survey Responses by Region***

Region	# of Responses
Large Urban	77
Urban Regional	58
Medium Urban	28
Rural Regional	17
Small Urban	12
Rural Collection - North	16
Rural Collection - South	8
Urban Depot - North	11
Urban Depot - South	12

Table 17: ***Summary Statistics of Household Survey Participants***

Variable	Mean/Percent
Gender	49.2%[1]
Age	41.2
College	51.5%[2]
Income	$45,000-$60,000[3]

[1]Percentage of respondents who identified as being male (else female)
[2]Percentage of respondents with college education or higher
[3]Respondents were asked to select from ranges of income that best represents their earnings, not actual values

3.8.9 Survey - Municipal Waste Managers

In collaboration with the Ministry of the Environment, semi structured interviews and surveys were developed in an attempt to gauge the attitudes and opinions of recycling stakeholders regarding existing and future policy initiatives.

Semi-structured interviews and surveys were conducted with recycling stakeholders from 9 geographic areas in the province. Interview participants were selected on the basis of representing Ontario's different recycling stakeholder groups (municipal officials, industry stewards & industry funded organizations). Table 18 below briefly describes each recycling stakeholder and their role within the provincial recycling system.

Table 18: ***Description of recycling stake holders***

Stakeholder	Description
Municipal Waste Managers	Municipal waste managers are municipal employees responsible for operation, delivery and maintenance of waste management services. Municipal waste managers are traditionally tasked with setting budgets, allocating staff resources and setting policy priorities for municipal waste programs. Sopme municipal waste managers belong to the Municipal Industry Panel Committee (MIPC), advocating for the financial interests of their particular municipality.
Packaging Producers	Packaging producers are representatives from packaging companies that are financially obligated to remit fees to Stewardship Ontario. These fees are used to (partially) finance the operation of the Blue Box program under Ontario's shared producer responsibility model. In most instances, packaging producers who agreed to participate in the study were specially designated employees responsible for end of life management of company waste.
Industry Funded Organization	Study participants from industry funded organizations included representatives from Stewardship Ontario, the Canadian Beverage

Stakeholder	Description
Municipal Waste Managers	Municipal waste managers are municipal employees responsible for operation, delivery and maintenance of waste management services. Municipal waste managers are traditionally tasked with setting budgets, allocating staff resources and setting policy priorities for municipal waste programs. Sopme municipal waste managers belong to the Municipal Industry Panel Committee (MIPC), advocating for the financial interests of their particular municipality.
	Council, The Paper and Paperboard Packaging Environmental Council and the Canadian Plastics Industry Association. Industry Funded Organizations represent and advocate for the interests of their respective members. They are financed through membership dues. Generally speaking, IFOs represent the interests of a specific sector or packaging type.

A request for participation was sent via email to potential study participants. This correspondence outlined the purpose of the study, what the data and findings would be used for, and what results would be shared with potential participants. Interviews were conducted in person, via telephone and electronic correspondence. How the interview was administered was decided by interviewees and scheduled at their convenience.

A high-level summary highlighting the findings from phase 1 of the study (best practice testing) was sent to all study participants two weeks prior to conducting the surveys/interviews. This was done to ensure that participants had sufficient time to review the outcome of the analysis and seek clarity on any issues surrounding methodology, findings, etc. Questionnaires were pre-tested and refined prior to conducting the official survey. The pre-test allowed for wording refinements and changes to the ordering of the questions. The finalized survey was conducted over a twelve-week period beginning in February and running through April 2014.

For the semi-structured survey, respondents were asked to answer questions using a combination of Likert scales and open-ended statements. Depending on how the survey was administered, respondents were either: a) read questions and asked to mark their responses on the survey with the assistance of an enumerator, or b) asked to complete the survey electronically and submit their responses via email to the project lead. Electronic surveys included a contact number and email for the project lead (I served as the project lead), in the event that the respondent required assistance in completing the questionnaire.

Upon completion of the survey, respondents were asked a series of open ended questions related to existing best practices, the current state or recycling in Ontario, the proposed waste reduction act and where they see the Blue Box program going in the future. Interviews conducted in person were recorded and later transcribed in full. For participants who opted to participate electronically, additional comment pages were included at the end of the survey to allow for respondents to record their answers.

A total of 114 stakeholders were contacted and asked to participate in the study. Of those contacted, 47 respondents successfully completed the survey (32 electronically, 15 in person), for a response rate of 41.22%. It should be noted that while this sample underrepresents municipal waste managers from rural and northern municipalities (when measured by the number of municipalities in the program). However, using tonnage based metrics (where most of the province's tons are generated), the sampled municipal waste managers represent more than 90% of all material generated in the province. Table 19 below provides the respective sectors that survey participants belonged to. Table 20 further breaks down the stakeholder group "municipal waste managers" by geographic region.

Table 19: ***Breakdown of respondents by sector***

Sector	# of Respondents
Municipal Waste Managers	29
Packaging Producers	12
Industry Funded Organization	6

Table 20: ***Municipal waste managers (by geographic region)***

Region	# of Respondents
Large Urban	12*
Urban Regional	4
Medium Urban	5
Rural Regional	2
Small Urban	1
Rural Collection - North	2
Rural Collection - South	1
Rural Depot – North	1
Rural Depot - South	1

Note: While the large urban group is comprised of only 6 municipal groups, more than one municipal waste manager from the Region of Peel, City of Toronto and York Region chose to participate in the survey*.

3.8.10 Interpretation of panel data from WDO data call and Stewardship Ontario PIM Model

Given the use of panel data in this study, regression analysis was used to test for relationships between dependent (recycling rate, program costs) and independent variables (promotion and education expenditures, municipal incentives, etc.).

Municipal recycling rates were modeled as a function of waste management policy, income and demographic variables. A regression was performed for each of the waste management tools identified as a recycling best practice.

Since the primary objective of this study was to examine the effect of policy variables on municipal and material recycling rates, income and demographic variables are limited to age, income, education and population density. While this is hardly an exhaustive list of potential drivers of recycling behavior, this approach is consistent with the literature and captures the most commonly identified behavioral antecedents (see Sidique et al., 2010). Following Callan and Thomas (1997), the role of socioeconomic/demographic variables is to empirically isolate the policy influence.

Table 21 below summarizes the list of variables included in each regression.

Table 21: ***Proposed list of variables to be included in each regression***

Variable	Description
RR (DEPENDENT)	Recycling Rate
PC (DEPENDENT)	Program Costs
TP	Municipal Transfer Payments
PAYT	1 if municipality implements pay as you throw scheme (0 otherwise)
CURB	Percentage of households with access to curbside recycling collection
PE	Municipal promotion and education expenditures (per household) ($)
INC	Income Per Capita ($)
AGE	Median Age
EDUC	% of Population with College education or higher
DEN	Population Density per square kilometer

Table 22 includes a list of column headers that were used from the WDO Data Call and Stewardship Ontario Pay in Model

Table 22: ***Column Headers***

WDO Data Call Information	Stewardship Ontario Pay IN Model
Municipal Group	Generation (Sheet 1)
Program Name	Recovery (Sheet 1)
Marketed or Calculated Marketed Tonnes	Per-tonne (Gross Cost)
Residential Collection Costs	Total Cost (Gross Cost)
Residential Processing Costs	Revenue Per-tonne
Residential Depot/Transfer Costs	Total Revenue
Residential Promotion & Education	Net Cost Per-tonne
Interest on Municipal Capital	Total Net Cost
Administration Costs	%'age of Net $
Gross Costs	%'age of Printed Cost
Total Gross Revenue	%'age of Pckg Cost
Administration Factor (Calculated)	Common Costs
Calculated Administration[1] and Interest on Municipal Capital[2]	
Net Cost	
Net Cost per Tonne	
PAYT (Y/N?)	
Material Flow	
Shipped to/Managed By	
Address	
Distance To Nearest MRF/Transfer Station	
# Of Municipalities serviced	
Single vs Multi	

3.8.11 Selecting the appropriate regression method and modeling methods

Selecting the appropriate regressive model used in this research posed numerous challenges, as there are competing views in the literature regarding which approach is most appropriate with panel data.

Table 23 below summarizes the advantages and disadvantages of commonly used regressive techniques, namely, pooled ordinary least squares, random effects and fixed effects regression.

Table 23: ***Advantages and disadvantages of various regressive techniques***

Method	Advantages	Disadvantages
Pooled Ordinary Least Squared	-Simple to use -Time tested -Easy to interpret	-The assumptions required for OLS are stringent -Neglects heterogeneity across individuals (not good for panel data)
Fixed Effects	-Controls for unobserved heterogeneity (when heterogeneity is constant over time and correlated with the independent variable)	-Cannot be used to investigate time-invariant causes of the dependent variables
Random Effects	-Allows for time-invariant variables to play a role as explanatory variables	-You need to specify time invariant characteristics that may influence the predictor variables. A failure to do so results in omitted variable bias -Harder to specify

A Breusche-Pagan Lagrange (LM) multiplier test and a Hausman misspecification test were conducted to choose between a pooled OLS, fixed or random effects regression.

With specific regards to this study, endogeneity poses issue, in that the independent variables (municipal transfer payments (MTF) and P&E investments) are a function of the dependent variable (recycling rate). Of note, both Kinnaman and Fullerton (2000) and Sidique et al. (2009) have argued that local government policy decisions may be endogenous. Unlike previous studies that assume that policy variables such as PAYT schemes and promotion and education provisions are exogenous; they argued that these variables tend to vary with community attributes and household characteristics (Sidique et al., 2009; Kinnaman and Fullerton, 2000). Endogeneity poses a significant statistical problem, in that it violates the assumption that the independent variables are uncorrelated with the error terms (Kinnaman and Fullerton, 2000).

To address this issue, a time lag of one year is introduced to the MTP and P&E variables. Prior year transfer payments and P&E investments affect current year municipal recycling rates, but current year recycling rates have no bearing on prior year independent variables. Instrumenting variables is a popular technique used in econometric modeling to overcome issues surrounding endogeneity.

Logit regression is also used to analyze which of the independent variables specified in table 21 affect either recycling rates or program costs. As opposed to predicting the strength of the relationship between the dependent (recycling rate and program costs) and independent variables, logit modeling was used to ascertain whether a dichotomous relationship is present, i.e. yes, promotion and education investments influence recycling rates, or no, they do not. Logit modeling was also used to gauge whether other explanatory variables (such as municipal grouping) affected dependent variables.

For a full elaboration of the statistical methodology employed for each research question, please refer to Chapter 5.

3.8.12 Use of Inferential/Descriptive Statistics

The statistical analysis used in this study can largely be divided into two types: 1) Descriptive Statistics and 2) Inferential Statistics.

Descriptive statistics were applied to the Statistics Canada and aggregated municipal data. Given that the sample of municipalities included in this study represents approximately 95% of the province's total population, descriptive statistics could be used to summarize the overall data (i.e. mean population density, income levels, etc)

Inferential statistics were primarily used for the sub-set of municipalities that were sampled from the survey data. With that being said, the sample of municipalities included in the survey section of the study may not represent a realistic approximation for all municipalities in the province. This issue is discussed in greater detail in section 5.11.3

3.9 Cost Modeling

In Chapter 6, two separate cost models were developed to quantify the economic and diversion impacts of making changes to the existing Blue Box system. Some of these changes include: changing the mix of materials included in the Blue Box program, eliminating certain materials from the program, contracting the service area for the Blue Box program (by specifically eliminating recycling in Ontario's rural and northern regions) and optimizing investments in certain low cost municipal groups. These cost models were developed in Excel using data from the Stewardship Ontario PIM model and WDO Data Call. A full elaboration on the development of the cost model, including assumptions and limitations, can be found in Chapter 6.

3.10 Interpretation of survey/interview data

Coding was used to quantify and interpret the qualitative data collected from surveys and stakeholder interviews. Given that the surveys primarily used defined Likert scales, the results were already pre-coded into their demarcated categories.

For open-ended survey questions and semi-structured interviews, codes were developed to capture key words and phrases, themes and core concepts related to recycling behavior and attitudes.

Following Bogdan and Biklen, 1992; Strauss, 1987; Mason, 1996; and Gibbs, 2006), the following considerations (Shown in Table 24) were made when developing the codes related to household recycling habits. Provalis Word Stat was used to manage, code and analyze qualitative data.

Table 24: ***Coding considerations***

WHAT CAN BE CODED	EXAMPLES
Behaviors, attitudes	Attitudes towards recycling and sustainability "I feel good about recycling because it helps the environment"
Activities –involve other people within a particular setting	Act of recycling and garbage disposal "My family and I make sure to recycle every week"
Strategies, practice or tactics	Municipal policy initiatives designed to increase diversion, i.e. PAYT
States – general perception experienced by people	Measures of self efficacy, i.e. "I feel as though my actions contribute towards sustainability"
Meanings – A wide range of phenomena at the core of much qualitative analysis. Meanings and interpretations are important pairs of what directs participants actions.	
a. What concepts do participants use to understand their world? What rules guide their actions	What constitutes recyclables "I know recycling is good, but I don't know what to put in the box besides glass and newspaper"
b. How do participants construe events, what are the feelings?	Evaluation of effort expended "Recycling is a hassle, but I will be fined if I don't do it"
c. What symbols do people use to understand their situation? What names do they use for objects, events, persons, roles, setting and equipment?	Blue Box, the 3 Rs (Reduce, Re-use and Recycle)
Participation – adaptation to a new setting or involvement	Recycling participation "Where I come from, we never recycle. Now I have to do it every week"
Relationships or interaction	Social norms "Seeing my parents recycle makes me want to recycle"
Conditions or constraints	Lack of recycling accessibility, "It's too difficult for me to drop my recyclables at a depot"
Consequences	Fines and Penalties "I was fined for putting out more than 2 bags of garbage"
Settings – the context of the events under study	Single Family/Multi Family residences, Urban/Rural

For the purposes of this study, container categories were created to classify participant responses, and then coded accordingly. For example, two container categories might be Positive and Negative attitudes towards recycling. Under each of these categories, open ended responses would be sorted using a “best fit” approach, i.e. “I think recycling is a good thing” would be placed under positive attitudes towards the environment. A more detailed elaboration on how survey responses were coded can be found in Chapter 5.

3.11 Methodological Limitations

While every reasonable effort was made to ensure that the data (and subsequent analysis) used in this study was accurate and credible, there remain some significant methodological concerns that are worth highlighting.

There is an adage in academia that your research is only ever as good as your data. Fortunately for me, the panel data obtained from the WDO and Stewardship Ontario is widely regarded as among the most comprehensive and robust municipal waste data in North America (Wilson, 2009). However, even the best data sources has its limitations - and the WDO data call and Stewardship PIM model are no exceptions.

3.11.1 Issues and Limitations with the WDO Data Call

Despite the comprehensiveness of the data call, the nature of self-reported data may lead to errors in reporting and data accuracy. Municipalities may be inclined to overstate diversion levels or misinterpret the questions being asked by the municipal data call survey. To maintain data integrity and ensure that municipalities are correctly interpreting and answering data call questions, the WDO, in association with the Municipal Industry Program Committee (MIPC) and Stewardship Ontario, provide data call support and third party verification of the information reported into the data call. Municipalities work directly with a MIPC representative to ensure that the data call survey is filled out and submitted correctly. Stewardship Ontario finances 3rd party audits of municipal recycling programs to ensure that cost and recovery information is accurate. However, due to the administrative burden and costs of verifying data for all 223 provincial municipalities, these audits are normally conducted at random, and consist of approximately 10-15 samples per year. While extensive efforts are made to ensure that the data reported to the data call is accurate, there have been (and continue to be) instances in which information is misreported.

As such, every year, the information reported by municipalities in to the data call under goes a "reconciliation" period. All municipal data is reviewed by WDO staff, who in turn compare year over year changes in municipal costs and diversion to flag any "peculiar" or "unexpected" results. These red flags are then investigated by WDO staff or a MIPC representative, who contact the municipalities in question to identify whether there were any issues in data reporting or the operation of the program. In the event that municipalities are unable to provide a satisfactory explanation for anomalies in reported costs, they may be targeted for follow up audits or forfeit a percentage of their municipal waste funding (under Ontario's EPR program, municipalities are reimbursed 50% of the costs for operating and maintain their residential recycling program).

This study operates under the assumption that the data extracted from the WDO data call is valid and consistent with actual municipal costs and recycling performance. Generally speaking, discrepancies between self-reported and actual costs/diversion levels are identified and rectified during the reconciliation process. The WDO performs ongoing data integrity checks to ensure that the information contained within the data call is accurate, and will amend historical data entries should new information become available that suggests a reporting error has been made. While it is impossible to know with absolute certainty that the WDO data call is wholly accurate, we can say that all reasonable efforts have been made to ensure data credibility.

3.11.2 Issues and limitations with the Stewardship Ontario PIM Model

As mentioned in section 3.7.4, the Stewardship Ontario PIM model uses cost and recovery data reported by municipalities into the WDO data call. The number of recovered tonnes and the total system cost are actual measurements. However, to calculate the recycling rate, the total quantity of material generated has to be estimated. There is no actual measurement of this number - instead, it is a modeled number based on total producer sales into the province and curbside waste audits of households. Based on what packaging producers are reporting in terms of sales and what households are throwing away, Stewardship Ontario uses a generation model to estimate generation figures by material type. This is an inexact process - many packaging producers have been critical of the generation methodology used by Stewardship Ontario and say that the existing approach overestimates quantities of material generated in the province.

A similar approach is used to allocate costs to individual materials. While total system costs are a reported figure, these costs need to be allocated to individual materials using the activity based costing (ABC) cost allocation model. Consider briefly the way Blue Box material is collected and moves through the system - it is collected as a commingled container and enters the MRF for sorting. The ABC cost allocation model assigns system costs to individual materials by allocating the capital, labour and operating cost of collection and processing operations. This is based on the direct expenses for a material and drivers such as time expended on each activity, building space allocated to each activity, and the relative volume and weight of materials on which each activity is performed. While the Stewardship Ontario ABC model has been developed collaboratively with both municipalities and packaging producers, activity based costing data is collected infrequently, with only two studies conducted over the past decade (2006 and 2012). If there are new technologies or efficiencies in the recycling process, these changes would not be captured under the existing cost allocation methodology. With that being said, the limitations of activity based costing are difficult to overcome. Due to the nature in which Blue Box material is collected and processed, ABC principles are the only way to allocate costs to individual materials.

3.11.3 Issues and Limitations with Survey and Interview Data

While the data limitations associated with the WDO data call and Stewardship Ontario PIM model are important to note, they pale in comparison to the issues associated with the survey and interview data used in this study. That is not to say that the qualitative component of this study is without merit - the information gleaned from the surveys/interviews was immeasurably useful. However, the very nature of qualitative research - designing surveys and interview questions, selecting study areas and finding amenable study participants, is rife with difficulty.

The development of the household survey proved particularly challenging, in that I was asking study participants to comment on topics and terms that they were not familiar with. For example, when enumerators asked study participants to comment on the effectiveness of pay as you throw policy, few were familiar with the term. It was only after examples were provided by the enumerator that interviewees understood what was being asked. The household survey underwent several revisions and wording changes before being rolled out, and even then, respondents frequently required the assistance of the enumerator for clarification. This subsequently raises the question as to whether the responses provided by interviewees reflected their actual attitudes and opinions towards recycling initiatives. Did respondents fully understand what was being asked of them? To help control for this, open ended interview questions accompanied the surveys. Interviewees were asked to comment freely on the policy in question and their general attitudes towards recycling and the environment. In addition to gathering useful information on household recycling behavior, it also served as a test to see whether respondents fully understood the survey questions. Most respondents were able to provide specific anecdotes regarding policies, i.e. "I notice my neighbor putting out more than two bags of garbage", so it is a reasonable assumption that respondent feedback was accurate.

Selecting study sites was almost entirely a function of which municipalities were amenable to surveys being conducted in their area. While each of the 9 geographic regions classified for by the WDO were represented in the study areas, many of the municipalities initially identified as being suitable sites for surveys declined to participate in the research (or more specifically, did not respond to the study request). Ontario's rural northern areas are underrepresented in this research, as no municipality north of the 50th parallel is included. That being said, the majority of the Blue Box tonnes generated in the province are from Southern Ontario, the three largest municipalities were captured in this study.

3.12 Chapter Summary

This chapter reviewed the methodological approach utilized in this research project. The research philosophy, data sources, and quantitative/qualitative techniques were described in general terms. For a full elaboration of the methodological techniques employed in this theses, please refer to the results chapter (Chapter 5).

Chapter 4: Recycling in Ontario

This chapter provides background information on recycling in Ontario, with a particular focus on the province's residential printed paper and packaging system (Blue Box). This chapter begins by characterizing Ontario's waste and diversion streams for both the residential, Industrial, Commercial and Institutional (IC&I) and hazardous waste sectors. This is then followed by an overview of the mandatory and voluntary recycling programs presently in place in the province for each of Ontario's waste streams. A brief history of the Blue Box program also accompanies this discussion. The chapter concludes with a detailed analysis of the economic and diversion trends for Blue Box materials and program management costs.

4.1 Characterization of Ontario's waste streams (Generation)

Broadly speaking, Ontario's solid waste can be divided into two primary streams: 1) Hazardous and 2) Non Hazardous waste.

We define these terms as:

Hazardous Waste:

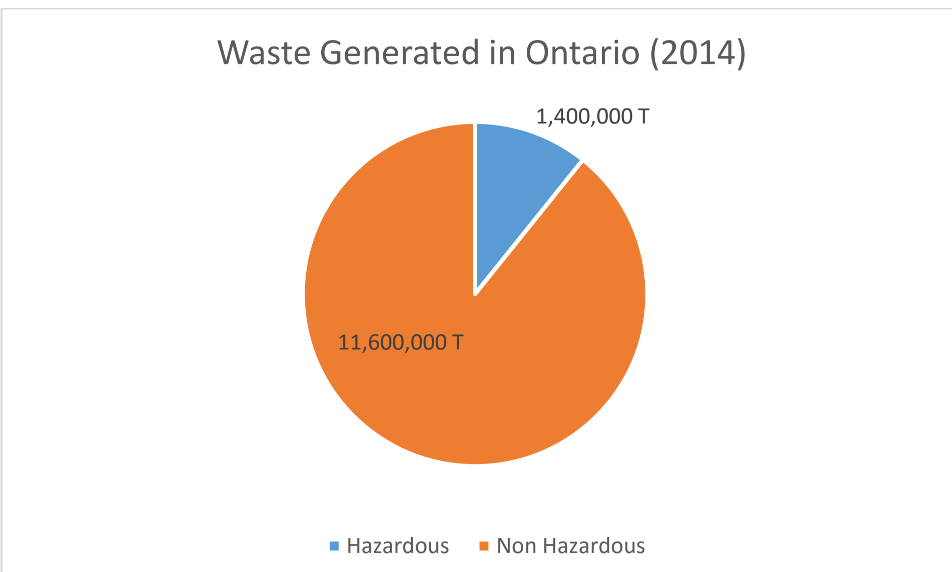
"A solid waste, or combination of solid waste, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness; or (b) pose a substantial presentor potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. (RCRA 1004(5))"

Non Hazardous Waste:

"Non-hazardous waste is defined by the Environmental protection Act (EPA) through Regulation 347 – General Waste management. Regulation 347 defines curbside household garbage and similar waste generated by businesses and institutions as solid non-hazardous waste – this definition also includes construction and demolition wastes such as drywall and roofing materials." (Ontario Environmental Protection Act, RRO: 1990, Reg. 347)

Figure 10 below illustrates the percentage split between hazardous and non-hazardous waste generated in the province (WMIS, 2012).

Figure 10: ***% split between hazardous and non-hazardous waste generation in Ontario***

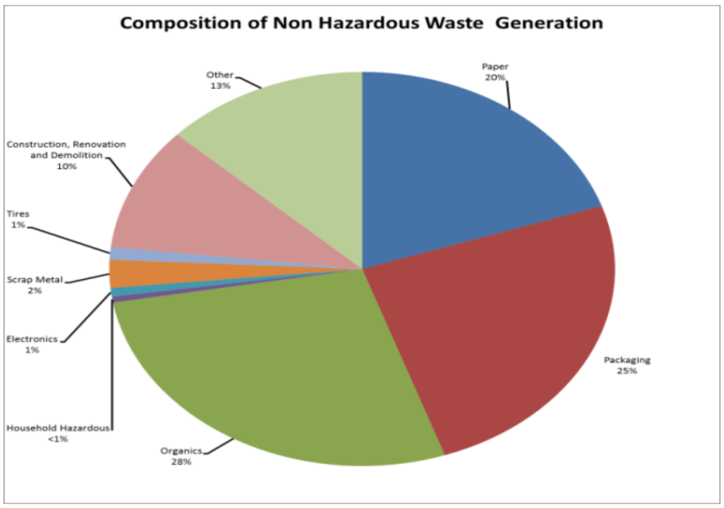


Approximately 89% of all materials generated in Ontario in 2012 came from the Non Hazardous sector (WMIS, 2012). Figure 11 below provides the composition of non hazardous waste generated in the province. Approximately 4.8 (41%) million tonnes of all non hazardous waste generated comes from residential sources, with the remaining 6.8 million tonnes (59%)

coming from the industrial, commercial and institutional sector (IC&I)[1](WMIS, 2012). Data for the composition of the hazardous waste stream was unavailable at the time of thesis preparation.

Figure 11: ***Composition of Non Hazardous Waste Generated in Ontario***

(Data sourced from the Statistics Canada Waste Management Industry Survey, 2012)



As show in figure 11, approximately 73% of all waste generated in the province is made up of organic (food, wood & yard waste) and paper based (newsprint, corrugated cardboard, boxboard, office paper, magazines, composite paper containers) materials. C&D waste also makes up 10% of total waste generation. In theory, all of these materials can be diverted under existing provincial waste management programs. However, as shown in section 4.2, what ultimately ends up being diverted has little to do with whether a material can be recycled or not. Often, the decision to recover a material is driven by economic factors - the infrastructure may exist to recycle most materials, but the costs associated with doing so may be prohibitive (or stated alternatively, the costs of disposal are significantly cheaper)

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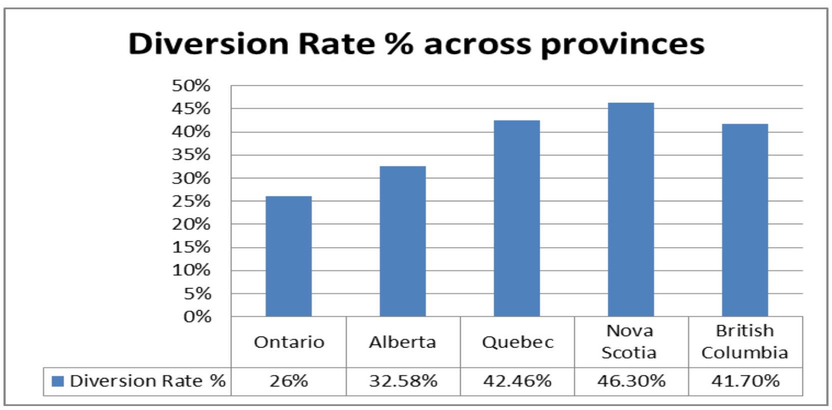
[1]The IC&I sectors consist of a range of establishments, including: malls, office buildings, construction and demolition sites, restaurants, hotels, hospitals, educational institutions, manufacturing plants, and multi-residential buildings.

Unfortunately, due to nature in which the Statistics Canada Waste Management Industry survey reports data on material specific generation, I am unable to further breakout these results in to the composition of sub material categories (i.e. paper is made up of X% newsprint, Y% office paper etc.)

4.2 Characterization of Ontario's Waste Stream (Wase Diverted)

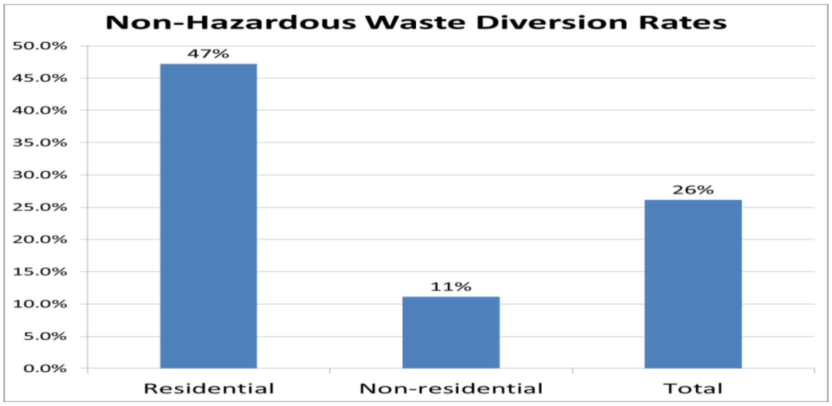
While Ontario's recycling rate for residential printed paper and packaging (Blue Box) is the highest in Canada, the diversion level for the province as a whole lags behind other jurisdictions (As shown in figure 12)

*Figure 12**: Overall Diversion Rates Across Canadian Jurisdictions***



This is a seemingly unexpected result - Ontario has had a recycling system in place for more than 30 years, and has regulations legislatively requiring both households and industrial, commercial and institutional (IC&I) establishments to recycle. However, the scope of waste generation, both with respect to the sources of waste and what is actually covered by existing regulations helps shed some light on the issue. The poor diversion rates for Ontario as a whole is largely attributed to the province's low diversion of materials generated from the IC&I sector (as shown in figure 13).

Figure 13: ***Diversion rates of non-hazardous waste from both residential and non-residential sources.***



The IC&I sector in Ontario is responsible for more than 70% of all material generated in the province (Statistics Canada, 2012), but manages to divert only a small percentage of their overall waste. While the provincial 3R regulations apply to large IC&I waste generators (see description below), it is estimated that most of the waste generated by the IC&I sector comes from small and medium size establishments, and thus, fall outside the purview of existing regulations (Kelleher, 2006).

4.2.1 Description of legally mandated IC&I establishments

- Large IC&I establishments to prepare waste audits and waste reduction work plans (O.Reg 102/94). These plans are submitted to the ministry upon request.
- Large IC&I establishments to source separate and make reasonable efforts to recycle specified waste such as fine paper, and aluminium cans (O.Reg 103/94).
- Large manufacturers, packagers, and importers to undertake packaging audits and implement packaging reduction work plans; these plans are submitted to the ministry upon request (O.Reg 104/94).

According to Industry Canada, only 19% of all employees in the province work in large IC&I establishments (where large is defined as an establishment with more than 500 employees) (Industry Canada, 2014). Thus, in order to divert (or at the very least, regulate) the material being generated by the IC&I sector, the 3R regulations will have to be amended to increase the threshold to include medium and small businesses.

However, there are a number of unique challenges for establishing and implementing waste division programs in the IC&I sectors:

- Diverse types and volumes of wastes generated between sectors.
- Sectors do not report the types and volumes of waste managed and diverted.
- The wide variety of individual establishments, which range from small family businesses to large, global companies.
- The disparity in the cost of disposal vs. the cost of recycling for IC&I establishments.

This last point may require some elaboration, in that the economics of recycling for IC&I establishments is a topic that has received scant attention from researchers and policy planners. Ontario has unique characteristics with respect to the economics of waste management relative to other jurisdictions.

Table 25 below summarizes interprovincial costs of recycling for five Canadian provinces.

We note that provinces differ significantly in the costs to both dispose and recycle material. The most salient examples include differences in tipping fees, cost of operating transfer stations and recycling facilities and the cost of shipping material to US Landfills.

Figures 14 through 17 graph the interprovincial costs for certain disposal activities (tipping fees and cost to ship material to US landfills).

Figure 14: Tipping Fees

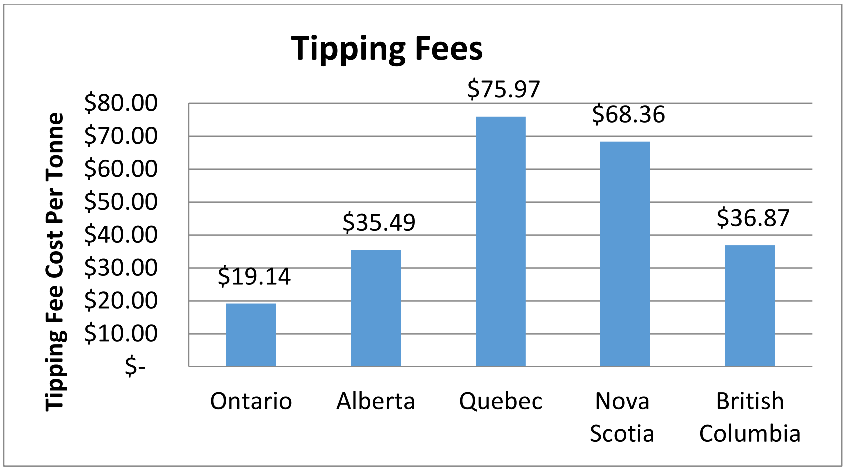


Figure 15: Operation of Recycling Facilities

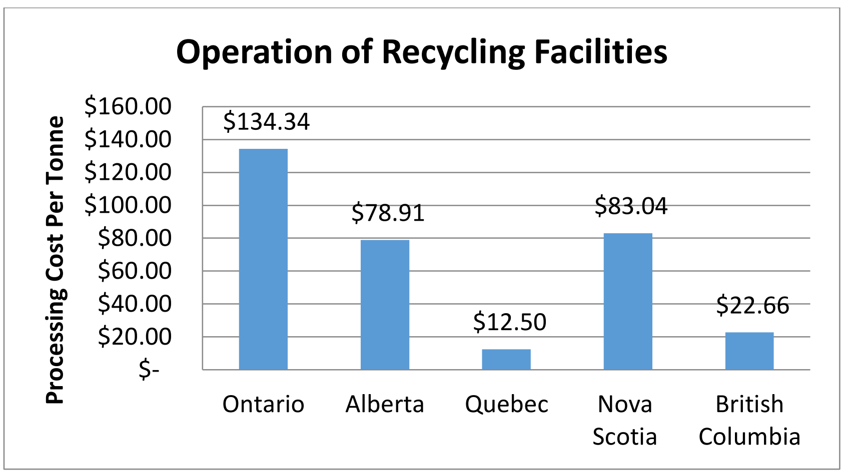


Figure 16: Operation of Transfer Stations

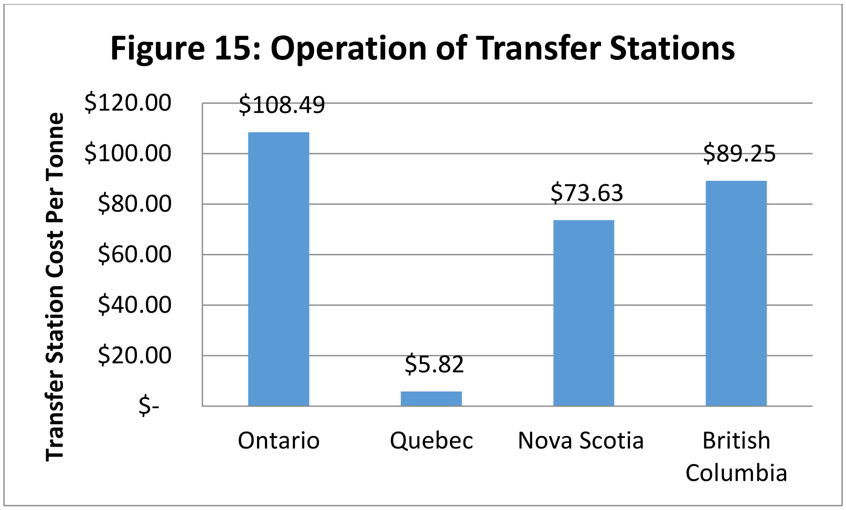
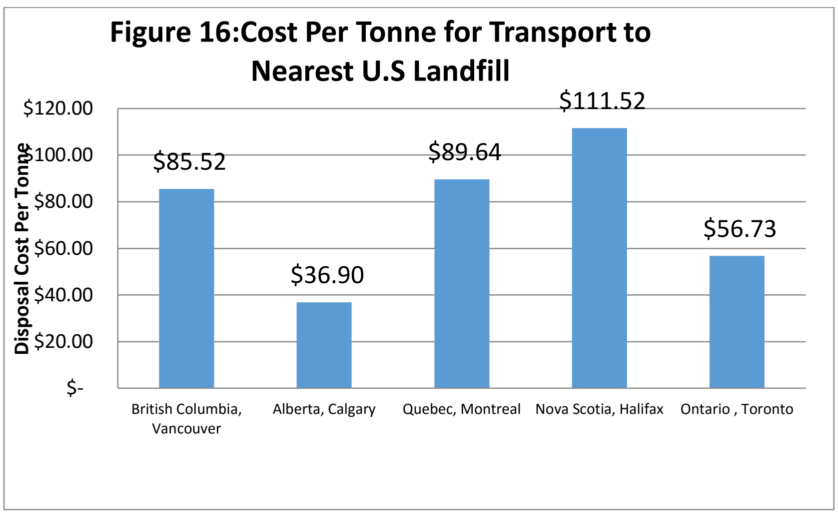


Figure 17:Cost Per Tonne for Transport to Nearest U.S Landfill



The following inferences can be drawn from the above graphs:

- Provinces with the lowest cost to dispose material (expressed as either provincial tipping fee or cost to ship material to U.S landfills) divert the least amount of material (Ontario, Alberta).
- Provinces with the lowest diversion rates also, on average, face higher costs of recycling. Provinces with the highest levels of diversion face both A) the highest cost of disposal and b) the lowest cost to recycle

*Table 25: **Interprovincial comparison of disposal and recycling costs***

Activity Type	Ontario	Alberta	Quebec	Nova Scotia	British Columbia
Total Tonnes (Disposed)	**5,083,500 T**	**2,297,149 T**	**2,107,422 T**	**165,524 T**	**1,256,163 T**
Total Tonnes (Diverted)	**598,268 T**	**330,585 T**	**1,012,706 T**	**94,337 T**	**582,942 T**
Diversion Rate %	**11%**	**12.58%**	**32.46%**	**36.30%**	**31.70%**
Transportation	$ 83.29	$ 58.41	$ 111.97	$ 114.84	$ 75.81
Tipping Fees	$ 19.14	$ 35.49	$ 75.97	$ 68.36	$ 36.87
Operation of Disposal Facilities	$ 33.63	$ 23.53	$ 38.10	$ 178.78	$ 100.49
Operation of Transfer Stations	$ 108.49	$ -	$ 5.82	$ 73.63	$ 89.25
Operation of Recycling Facilities	$ 134.34	$ 78.91	$ 12.50	$ 83.04	$ 22.66
Other Expenditures	$ 21.89	$ 12.61	$ 16.47	$ 37.43	$ 21.37
Cost of Shipping Material to United States*	$ 56.73	$ 36.90	$ 89.64	$ 111.52	$ 85.52

One pay posit that the reason for differences in diversion across provinces may simply be economic in nature – it's not necessarily that other provinces are performing "better" than Ontario, but rather, they do not enjoy the same cost advantages when it comes to disposal. The net result of these unique challenges is that IC&I waste generators, rather than product manufactures, tend to pay directly for the cost associated with waste diversion. Limited data is available to provide a clear picture of the types and volumes of materials that each IC&I sector produces. As of 2014, the Ontario Ministry of the Environment was undertaking a comprehensive review of the IC&I program and exploring options to amend or repeal the existing regulations.

4.3 Description of legislated and voluntary recycling initiatives in Ontario

This section undertakes a high level overview of the legislated and voluntary recycling initiatives presently in place in Ontario. While the focus of this study is on Blue Box recycling, it is important to highlight that the Blue Box program is only one of several mandatory recycling programs that exist under the Waste Diversion Act. Several voluntary initiatives also compliment the Waste Diversion Act to address the management of non-obligated (but potentially environmentally burdensome) materials. What is interesting to note is the apparent disconnect between the range of materials covered by recycling programs and diversion performance. While either voluntary or mandatory recycling programs exist for the full range of materials found in Ontario's waste stream, overall diversion remains quite low (as noted in section 4.2). It should be noted that the recycling performance of mandatory programs is materially higher than voluntary initiatives - an expected result. As shown in table 25, most voluntary initiatives fail to keep track of overall generation and diversion rates.

Breakdown of waste diverted: programs under the Waste Diversion Act, 2002

The Waste Diversion Act (WDA) establishes waste diversion programs through arm's length, not-for-profit organizations. Waste Diversion Ontario oversees program development and implementation, while the industry-funding organizations (Stewardship Ontario; Ontario Tire Stewardship; Ontario Electronic Stewardship) report to WDO on targets achieved, operate the programs, and levy fees on producers to cover program costs. The Minister of the Environment may issue policy direction to WDO and is responsible for enforcement, but does not otherwise have a direct relationship with the IFOs under the WDA.

Table 26: ***Legislated Recycling Programs in Ontario under the Waste Diversion Act***

Program Name	Wastes Managed	Implementing Organization(s)	Tonnes Managed[2]	Diversion / Collection rate[3]	Waste generated as approx. % of total ON generation[4]	Source of waste
Blue Box	Packaging comprised of: • Glass • Metal • Paper • Plastics • Textiles Printed paper (e.g., newsprint, magazines)	Municipalities responsible for delivering services to residents. Stewardship Ontario is responsible for funding 50% of net municipal costs.	892,924 diverted (2012)	63%	12%	Residential

[2] MHSW and WEEE programs use "collection" rather than "diversion" to measure performance, as these programs are intended to recycle or safely dispose of wastes.
[3] Diversion/collection rate is listed as a percentage of tonnes available for diversion/collection.
[4] This column shows the total wastes available for diversion/collection in each program, as a percentage of total non-hazardous waste generated in Ontario.

Municipal Hazardous or Special Waste Public name: "Orange Drop"	Nine types of waste, including: • Paints and solvents • Single-use batteries • Antifreeze and coolants • Fertilizers • Pesticides • Empty oil containers and oil filters • Propane tanks and other pressurized containers	Stewardship Ontario	28,280 collected (2013)	66%	0.4%	Residential/small quantity IC&I
Used Tires	Tires (e.g., passenger tires, off-the-road tires)	Ontario Tire Stewardship	170,184 diverted (2013)	109%	1.3%	Residential/IC&I
Waste Electrical and Electronic Equipment	Forty-four wastes, including: • TVs and monitors • Computers • Mice and other peripherals • CDs, DVDs, and players • Phones • Printers, photocopiers • Radios • Audio-visual equipment	Ontario Electronic Stewardship	76,764 collected (2013)	63%	1.1%	Residential/IC&I

Breakdown of waste diverted; other programs operating in Ontario (using data from most recent year available)

The following waste diversion programs operate in Ontario, but not under the framework of the Waste Diversion Act, 2002. Programs under the EPA and the Ministry of Finance must report to the ministry of Environment or Finance respectively on the outcomes achieved; there is no external oversight body similar to Waste Diversion Ontario. Voluntary programs have no reporting requirements or oversight, and as a result, detailed program results often are not publicly available. Because most programs manage a relatively small amount of material and do not provide public information on tonnages available for collection/diversion, it is not possible to accurately estimate the tonnes managed as a percentage of non-hazardous waste generated.

Table 27: **Voluntary Recycling Programs in Ontario**

Framework	Program Name	Wastes Managed	Implementing Organization	Tonnes Managed[5]	Source of waste
Environmental Protection Act	Ontario Medications Return	Pharmaceuticals	Health Products Stewardship Association[6]	331 tonnes collected (2013)	Residential
	Ontario Sharps Collection	Sharps	Health Products Stewardship Association[7]	212 tonnes collected (2013)	Residential
Ministry of Finance	Ontario Deposit Return Public name: "Bag it Back"	Alcohol beverage containers (plastic, metal, glass, or any combination) and packaging	Brewers' Retail Inc. is responsible for collection and diversion. LCBO is responsible to fund the program.	302 million containers collected (80% collection rate); over 112,000 tonnes of packaging diverted (2012/13)	Residential/IC&I
Exemption from the *Waste Diversion Act, 2002*	The Beer Store Bottle Return[8]	Beer containers (metal, glass, plastic) and packaging	Brewers' Retail Inc.	2 billion containers collected (92% collection rate); over 333,000 tonnes of packaging diverted (2012/13)	Residential/IC&I

[5] Where programs use "collection" rather than "diversion" to measure performance, these programs' objectives are often to recycle and safely dispose of wastes.

[6] Individual producers are subject to the regulatory requirements, but the HPSA voluntarily reports on producers' behalf.

[7] Individual producers are subject to the regulatory requirements, but the HPSA voluntarily reports on producers' behalf.

[8] Brewers' Retail Inc. is exempted by the *WDA* from Blue Box requirements for packaging associated with beer but is required to report to WDO on the operation of its Bottle Return system. The *WDA* grants the Minister the regulatory power to lift this exemption and subject Brewers' Retail Inc. to Blue Box producer requirements.

None (Voluntary programs)	Return to Retail	Mercury-containing fluorescent lamps and bulbs	Rona; Lowe's; Ikea	N/A	Residential
	Take Back the Light	Mercury-containing fluorescent lamps and bulbs	Recycling Council of Ontario (environmental NGO)	1,961 tonnes collected (2008-2013)	IC&I
	Switch the 'Stat	Mercury-containing thermostats	Summerhill Impact (consultancy)	25,000 units collected (2006-2010)	Residential/IC&I
	Recycle My Cell	Cell phones and accessories	Canadian Wireless Telecommunications Association	Over 580,000 units collected (2005-2012)	Residential/IC&I
	Call2Recycle[9]	Rechargeable batteries, cellphone batteries	Call2Recycle Canada	100 tonnes collected per year (on average, between 1997 and 2013)	Residential/IC&I

[9] Call2Recycle Canada has submitted for WDO's consideration an Industry Stewardship Plan to manage single-use (non-rechargeable) batteries. Call2Recycle Canada indicated its intent to continue to manage rechargeable batteries in Ontario.

	Selected Household Hazardous Waste Initiative Public name: "Phase2"	Wastes formerly included in MHSW: • Rechargeable batteries • Portable fire extinguishers • Fluorescent light bulbs and tubes • Mercury-containing devices • Pharmaceuticals and Sharps	Municipalities responsible for delivering services to residents. Government (through a grant administered by the Recycling Council of Ontario) is responsible for funding program costs (3 year commitment).	388 tonnes collected (estimated annual collection based on 2012-2013 data)	Residential/small quantity IC&I

4.4 History of Blue Box Recycling

A meaningful examination of solid waste management in Ontario is best informed by the context of its historical evolution. It is as part of this history that the structure, scale and operation of municipal solid waste management (MSWM) systems today may be better understood.

The switch from refillables to recyclables beverage containers during the 1980s resulted in significant increases in household waste generation in Ontario. The infrastructure to collect and manage recyclable containers was still very much in its infancy, and by the late 1980s, Ontario was faced with a looming crisis in landfill capacity (Pollution Probe, 1997). Despite repeated efforts by the Minister of the Environment (MOE) to abolish the use of non refillable containers, the beverage industry ultimately prevailed in striking down any proposed legislation. Beverage brand owners threatened job cuts and facility closures if the mandatory use of refillable containers were imposed (Pollution Probe, 1997). These threats were taken quite seriously, as the economic recession of the early 1980s forced policy planners to prioritize job preservation.

As a compromise solution, the provincial government drafted Regulations 340 and 357 under the Environmental Protection Act. These regulations were designed to promote recycling, while also trying to ensure that refillable beverage containers would continue to be sold (McRobert, 1992). The regulations initially asked beverage brand owners to voluntarily bottle 40 % of products in refillable container. The remainder could be bottled in any recyclable container, but with a requirement these materials achieve a 50% recycling rate by December 1988 (McRobert, 1992).

To help achieve this diversion target, the Ontario Soft Drinks Association established Ontario Multi Material Recycling Incorporated (OMMRI), an industry funded organization tasked with funding and developing a curbside recycling program (McRobert, 1992). In 1987, OMMRI pledged 20 million dollars in funding over four years, which was matched by municipalities and the Ontario government to fund the Blue Box recycling program (McRobert, 1992).

The development of curbside recycling ultimately proved to be the death knell for Ontario's deposit return system for non alcoholic beverages. Despite the aforementioned regulatory requirements, the use of refillable containers declined to 3% by the end of the decade. At the same time, Ontario's curbside recycling program flourished, implemented in over 100 provincial municipalities by 1990 (McRobert, 1992).

4.4.1 The 3R policy platform in Ontario

By the beginning of the 1990s, the Ontario government and the MOE recognized that a deposit return system was unlikely to succeed in the province. Further to that point, household waste generation was at a historical high, while available landfill space was becoming increasingly scarce (McRobert, 1992). As such, the policy focus of the MOE shifted to prioritizing waste diversion and promoting the 3R platform of "Reduce, Re-use and Recycle". The Minister of the Environment launched the Waste Reduction Action Plan (WRAP) in February of 1991 (McRobert, 1992). The WRAP included a number of initiatives designed to promote waste diversion and the 3Rs. These included: regulatory measures; financial and technical support; public education; and the development of markets for recyclable materials (McRobert, 1992).

Table 28 below summarizes the 3R regulations that were implemented to further enhance the efficacy of WRAP.

*Table 28: **3R Regulations under the Waste Reduction Action Plan***

Regulation	Objective
Recycling and Composting of Municipal Waste (O. Reg. 101/94)	Every municipality with a population of 5,000 or more residents are obligated to operate a Blue Box program accepting at least five mandatory materials (MOE, 2011).
Waste Audits and Waste Reduction Work Plans (O. Reg. 102/94)	Designated organizations from the IC&I sectors are required to conduct annual waste audits. A waste audit highlights the types of wastes that are produced, the manner in which wastes are produced, and in what quantities they are produced, within an organization (MOE, 2011).
Industrial, Commercial and Institutional Source Separation Programs (O. Reg. 103/94)	Organizations must implement the use of a source separation program. As part of the source separation program, collection, handling and storage facilities must be provided for recyclable materials. A business must make reasonable efforts to ensure that the system is used and that source separated materials are reused or recycled (MOE, 2011).
Packaging Audit and Packaging Reduction Work Plans (O. Reg 104/94)	The regulation requires manufacturers, packagers and importers of packaged food, beverage, paper or chemical products to conduct a packaging audit and implement a packaging reduction work plan (MOE, 2011).

O. Reg 101/94 should be seen as a critical development in the evolution of Ontario's MSWM system. Household and municipal participation in recycling was no longer a voluntary initiative, but a legislative requirement. In many ways, Reg 101/94 symbolized Ontario's commitment to recycling as a core element of the province's sustainability strategy. The effects of the regulation were immediate, with the province's diversion rate increasing by 5% in the following year (Pollution Probe, 1997).

4.4.2 Funding the Blue Box Program: Building the relationship between industry and local government

Despite the successes of the Blue Box program, funding the recycling system remained a significant challenge. Revenue from recyclable material failed to meet expected levels, while the amount of material being managed by the residential recycling system increased by 50% over an eight year period (1990-1998) (Stewardship Ontario, 2012c). While industry continued to contribute financially towards the operation of the Blue Box program, municipalities struggled to cope with rising material management costs and became increasingly dependent on the government for financial assistance (Menzies, 1997).

By 1999, the Blue Box program teetered on the brink of insolvency, necessitating that industry and municipal actors collaborate to develop a more equitable and sustainable recycling solution. In 2000, a number of packaging organizations and municipal representatives signed a memorandum of understanding with the MOE to work towards achieving a sustainable municipal recycling system (CCME, 2009). The organization produced a report entitled "Achieving Sustainable Municipal Waste Diversion Programs in Ontario", which ultimately served as the precursor to the 2002 Waste Diversion Act (CCME, 2009).The Ontario Waste Diversion Act (WDA) came into effect on June 27, 2002, and was designed to "promote the reduction, reuse and recycling of waste and to provide for the development, implementation and operation of waste diversion programs" (Waste Diversion Act, 2002, c. 6, s. 1)

The Act also lead to the creation of Waste Diversion Ontario, a non-crown corporation tasked with promoting and maintaining sustainable waste diversion programs for Blue Box materials, hazardous and special waste, waste electronics, and used tires. On September 23, 2002, Blue Box Waste became the first waste to be designated under the WDA. Stewardship Ontario was named as the Industry Funding Organization (IFO) for the Blue Box Program (CCME, 2009).

The Blue Box Program Plan (BBPP) was approved by the MOE on December 22, 2003 and went into operation on February 1, 2004. Under provincial regulation 274/04, all producers of printed paper and packaging would pay a fee to finance the end of life management of material generated in the province (CCME, 2009). Producers were financially obligated to contribute 50% of reported municipal costs for the operation and maintenance of the Blue Box program. With this regulation, Ontario became the first province in Canada to implement an extended producer responsibility (EPR) scheme (CCME, 2009).

4.4.3 The implementation of extended producer responsibility and its importance to the circular economy

Ontario's transition to an EPR scheme marked a shift in the cost of managing end of life products from the local tax base to packaging producers (Deutz, 2009). While its implementation was initially met with opposition from the packaging industry, the MOE remained steadfast in their desire to move towards a full "Polluter Pays" system (Crittenden, 2006). To date, Ontario's partial EPR scheme remains the foundation for managing and financing the provincial Blue Box program. Table 29 below summarizes the underpinning policy rational for implementing EPR in Ontario (Adapted from Deutz, 2009 & Waste Diversion Ontario, 2012)

Table 29: ***Rational for EPR***

Rational
1. To transfer the costs of managing packaging waste from the local tax base to the producer and user of the product.
2. To provide a direct economic incentive for the producer of the package to reduce packaging materials and design packaging for improved recyclability.
3. To bring the expertise and resources of industry to bear for the design and ongoing management of comprehensive materials management systems (as opposed to local waste management systems).
4. As an initial step towards the development of a circular materials economy – where waste materials serve as feedstock for new processes (as opposed to the current norm: a linear extraction/production/consumption/disposal economic system).
5. To make the producer and consumer of the packaging fully responsible for the environmental impacts of it production, use and end-of-life management.

Point #4 is of particular importance, in that both the MOE and federal government have expressed their desire to design circular industrial systems as a means to minimize waste generation and environmental impacts (Mabee et al., 2011). Rooted in the principles of industrial ecology, the circular economy represents the final evolution of modern MSWM systems (Gertsakis, 2002). Waste generated by either households or the IC&I sector are used as inputs for production for other industrial processes.

While Ontario's Blue Box system does an effective job in recycling and repurposing waste, numerous challenges exist to achieving a closed loop system. Coincidentally, these challenges are a direct result of how packaging producers have responded to the evolution of Ontario's MSWM systems. The fees charged to packaging producers as part of the province's EPR system are calculated on a per tonne basis. As such, many packaging producers have opted to switch to light weight packaging (namely LDPE, PET thermoforms and polystyrene crystal) to minimize the impact of the fee. The issue with this is twofold, 1) consumers don't readily recognize these materials as being recyclable and 2) these items are voluminous but not very heavy. This not only results in less material being placed in the Blue Box, but lower tonnages (and thus, lower recycling rates) for the material that is collected. The impact of these changes have been significant, as Ontario's recycling rate stagnated at 68% in 2010, and subsequently declined to 63% in 2012 (Stewardship Ontario, 2013).

4.5 Blue Box waste characterization and trends (Material Specific)

This section provides a high level overview of how the composition, costs and revenues for Blue Box materials have changed over the past decade. The purpose of this section is to identify trends in the data to project how material costs, revenues and tonnage have changed in the past and may change in the future.

For the purposes of this analysis, the 23 Blue Box materials accepted by municipalities have been collapsed into 9 like categories. This was done to better facilitate comparisons within material groups and organize the data in a more coherent fashion. Table 30 below summarizes how the material categories were grouped:

Table 30: ***Blue Box Material Categories***

Material Category	Materials Included
Newsprint	Newsprint –CNA/OCNA Newsprint – Non CAN/OCNA
Mag, Tel, OPP	Magazines and Catalogs Telephone Books Other Printed Paper
OCC & OBB	Corrugated Cardboard Boxboard
Composite Paper	Gable Top Cartons Aseptic Containers Paper Laminants
PET & HDPE	PET Bottles HDPE Bottles
Film, Lam, Poly, OP	Plastic Film Plastic Laminants Polystyrene Other Plastics
Steel	Steel Food And Beverage Cans Steel Aerosols Steel Paint Cans
Aluminum	Aluminum Food and Beverage Cans Other Aluminum Packaging
Glass	Clear Glass Colored Glass

It is important to caution readers against drawing any definitive conclusions regarding why material costs, recovery, generation etc. have changed. The drivers of these factors are complex, interconnected, and often, not readily identifiable. As such, attributing changes to any one source may prove erroneous.

Data used in this section was obtained from the Stewardship Ontario Fee Calculation Model (2002-2014) (Hence forth referred to as the Pay In Model (PIM Model) (http://www.stewardshipontario.ca/stewards-bluebox/fees-and-payments/)

Note: While the PIM model files available on the Stewardship Ontario website date back until 2003, it should be noted that the PIM models for years 2003 and 2004 were revised to use the 2005

PIM data. As such, their inclusion is omitted, as the data is identical across all three years. A total of 1208 data points (each representing a material's generation, recovery, revenue and gross cost per tonne) were included in the analysis.

Given that some of the materials included in the like categories had different values for revenue and gross costs (i.e. Telephone Directories receive revenue of $91.61 per tonne, while Magazines receive a revenue of $87.95 per tonne), weighted averages were calculated to reflect these differences (in lieu of taking the straight average of the group, which would not reflect the relative contribution of total tonnage)

4.5.1 Plotting how overall Blue Box Composition and Recovery has changed

Pie charts were graphed highlighting the relative contribution of each material category to the overall generation and recovery of Blue Box materials. For illustrative purposes, the years 2005 and 2014 are compared.

Figure 18: ***Breakdown of 2014 material generation***

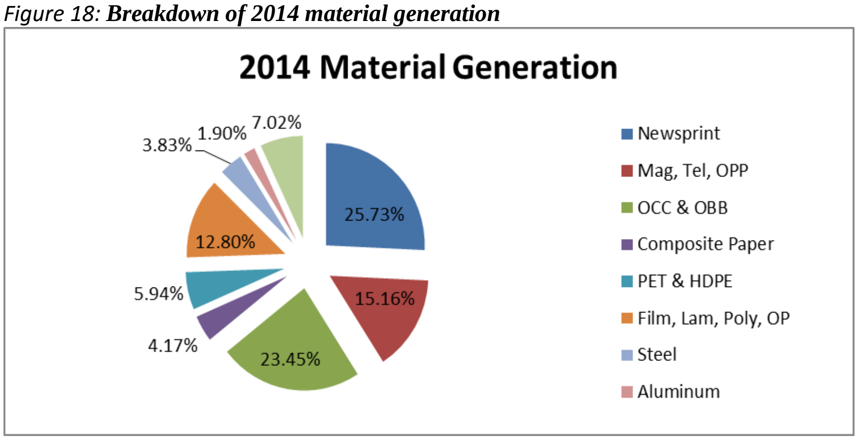


*Figure 19: **Breakdown of 2014 material recovery***

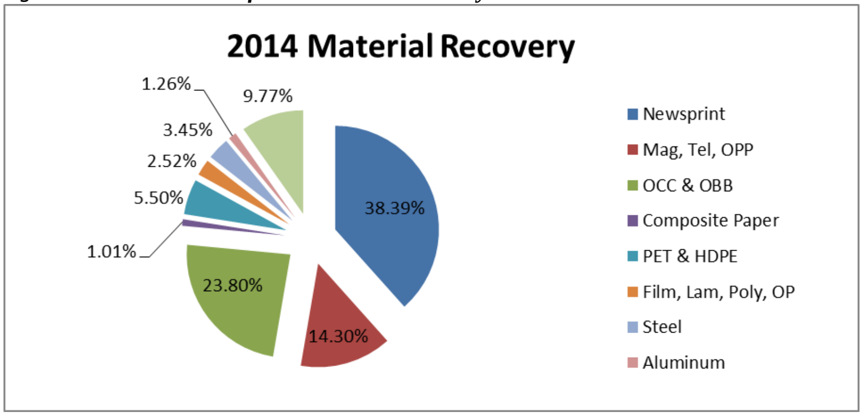


*Figure 20: **Breakdown of 2005 material generation***

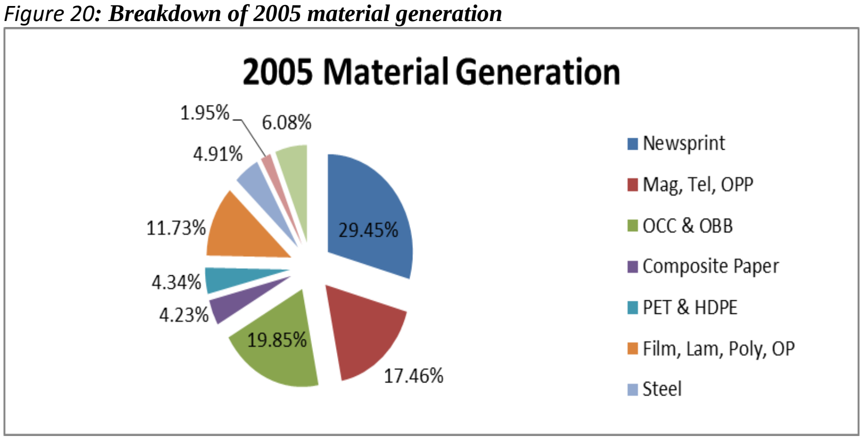
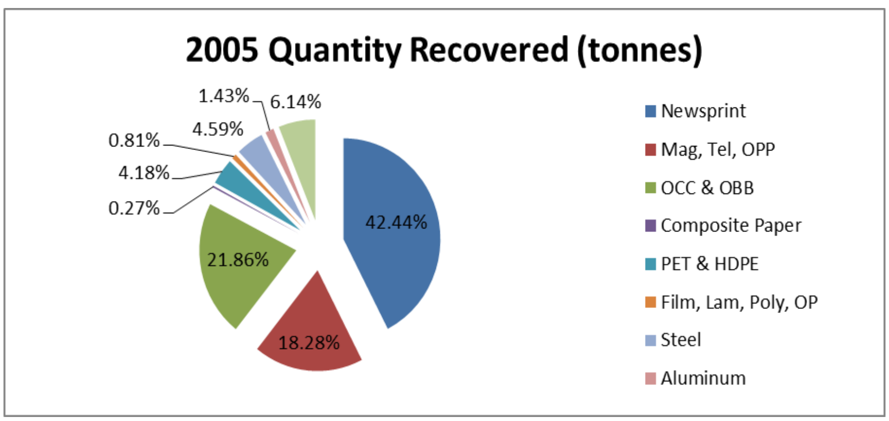


*Figure 21: **Breakdown of 2005 material recovery***



The results of year over year changes are summarized in Table 31 Below:

Table 31: **Changes in Blue Box Material Generation and Recovery**

Blue Box Material Categories	**% Change Generation 2005-2014**[10]	**% Change Recovery 2005-2015**
	(tonnes)	**(tonnes)**
Newsprint	-3.72%	-4.06%
Mag, Tel, OPP	-2.30%	-3.98%
OCC & OBB	3.60%	1.95%
Composite Paper	1.16%	0.74%
PET & HDPE	1.60%	1.32%
Film, Lam, Poly, OP	1.07%	1.72%
Steel	-1.08%	-1.14%
Aluminum	-0.04%	-0.17%
Glass (clear and colored)	0.94%	3.63%

Key findings:

- Printed Paper is declining as a % contribution to overall Blue Box generation and recovery
- Paper packaging is increasing as a % contribution to overall Blue Box generation and recovery
- Plastics and Composite Paper are increasing as a % contribution to overall Blue Box generation and recovery (the converse is observed for steel).
- Aluminum remain relatively unchanged with respect to their overall contribution to Blue Box Generation and Recovery

[10] Measured as change in percentage points

- The generation and recovery of light weight plastics such as Film, laminants and polystyrene has increased, while heavier materials such as telephone directories, newsprint and printed paper have decreased.

Note: The relative contribution to overall Blue Box generation and recovery may not change significantly over time for certain materials. This is due to the fact that they represent a small % of the total tonnes being generated/managed within the system (i.e. composite materials), and thus, even large year over year changes in their recovery and generation are unlikely to affect the relative contribution to Blue Box tonnages as a whole.

4.5.2 Graphing Trends in Generation, Recovery, Gross Costs and Revenue

For each of the 9 material categories, graphs were created plotting how material generation, recovery, gross costs (per tonne) and revenue (per tonne) have changed over time. Where appropriate, best fit and R^2 values were calculated and plotted to determine the strength of the trend given the data. Graphs for each of the 9 material categories outlined in Table 29 are shown below. A brief commentary explaining the general trends observed and potential short term trends are also offered.

4.5.2.1 Newsprint:

The following can be surmised from examining Figures 22 & 23 below. Newsprint generation is trending down over time. This result has moderate statistical support and is consistent with the prevailing opinions on the subject (i.e. newsprint is a dying medium being replaced by electronic media). Newsprint recovery has remained relatively consistent over time, trending up very slightly. There is insufficient statistical support to say that newsprint recovery is likely to stay the same moving forward. Given decreases in newsprint generation, it seems plausible that newsprint recovery will actually begin to decrease in a future time period.

*Figure 22: **Newsprint Generation and Recovery***

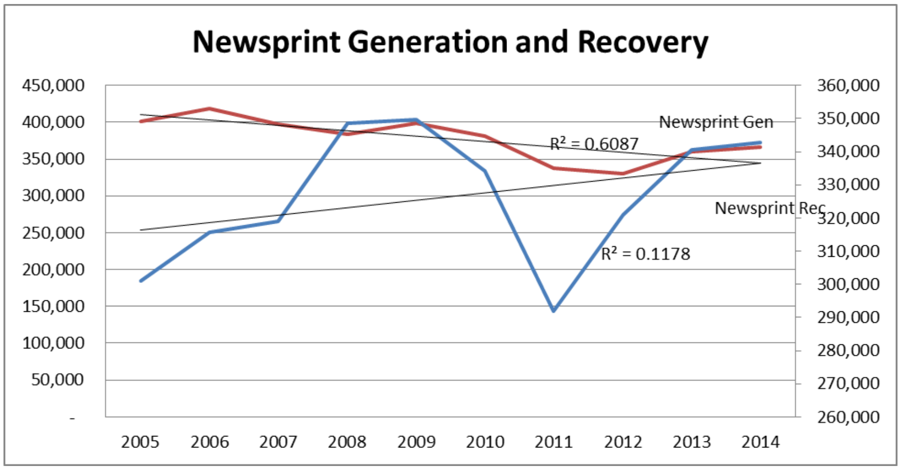
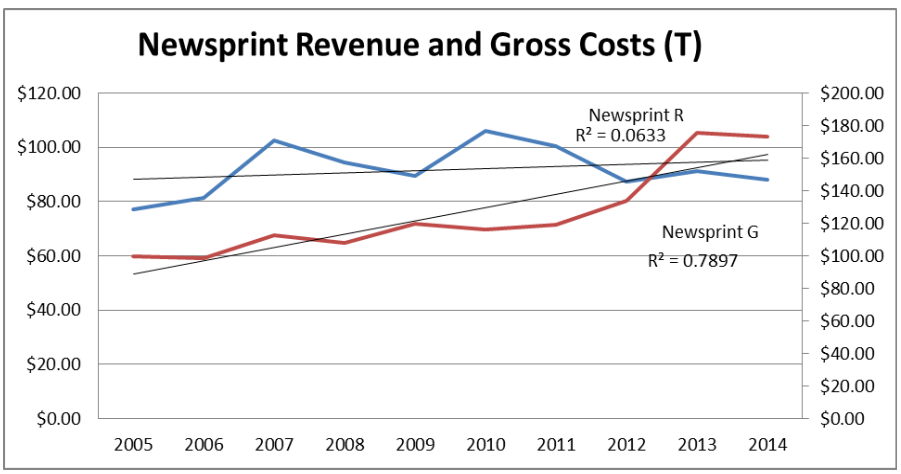


*Figure 23: **Newsprint Revenue and Gross Costs***



Newsprint revenue has fluctuated over time, but remains relatively flat as a whole. There is no statistical support suggesting expected revenue increases or decreases over time. The effect of decreasing newsprint generation on material revenues is indeterminate at this time. Decreasing generation leads to increased scarcity for recyclable material (increasing revenue price signal).

However, decreases in generation is indicative of a decrease in demand for the commodity as a whole (decreasing revenue price signal) Gross costs of material management for newsprint have increased significantly over time.

4.5.2.2 Mag, Tel, OPP

Magazines, telephone directories and Other Printed paper have experienced significant decreases in generation over the past decade (strong statistical support). This is once again consistent with the assumption that magazines and telephone are dated mediums.

Recovery of these materials has remained relatively flat over time, although there is a minor kink (point of inflection) in the trend (starting in 2012) that indicates decreased recovery over time. Realized revenue for magazines, directories and other printed paper has remained unchanged over the past decade. No discernable or statistically support trend exists indicating the future trend for revenue. Like with newsprint, the effect of decreasing Mag, Tel and OPP generation over time on revenue is indeterminate.

Gross costs of material management for Mag, Tel and OPP is trending up significantly over time.

Figure 24: ***Mag, Tel, OPP Generation and Recovery***

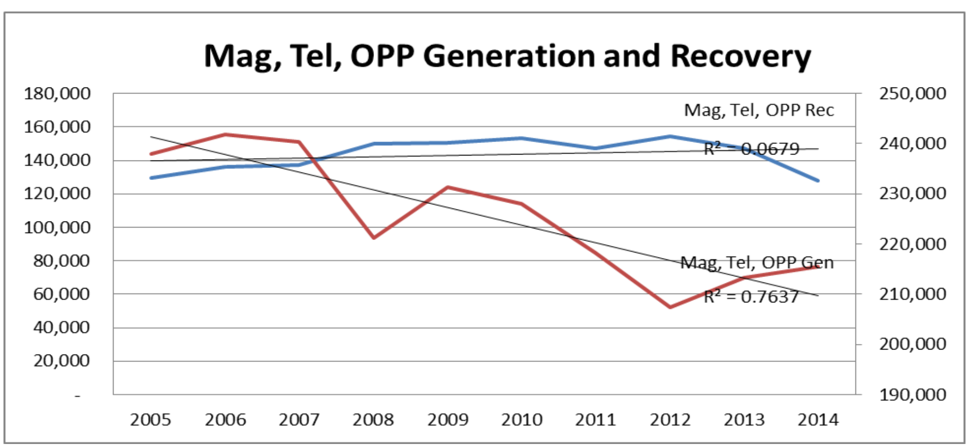
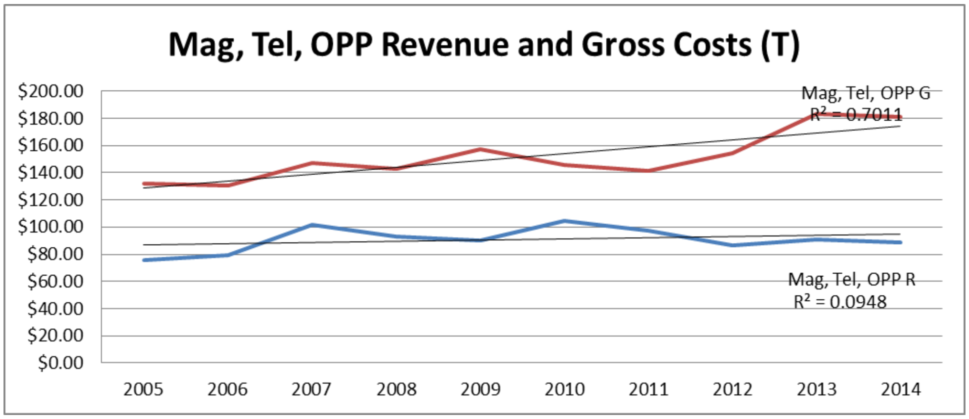


Figure 25: ***Mag, Tel, OPP Revenue and Gross Costs***



4.5.2.3 OCC & OBB

Both the generation and recovery of corrugated cardboard and boxboard have increased significantly over time (moderate statistical support). However, a kink is observed in the recovery of OCC and OBB in 2010, with a downtrend established in the following three years. As such, no reasonable projections regarding the future recovery of OCC and OBB can be made

Realized revenues for OCC & OBB are increasing significantly over time (strong statistical support). Gross costs of material management are indeterminate, as a significant break in the trend occurs between 2012 and 2013 (fall in costs).

Figure 26: ***OCC & OBB Generation and Recovery***

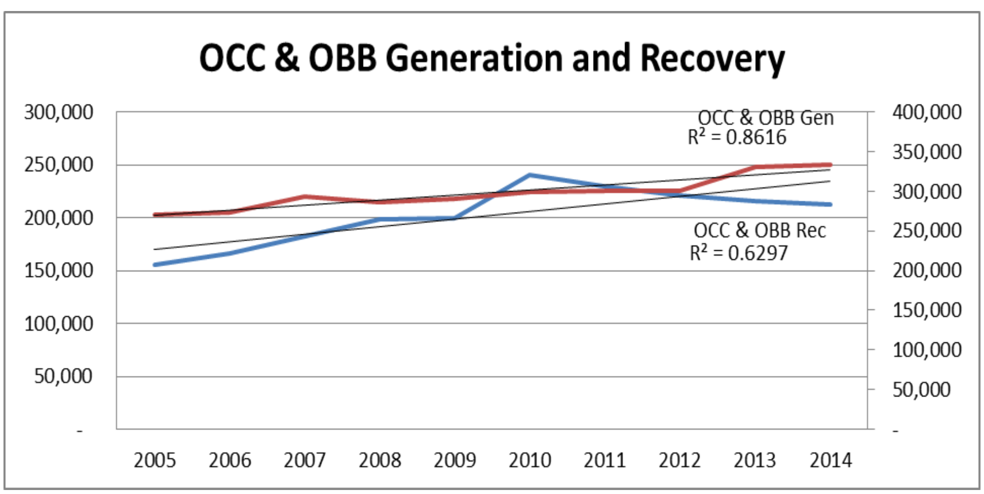
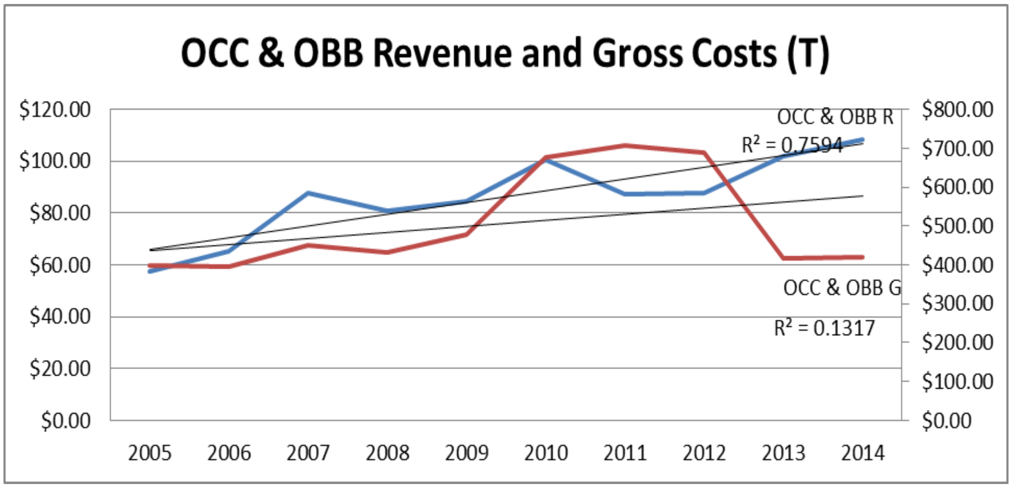


Figure 27: ***OCC & OBB Revenue and Gross Costs***



4.5.2.4 Composite Packaging

Recovery of composite packaging has increased significantly over the past decade (extremely strong statistical support) and there is a reasonable expectation that this trend is likely to persist into the future. These increases in recovery may be attributed to new recycling capacity and end markets being developed for composite packaging.

Generation of composite packaging is trending up slightly (weak statistical support) over time, although no projections can be reasonably made at this time. The realized revenue for composite packaging has increased significantly over time (see above reasons for explanation), with gross costs of material management remaining flat. A kink in the trend occurs between 2012 and 2013 that suggests a rise in gross costs, although additional observations need to be made before a trend emerges.

Figure 28: ***Composite Generation and Recovery***

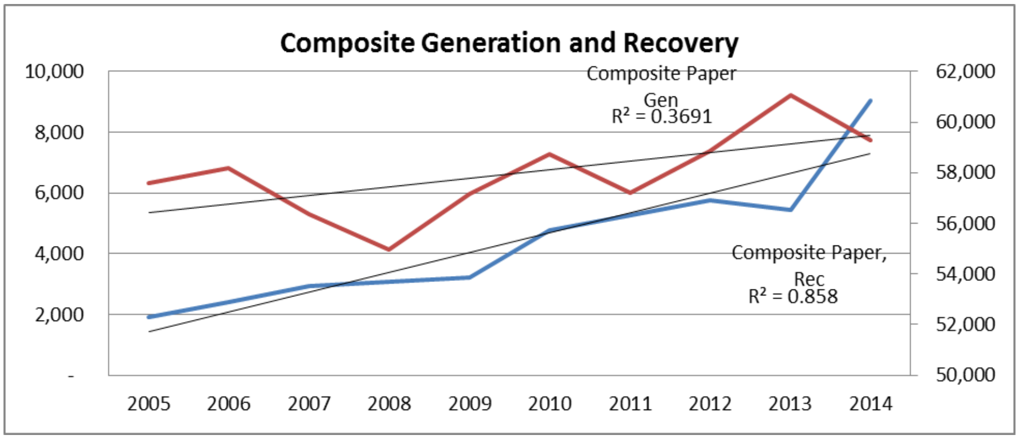
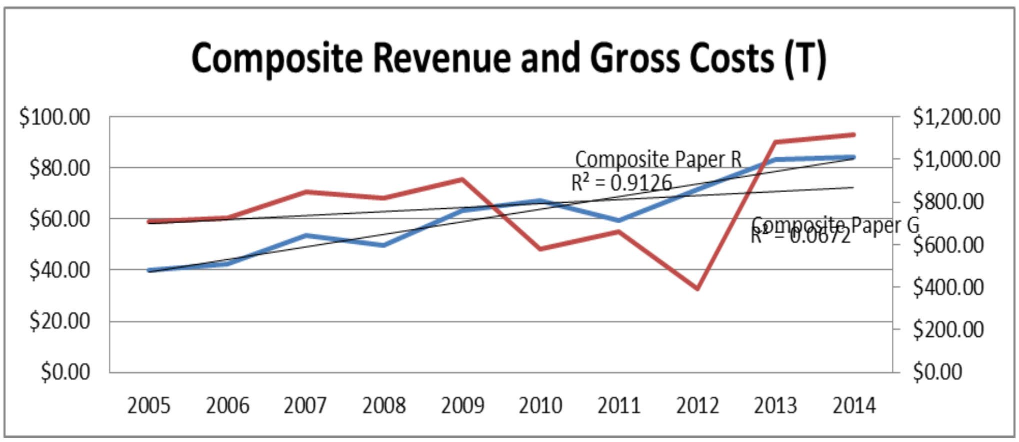


Figure 29: ***Composite Revenue and Gross Costs***



4.5.2.5 PET and HDPE

Both PET and HDPE generation and recovery are trending up significantly over time (strong statistical support). This trend is likely to persist into the future.

Revenues from the sale of PET have fluctuated significantly over time (as per the Ontario Price Sheet, plastics tend to be a volatile commodity), although the trend for revenue as a whole appears to be slightly upward. No discernable future trend can be extrapolated given the existing data points and R^2 values.

Gross costs of material management for PET and HDPE have increased significantly over time (strong statistical support). While the drivers of these costs are unable to be identified at this time, this trend is projected to persist into the future.

Figure 30: ***PET & HDPE Generation and Recovery***

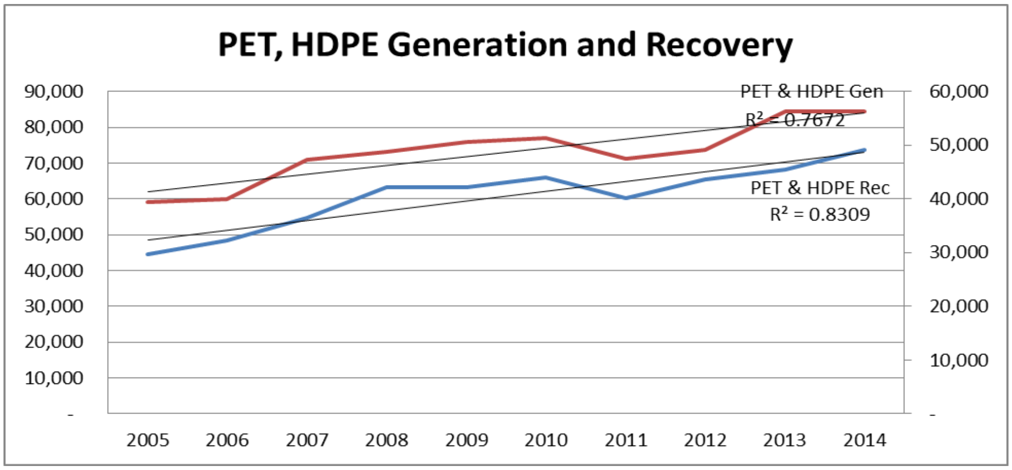
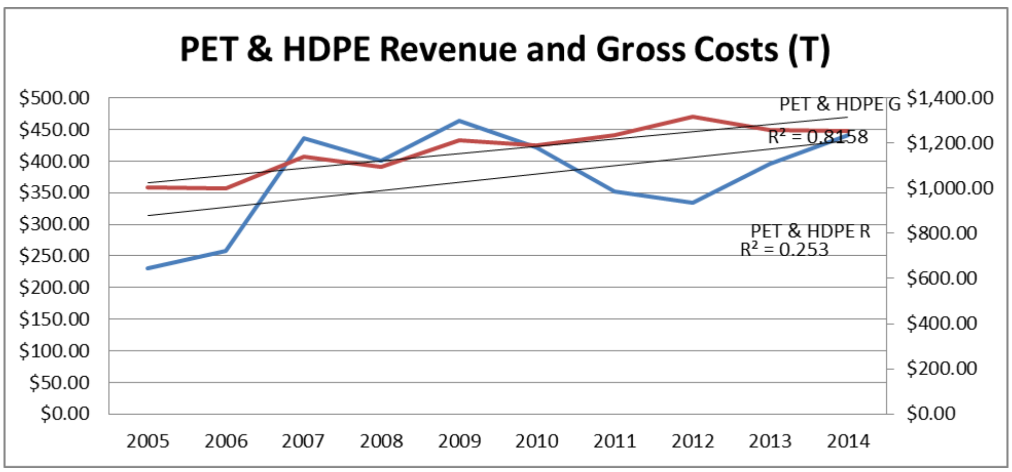


Figure 31: ***PET & HDPE Revenue and Gross Costs***



4.5.2.6 Film, Lam, Poly and Other Plastics

Both the generation and recovery of Film, Laminants, Polystyrene and Other Plastics is trending up significantly over time. This reflects an increasing trend by packaging producers to select light weight packaging like PET thermoforms, film and polystyrene crystal. This trend is likely to continue over time (strong statistical support)

Revenues from the sale of Film, Lam, Poly and OP have increased materially over time, however, as observed with PET and HDPE plastics, revenue prices tend to be quite volatile. Gross costs of material management are trending up, although only weakly.

Figure 32: ***Film, Lam, Poly, OP Generation and Recovery***

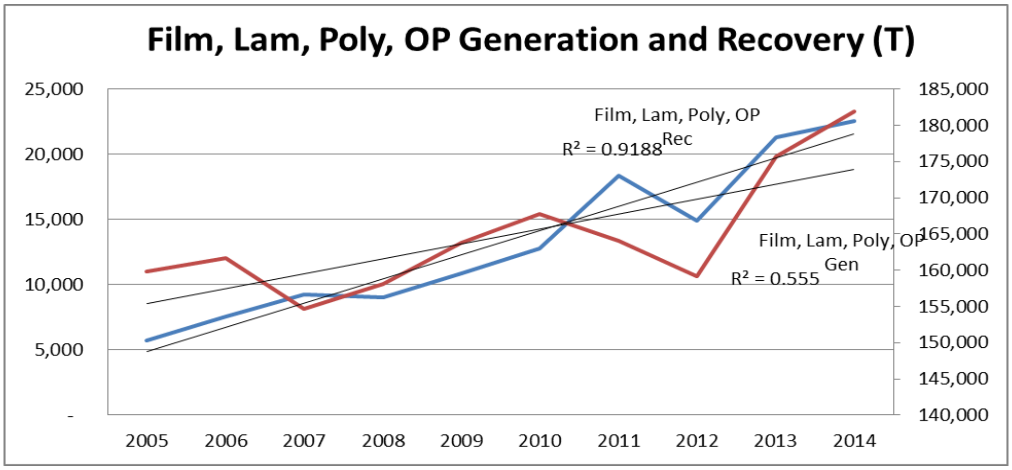
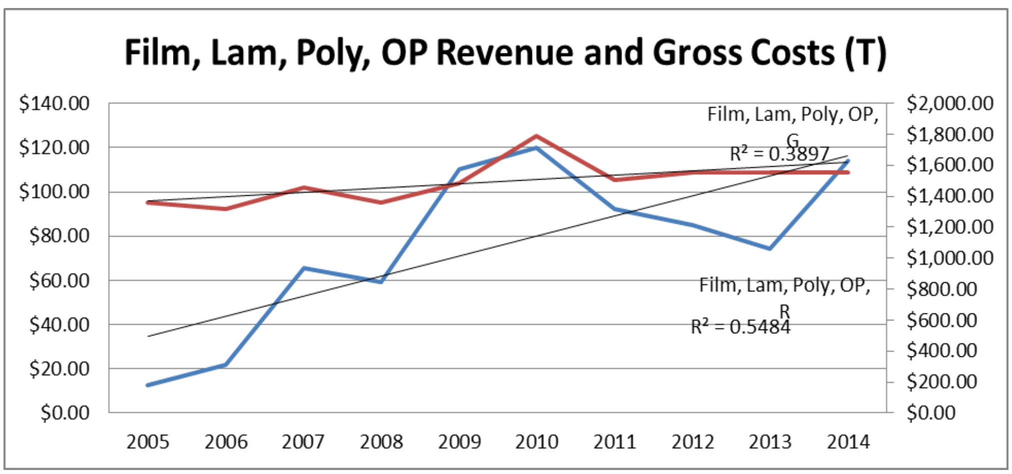


Figure 33: ***Film, Lam, Poly, OP Revenue and Gross Costs***



4.5.2.7 Steel

Both the generation and recovery of Steel is trending down over time (moderate statistical support). There is insufficient statistical evidence to project whether this trend is likely to persist.

Realized revenue and gross cost of material management for steel have increased significantly over time. While there is strong statistical support to suggest that this trend is likely to continue, the reasons for these increases are not readily apparent at this time.

Figure 34: ***Steel Generation and Recovery***

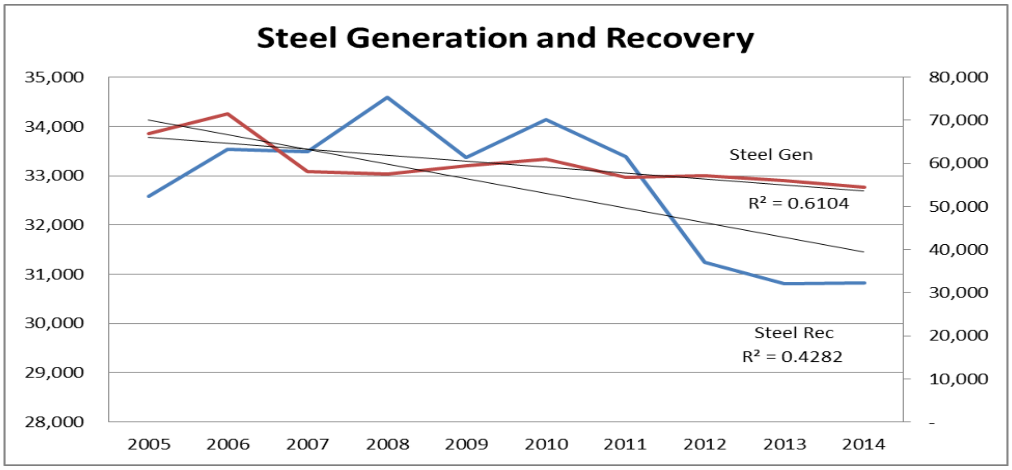
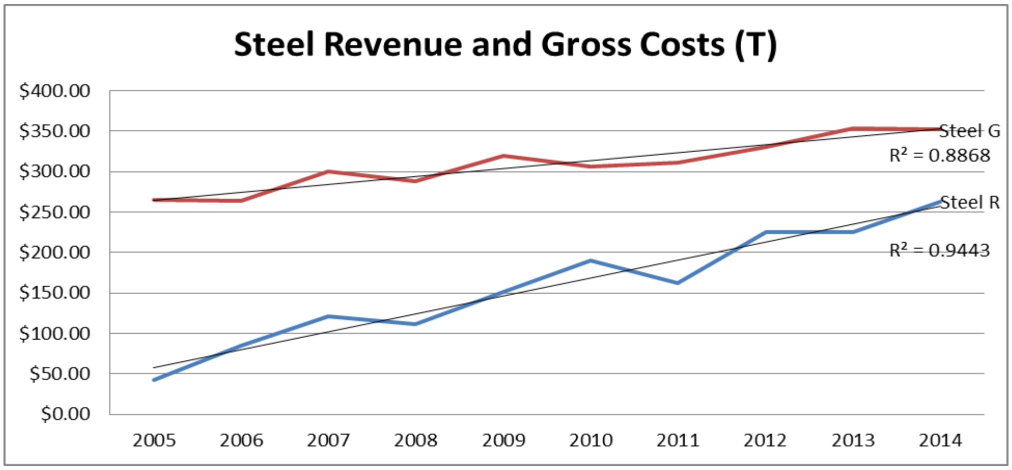


Figure 35: ***Steel Revenue and Gross Costs***



4.5.2.8 Aluminum

No discernable trend for the generation and recovery of aluminum was observed. While generation and recovery figures fluctuated significantly from year to year, when evaluated over the length of the study period, no material changes were observed. It should be noted that aluminum recovery will most likely be understated, as it is a target for scavengers who "pick" the material from residential blue boxes.

Revenue for aluminum has also remained relatively flat over time, although commodity prices did spike significantly between 2009 and 2010. Gross costs of material management have trended up significantly over time (very strong statistical support).

Figure 36: ***Aluminum Generation and Recovery***

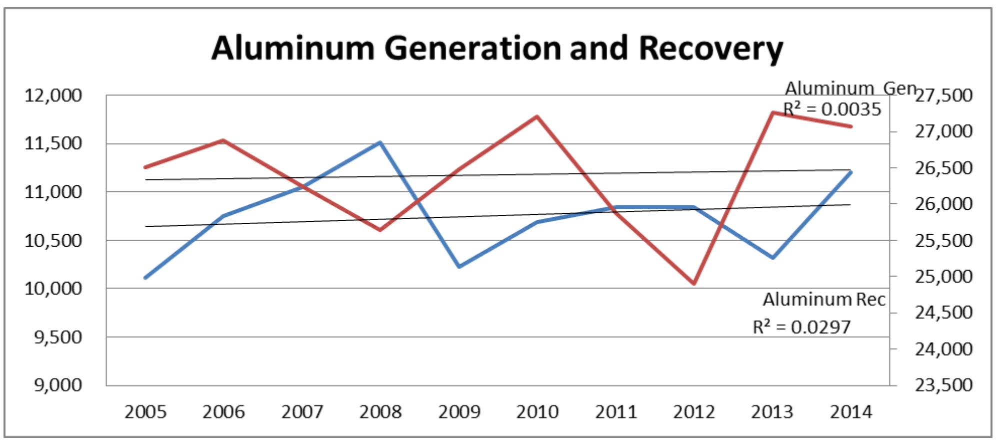
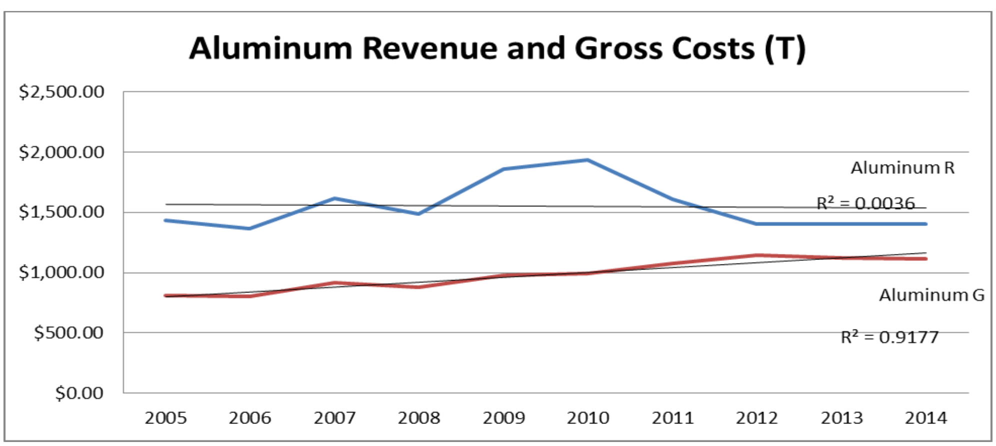


Figure 37: ***Aluminum Revenue and Gross Costs***



4.5.2.9 Glass

Both the generation and recovery of glass have increased significantly over time (moderate to strong statistical support). Revenues for glass cullet have also trended up, although it should be noted that traditionally, glass is a low (no) value material that is commonly used in aggregate applications. While revenues have increased, it is not in any way that would have a significant impact on a municipalities net cost. Gross costs of material management have decreased slightly for glass cullet.

Figure 38: ***Glass Generation and Recovery***

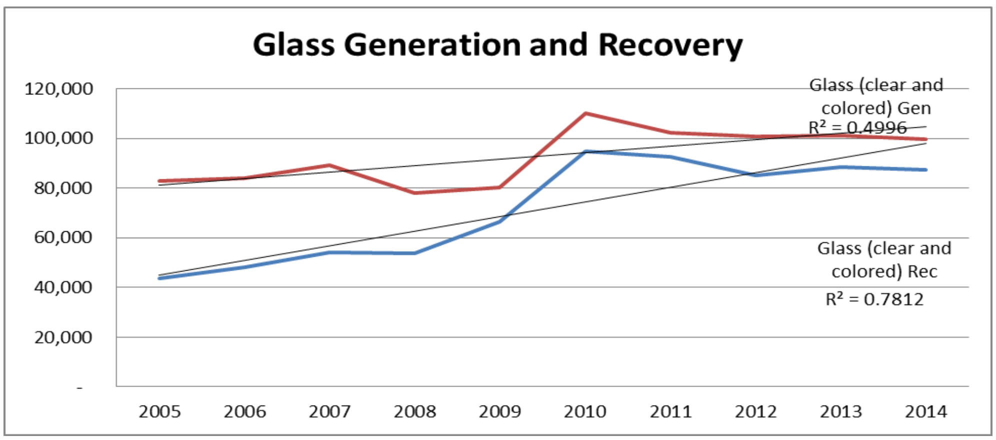
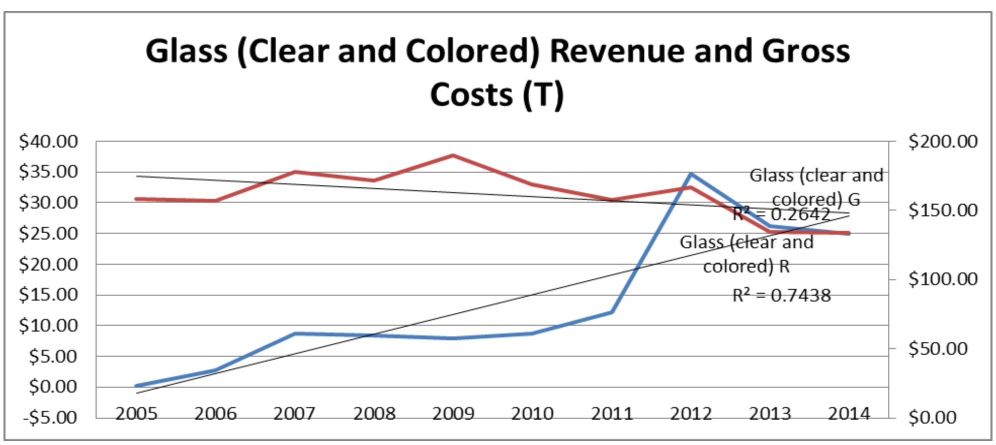


Figure 39: ***Glass Revenue and Gross Costs***



4.5.3 Summary comments on trends on material generation, recover and cost of material management

While the above analysis is a first step in identifying how material recovery, generation and costs have changed over time, some salient findings are outlined below:

1) The assertion that rising system costs are attributable to decreases in material revenue is erroneous: In 8 of the 9 material categories, material revenues are either trending up over time or remaining flat.
2) More than 80% of increases in total system cost is attributable to increases in the gross cost of material management – costs that are independent of revenue

Section 4.6 investigates why material management costs for Blue Box materials have been increasing over time.

4.6 Changes in Blue Box Component Costs

Since the formal inception of the Blue Box program under the Waste Diversion Act, the costs of managing the recycling system have increased by 78% over a nine year period (2002-2011) (Stewardship Ontario, 2012c). During this time, the provincial recycling rate has increased by only 10.4%. Packaging producers have expressed extreme concern over the inordinate rise in system costs relative to the increase in waste diversion (Stewardship Ontario, 2007). This section provides a high level overview of how Blue Box component and net costs have changed over the past 5 years. For the purposes of this discussion, component costs are defined as:

- Residential Collection Costs
- Residential Processing Costs

- Residential Depot/Transfer Station Costs
- Residential Promotion and Education Costs
- Administration Costs
- Interest on Municipal Capital

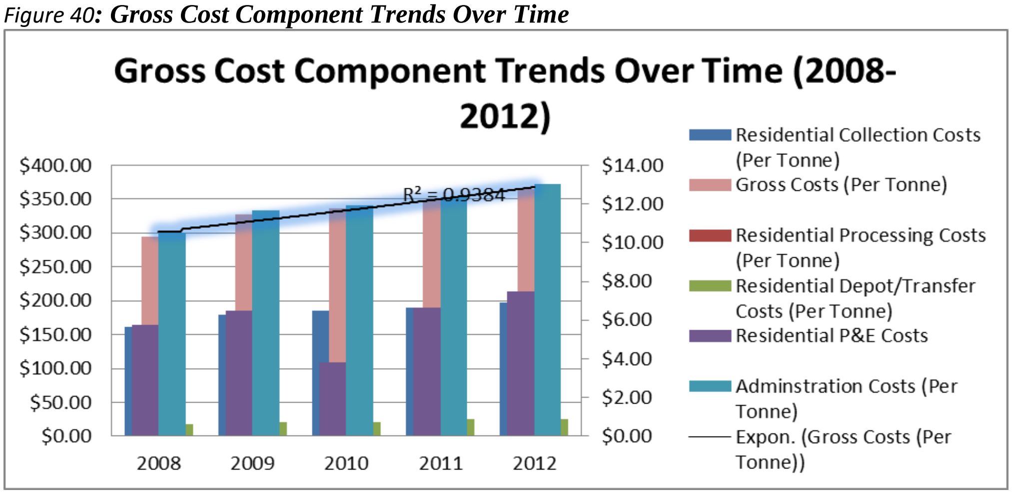
While data on municipal program costs date back to 2002, Waste Diversion Ontario requested that data years prior to 2008 be omitted from the analysis (as the data was not available for public use at the time).

4.6.1 Changes in Gross Costs Over Time

In an attempt to identify how costs have changed for the Blue Box component categories, gross cost per tonne figures were graphed over time. Where appropriate, best fit lines and R^2 values were calculated and applied to identify potential trends in the data.

Figure 40 below graphs how the costs for each of the Blue Box cost component categories have changed between 2008 and 2012.

Figure 40: ***Gross Cost Component Trends Over Time***



As shown above, each of the Blue Box cost component categories have increased each successive year between 2008 and 2012. A best fit trend line was applied to the gross cost per tonne data points, resulting in an R^2 of 0.94 and a positive slope of 14.06 (Very strong relationship indicating upwards trajectory of gross costs). This would suggest that the gross costs of material management are expected to increase into the future.

Table 32 below summarizes the percentage cost increases for each of the cost component categories:

Table 32: **% Cost Increases for each component cost category (2008-2012)**

	Residential Collection Costs (Per Tonne)	**Residential Processing Costs (Per Tonne)**	**Residential Depot/Transfer Costs (Per Tonne)**	**Residential Promotion & Education Costs (Per Tonne)**	**Interest on Municipal Capital (Per Tonne)**	**Administration Costs (Per Tonne)**
2008-2012 Change	22%	23%	49%	30%	8%	24%

4.6.2 Relative Contribution of Costs

The relative contribution of each cost component category to total reported gross costs was calculated and graphed in an attempt to determine whether a certain cost category (i.e. residential collection costs) are driving costs more/less relative to other categories.

Figures 41 and 42 below graphs the relative contribution of each of the Blue Box component cost categories to the total gross cost between 2008 and 2012 (measured on a per tonne basis).

Figure 41: ***Breakdown of Recycling Costs (2008)***

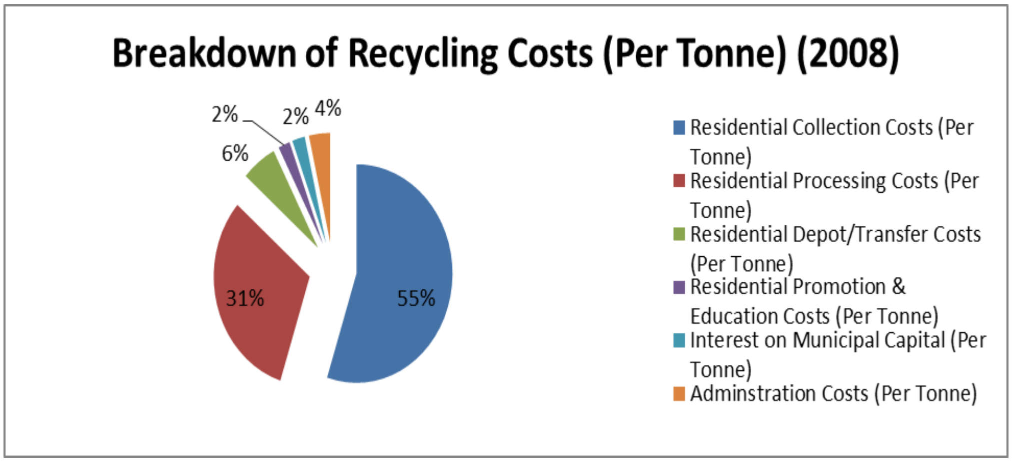
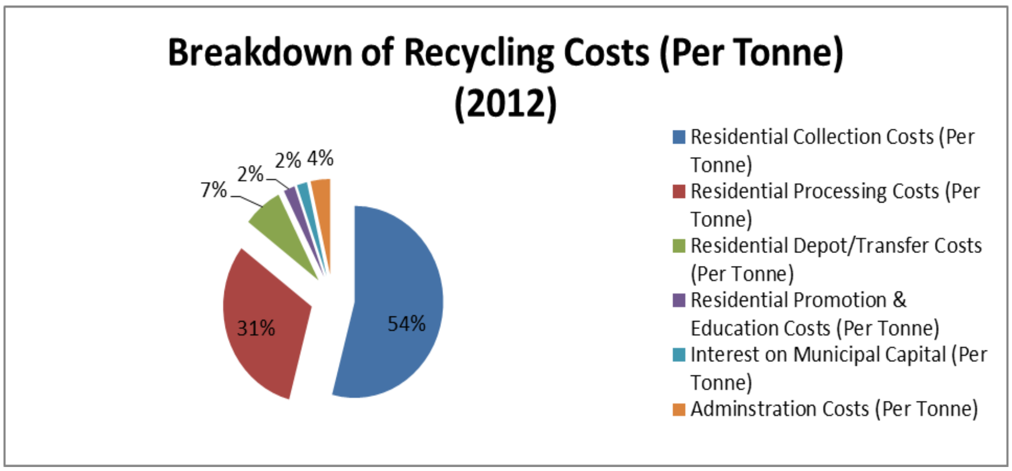


Figure 42: ***Breakdown of Recycling Costs (2009)***



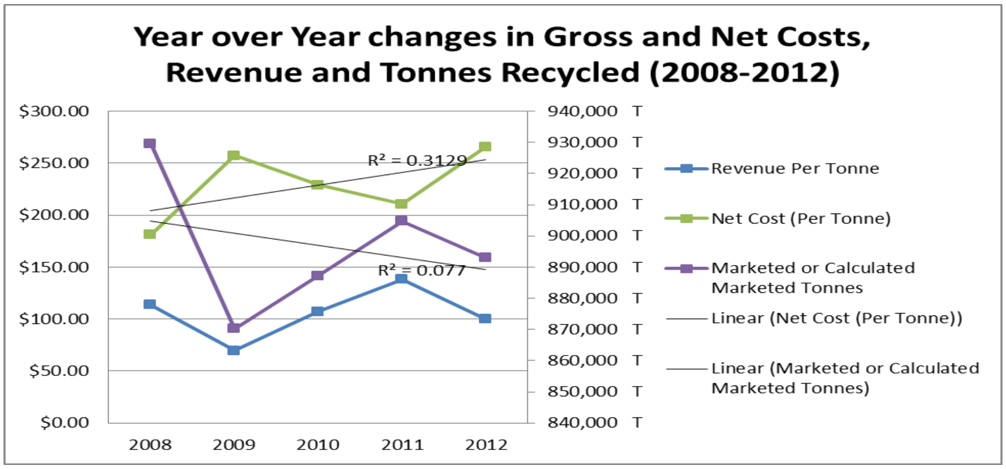
While the results in Table 30 seemingly suggest that there are differences in the percentage increase of costs for each of the cost component categories (between 2008 and 2012), the above pie charts show that the relative contribution of said categories to the total gross costs remains unchanged. This is because two of the cost component categories (Collection and Processing) accounts for nearly 86% of the total gross material management costs. Thus, even significant changes in the cost of administration or promotion and education are unlikely to affect the relative breakdown of costs as a whole.

4.6.3 Changes in Revenue and Net cost Per Tonne

Revenue figures for municipalities were calculated and graphed to determine how changes in revenue have affected the net cost per tonne over the past 5 years. As shown in figure 43, net cost per tonne and revenue received from the sale of material has fluctuated over time. While net costs per tonne appear to be trending up over time (possibly in part due to the rising gross costs of material management), the significance calculation was too low to draw any meaningful inferences. These data points were also plotted against the total amount of material marketed by municipalities for each of the 5 years included in this study. Once again, while the total number of tonnes marketed has decreased over the past 5 years, no definitive trend could be established.

Of note, the years 2009 and 2010 are generally considered outliers relative to a normal operating year. The economic recession of ‘09, followed by the subsequent recovery in ‘10, resulted in radical swings in the amounts of material generated, recovered and the revenues received by municipalities. Inclusion of these two years in the data set may obscure the overall trends for revenue, tonnes marketed and net costs. However, when weighed against the issues that arise from omitting these two years from the data set, the decision was made to include all years in the analysis.

Figure 43: ***Changes in Gross and Net Costs, Revenues and Tonnes Recycled, 2008-2012***



Individual material management costs were also analyzed in an attempt to (in part) explain the changes observed in component category costs over time. Some salient findings include: Collection, Processing, Depot, Administrative, P&E and Interest costs are increasing over time. However, the relative contribution of each of the above cost categories to gross cost remains unchanged. Revenue received and (and thus, net cost of material management) is fluctuating over time. There is no statistical support to comment definitively on the trends for revenue and net cost. Total quantities of Blue Box material being managed by the system is also fluctuating over time. While total units of packaging sold/generated into the province has increased over the past decade, using strictly weight based metrics (tonnes) to measure overall generation reveals no definitive trend.

With this in mind, we must consider why the gross costs of material management are increasing, and place it within the context of changes to the recycling system as a whole. Changes in the types of material being generated and recovered have been cited as a primer driver of component costs over the past 5 years.

4.6.4 Changes in the Packaging mix

Using the PIM models provided by Stewardship Ontario, I examined whether changes in the types of material being managed by the system influence gross material management costs. Figures 44 & 45 below provide a quick snapshot of how municipalities are recovering greater quantities of "high cost" material (defined as having a net cost exceeding $700 a tonne, ex. Plastic Film, Polystyrene) over time, while capturing less of the "low cost" materials (defined as having a net cost lower than $250 a tonne, ex. Newsprint, OCC). For illustrative purposes, the percentage contribution of high vs. low cost materials for the years 2014 and 2005 are also provided (to show how the types of materials being recovered are changing over time)

Figure 44: ***Quantity of Material Recovered (High Cost Material)***

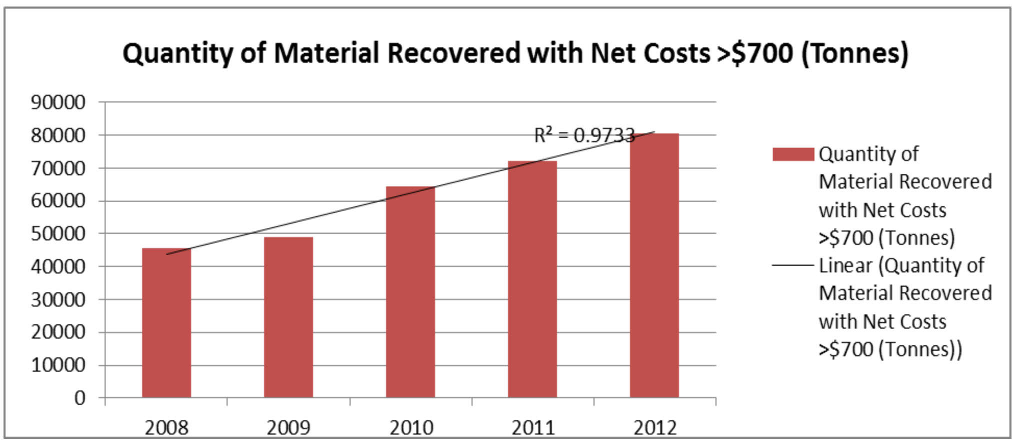


Figure 45: ***Quantity of Material Recovered (Low Cost Material)***

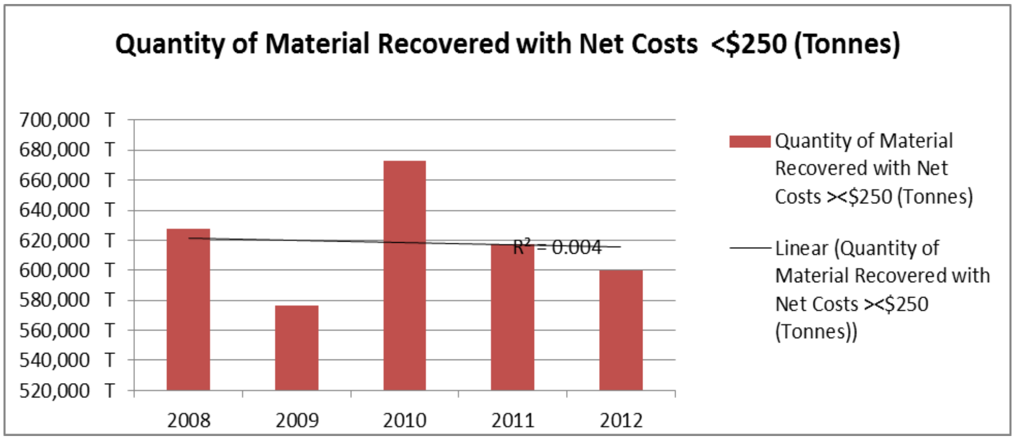


Figure 46: ***Recovery of High vs. Low Cost Materials (2014)***

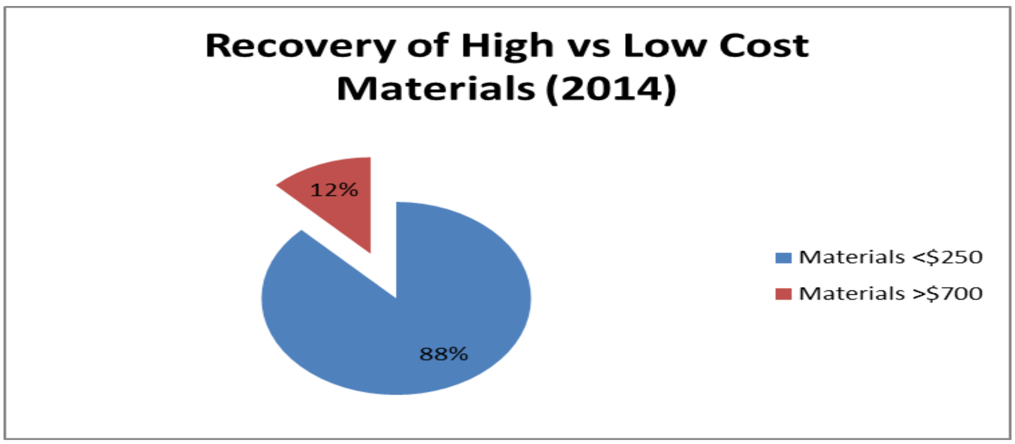
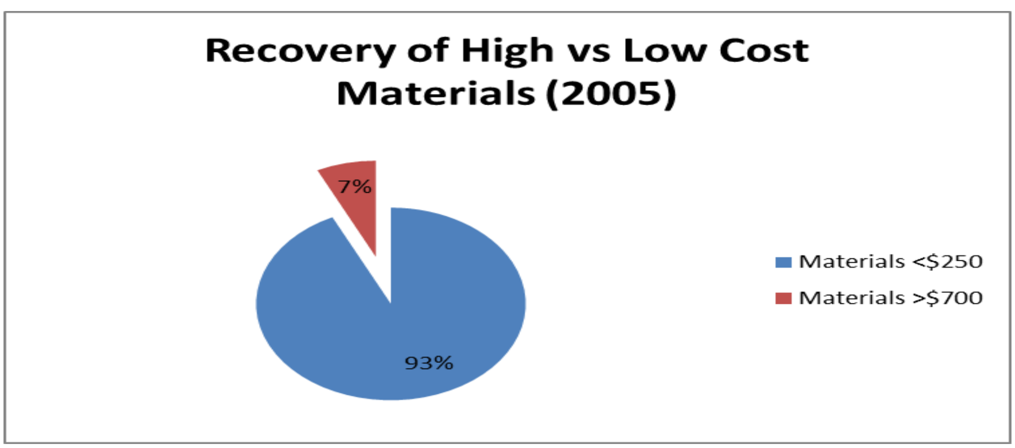


Figure 47: ***Recovery of High vs. Low Cost Materials (2005)***



From the above pie charts, we observe that the relative contribution of ``high cost" material is increasing (where high cost is defined as a material with a net cost per tonne exceeding $700). The converse is also true, in that the relative contribution of low cost materials (expressed as a % of the total number of tonnes being managed within the system) is decreasing.

4.6.5 Summary of changes to Blue Box component cost categories

Though the above analysis offers some very tentative explanations for rising material management costs as a whole, it does little to explain the increases in cost for individual cost component categories. Why does changing the types of material being recovered increase collection or administration costs? Are there drivers of cost being omitted from the aforementioned analysis that better explain why costs have changed the way they have? Answering these questions necessitates significant additional research and analysis.

4.7 Chapter Summary

In this chapter, I provided an overview of the state of recycling in Ontario, including detailed discussions on the types of material being generated and diverted and the economics of Blue Box recycling. I also described how Blue Box generation, recovery and costs have changed over time, and identified trends in the data to suggest that material management costs are increasing inordinately relative to the quantities of material being recovered. While it is difficult to specifically isolate the cause for rising system costs, there is evidence in the data to suggest that high cost "fringe" materials now comprise a larger share all material being generated in the province. Given that there is strong statistical support to suggest that this trend is likely to continue into the future, policy planners need to take a step back and identify not only how to reverse these trends, but develop policies that optimize the mix of materials being recovered. While increased recycling should continue to be a policy priority, we need to recognize that the most sustainable recycling system isn't necessarily the one that diverts the most material. A recycling system that does not encourage cost containment cannot be considered tenable in the long run.

Chapter 5: Evaluation of Best Practice Policies

This chapter undertakes an extensive review of Ontario's recycling best practices, applying the evaluative framework developed in Chapter 2 to gauge the effectiveness of municipal incentivization, recycling promotion and education, pay as you throw schemes and single stream recycling. This framework is applied in four separate policies, examining each of the recycling best practices identified in Chapter 1. The three criteria used to evaluate the effectiveness of recycling policies include: 1) the ability to increase municipal waste diversion, 2) the ability to minimize recycling program costs, and 3) stakeholder "buy in" - wherein stakeholders agree on the effectiveness and appropriateness of the policy. To apply these criteria, a series of statistical tests, as well as stakeholder surveys and interviews (representing residential households, municipal waste managers and packaging producers) were conducted. Due to the different roles and responsibilities of stakeholders (households participate in recycling programs, waste managers are responsible for program delivery and packaging producers are legally obligated to fund waste management programs) it should be noted that not all stakeholders were asked to complete the same set of surveys or interview questions. Further to that point, certain stakeholders (i.e. households) were not expected to participate in the qualitative section of certain case studies, as they have no pre-existing knowledge about the policies in question. Table 33 below summarizes what types of tests were conducted, as well as the survey/interview type administered for each of the case studies examined in this chapter. For a general description of the methodological techniques used in this study, please refer to Chapter 3. A more detailed description of the material and methods can be found in each of the respective case studies. It should also be noted that it is beyond the scope of this study to propose solutions or provide definitive answers to the issues facing the Blue Box program. This research should be seen as a “first step” in better understanding why certain policies may or may not be working. At the very least, this research challenges the accepted and prevailing opinions with respect to what are best practices in recycling policy, particularly in an Ontario context.

*Table 33: **Methodological techniques used in this study***

Policy Type	Statistical Technique	Semi Structured Surveys	Semi Structured Interviews
Municipal Incentivization	Linear Regression	• Packaging Producers • Municipal Waste Managers	• Packaging Producers • Municipal Waste Managers
Recycling Promotion and Education	Linear Regression	• Households • Packaging Producers • Municipal Waste Managers	• Packaging Producers • Municipal Waste Managers
Pay as you Throw	Weighted Average	• Households • Packaging Producers • Municipal Waste Managers	• Households • Packaging Producers • Municipal Waste Managers
Single Stream vs. Multi Stream Recycling	Weighted Average	• Packaging Producers • Municipal Waste Managers	• Packaging Producers • Municipal Waste Managers

5.1 Policy #1: The relationship between municipal waste diversion incentivization and recycling rate performance: An Ontario case study

Lahkhan, C. (2015). "The relationship between municipal waste diversion incentivization and recycling rate performance: An Ontario Case Study" Sage Open, Forthcoming

While a significant body of research exists exploring the efficacy of municipal recycling instruments in promoting waste diversion (see Sidique et al., 2009; Barr et al., 2004; Beatty et al., 2007; Domina et al., 2002, Hornik et al., 1995), there remains a paucity of relevant research regarding how municipalities respond to recycling incentives and disincentives . Historically, recycling literature has focused on the response of individual consumers or households to intrinsic and extrinsic motivators (DeYoung, 1986: Hopper and Nielson, 1991: Thogersen, 1996). In this research, municipalities have generally been characterized as external facilitators of recycling, encouraging consumer behavior through the provision of incentives, promotion and education and investments in recycling infrastructure (Jurczak et al., 2006; Simmons and Widmar, 1990; Reams and Ray, 1993; Tucker, 1999; Mee et al., 2004). While municipalities continue to assume these roles, recent developments in how municipalities fund waste diversion programs necessitate that the research focus be expanded beyond the household to include local governments. Municipalities operating in jurisdictions with extended producer responsibility schemes have their waste management costs fully or partially subsidized by packaging producers. In Ontario, the distribution of this subsidy is performance based, with the allocation of funding being in direct proportion to a municipality's recycling rate and cost of material management. All other things being equal, municipalities with high rates of waste diversion will have a larger percentage of their program costs subsidized compared to municipalities with low recycling rates. As such, municipalities have incentive to increase recycling rate performance at the lowest possible cost. This can be achieved by undertaking initiatives that encourage household diversion, increasing the recyclability of a broader range of materials and making direct investments in recycling infrastructure. Thus far, the effectiveness of this approach has yet to be evaluated. Policy planning decisions have been made predicated on the assumption that the funding methodology employed in Ontario improves recovery of household recyclables. This study seeks to test this assumption by evaluating how funding payments have influenced recycling rate performance and program costs for municipalities over the past nine years.

In doing so, the objectives of this research will be to explore the following questions:

1) Do incentives/disincentives at the municipal level encourage increased recycling of packaging material (paper, cardboard, boxboard, aluminum, steel, glass, plastics)?

2) Do incentives/disincentives at the municipal level encourage municipal cost containment?

3) What are stakeholder perception regarding the efficacy of Ontario's municipal incentivization methodology?

The analysis in this study builds upon the existing research, shifting the research focus away from individual consumers and households to municipalities. To date, no study has evaluated how incentivization at the municipal level affects recycling rates. The distinction between this study and those that preceded it is that this research explores incentives being provided *to* municipalities and not incentives being provided *by* municipalities. This study aims to examine whether municipalities respond to financial incentivization by increasing total recycling or decreasing costs. Doing so provides unique insights into the effectiveness of performance based funding, particularly as EPR spreads to other jurisdictions. Another unique feature of this research is the use of panel data for recycling rates, program funding, material generation and material recovery. Earlier works have tended towards the use of cross section data, and as such, are unable to evaluate the cumulative effects of policy or regulatory decisions over time. The robustness of the data used in this study enables meaningful and credible analysis related to the effects of incentive based municipal funding.

5.1.1 Materials and Methods

Please refer to chapter 3, section 3.6 for details on the data used in this study.

5.1.1.1 Waste Diversion Ontario municipal funding methodology

As mentioned earlier, 50% of Ontario's Blue Box net system cost is funded by the producers of printed paper and packaging. However, individual municipal programs do not necessarily receive reimbursement equal to 50% of their program costs (Waste Diversion Ontario, 2012b). The funding distribution and transfer payments received by Ontario municipalities are calculated using a three factor formula that evaluates a program's recycling performance based on the following variables: 1) adherence to prescribed recycling best practices 2) program efficiency (a ratio between net cost per tonne and recycling rate) and 3) stated net cost (Waste Diversion Ontario, 2012b).

Waste diversion funding received by municipalities in Ontario is distributed using the following weightings:

• 25% of funding based on responses to best practice questions;

• 50% of funding based on recycling performance; and

• 25% of funding based on net cost.

To further incentivize municipal waste diversion, the Waste Diversion Ontario funding methodology prescribes that municipalities with high levels of program performance will receive transfer payments from like municipalities who have a comparatively lower level of program performance. However, the performance of municipal programs within Ontario varies significantly depending on individual program characteristics (i.e. demography, population density and location). As such, meaningful comparisons cannot be made without consideration is the different types of municipalities in the province. To facilitate program performance comparisons, the WDO has grouped municipalities into nine groups based on population, collection type and location (Waste Diversion Ontario, 2012b). Individual municipalities are only compared with like programs found within the same municipal grouping (Waste Diversion Ontario, 2012b).

Each municipal group includes better, average and poorer performers that yield a range of performance factors (Waste Diversion Ontario, 2012b). A smaller range in factors suggests that members within a municipal group are achieving similar levels of performance (Waste Diversion Ontarioi, 2012b). Conversely, a large range suggests that the municipal group includes better performers that should be rewarded for their innovation, as well as poorer performers that should not accrue these same benefits. Municipal funding payments are distributed to each municipality based on the program's performance factor relative to other programs within its municipal group (Waste Diversion Ontario, 2012b).

A municipal group with a higher number of better performers relative to other groups will also receive a transfer of funds from poorer performing groups (and vice versa). Performance factors across groups are normalized to allow for a fair transfer of funds amongst the municipal groups (Waste Diversion Ontario, 2012b). The funding methodology, including the weightings of the three factor formula, is revisited each year through a consultation process with packaging producers, municipalities and Waste Diversion Ontario. The emphasis of the funding calculation moving forward will be placed on adherence to best practices and recyclables recovery (Waste Diversion Ontario, 2012b).

The intuition behind this funding approach is that municipalities will have an incentive to increase recycling rate performance in order to be a net recipient of funding transfers. Programs with a poor performance factor relative to their municipal group will be encouraged to adopt practices that improve the delivery of their waste diversion services (i.e. additional investments in promotion and education, reduction in waste management costs, following prescribed best practices etc.)

5.1.2 Methodology and data analysis

To determine the effects of funding payments, this study models changes in municipal recycling rates and program costs as a function of funding transfers. The expectation is that changes in municipal recycling rates are correlated with both increases and decreases in program funding (expressed as funding payments transferred both to and from municipalities). This may seem like a counter intuitive result, but the intended function of both the incentive (funding transferred to municipalities) and disincentive (funding transferred away from municipalities) is to encourage increased waste diversion. Good performers will want to continue to be a net recipient of funding transfers, while poorer performers will want to improve recycling efficiency in order to avoid transferring funding away.

The expected relationship between municipal funding transfers and program costs are not as readily apparent as they are with recycling rates. As mentioned above, the three factor funding formula is based on recycling performance, reported net cost, and adherence to best practices. A municipality can improve waste diversion performance by either increasing recycling performance, lowering program costs, or subscribing to best practices. Generally speaking, improvements in recycling rate or best practices will result in an increase in municipal waste diversion costs. Thus, the relationship between funding transfers and program costs is obscured, as some municipalities may be recipients of a funding transfer despite increases in year over year costs (due to improvements in the recycling rate or best practices). However, the intended purpose of the funding methodology is to encourage cost containment, as a municipalities reported costs have a significant weighting in performance factor calculations.

In order to determine whether the funding methodology is achieving its intended objectives, this study analyzes how municipal recycling rates and program costs have changed year over year with funding payments. Changes in municipal recycling rates/program costs are modeled as a function of municipal funding transfers, waste management policy, income and demographic variables.

As our focus is to examine the effect of funding transfers on municipal and material recycling rates and program costs, we limit income and demographic variables to age, income, education and population density. While this is hardly an exhaustive list of potential drivers of recycling behavior, this approach is consistent with the literature and captures the most commonly identified behavioral antecedents (see Sidique et al., 2010). Following Callan and Thomas (2006), the role of socio-economic/demographic variables is to isolate the effects of the policy in question.

Table 34 defines each variable that will be included in the statistical regression.

Table 34: ***Definition of Variables (Economic Incentives)***

RR = Municipal Recycling Rates PC = Municipal Program Costs TP = Municipal transfer payments ($) PE = Municipal promotion and education expenditures (per household) ($) PAYT = 1 if municipality implements pay as you throw scheme (0 otherwise) CURB = 1 if municipality implements a curbside recycling system (0 otherwise) INC = Median income Per Capita ($) AGE = Median Age EDUC = % of Population with College education or higher DEN = Population Density per square kilometer

Municipal recycling rates are calculated by dividing the amount of recyclables collected and marketed by municipalities by the amount of total recyclable waste generated in the municipality. It should be noted that the amount of recyclables generated and recycled in municipalities are aggregated across all Blue Box material types to arrive at a final municipal recycling rate.

PAYT (Pay as you throw) is the dummy variable representing whether a municipality implements some form of volume/weight based pricing for garbage disposal. Since data on the actual amount charged by the municipality was unavailable, by necessity, PAYT was coded as a dummy variable. Municipal Promotion and Education (PE) expenses are expressed on a per household basis. This the amount spent by a municipality in promoting household recycling initiatives divided by the number of households in the municipality.

The CURB variable refers to the percentage of a municipality's population with access to curbside recycling collection. EDUC refers to the % of population listed as having a college education or higher. INC, AGE and DEN refer the median income, age and population density levels for a municipality.

Table 35 below provides the summary statistics for each of the variables considered in this study. These results were calculated using StataCorp's Stata 13 Salient findings include:

- Recycling rates range from for .05% to 100% across provincial municipalities.
- Program costs range from \$304.96 to \$52,967,707.48
- Transfer payments range from -\$1,502,479 to \$2,204,678
- Investments in recycling promotion and education ranges from \$0 to \$47.50
- 49% of Municipalities implement pay as you throw pricing for garbage disposal
- 41% of Municipalities have curbside waste collection
- Median age and income in Ontario are 40.4 years and \$47,780 respectively

- 29.2% of Ontarian's have a college education or higher
- Population density in Ontario ranges from .141 people per km^2 1127.7 people per km^2

Table 35: ***Summary statistics of variables (Economic Incentives)***

Variable	*Mean*	*Std. Dev*	*Min*	*Max*
RR	.4850693	.2262528	.0052141	100.00
PC	996620	4233703	304.96	52967707.48
PAYT	.4890614	.5000568	0	1
PE	.8518109	2.263699	0	47.5
CURB	.4107269	.1921394	0	1
INC	47780.37	4011.308	38006	57993
AGE	40.40841	2.906578	32.002	41.996
EDUC	.2929972	.07787	.13	.52
DEN	14.14821	132.9052	.141	1127.7
TP	2507.11	82211.01	-1502478	2204678

5.1.2.1 Statistical Models used

Using the Breusche-Pagan Lagrange (LM) multiplier test, we test to see whether a random or fixed effects regression should be used in place of a pooled OLS analysis (Breusch and Pagan, 1979).The testing reveals that the null hypothesis is rejected, as the variance across entities is greater than zero. As such, pooled OLS is dismissed as an appropriate regressive technique. To determine whether a fixed or random effects model should to be used, a Hausman test was conducted to see whether the models unique errors (ui) were correlated with the regressors (Hausman, 1978).The results show that cross-sectional variance components are zero, suggesting that a random effects regressive model is the best available choice given the characteristics of the dataset.

However, with specific regards to this study, endogeneity poses an issue, as the independent variable (municipal transfer payments) is a function of the dependent variable (recycling rate). To correct for endogeneity of the transfer payment (TP) variable, we instrument the variable TP with its one year lagged variable. Prior year transfer payments affect current year municipal recycling rates, but current year recycling rates have no bearing on prior year funding transfers. An instrumental variable two stage lease squares regression is used to model our results.

The linear econometric specification of the municipal recycling rate and program cost functions are as follows:

Equation 1 $RR = \beta 0 + \beta 1\ TPit_{-1} + \beta 2CURBit + \beta 3INCit + \beta 4AGEi + \beta 5EDUCi + \beta 6DENit + \beta 7\ TIMEit + ai + uit$

Equation 2 $PC = \beta 0 + \beta 1\ TPit_{-1} + \beta 2CURBit + \beta 3INCit + \beta 4AGEi + \beta 5EDUCi + \beta 6DENit + \beta 7\ TIMEit + ai + uit$

RR and PC refer to the dependent variables, municipal recycling rates and program costs. Transfer Payments (TP) refers to the dollar amount received by municipalities in excess of, or lower than, calculated municipal funding under a net cost only system. As mentioned prior, under Ontario's EPR legislation, municipalities are entitled to receive 50% of their program costs from fees paid by packaging producers. However, the incentive-based funding methodology described above allows municipalities to receive anywhere from 25% to 75% of their program costs depending on their recycling rate performance relative to their peer group (Waste Diversion Ontario, 2012b).

Time is the dummy variable for each year except for the first year, and ai and uit are the components for the unobserved disturbance for municipality i during time t.

*Note: Some municipal programs have been omitted from the analysis as they do not contain a full data set for all years. A total of 17 missing/incomplete entries were removed from the data set. This could possibly be attributed to municipal amalgamations over time, or a municipality's failure to report data on their waste diversion program.

While the specified model used in this study may seem simplistic in design, it is important to note that the emphasis of the testing is to see how funding transfers affect changes in municipal recycling rates and program costs. Work by Sidique et al. (2009) and Oom Do Valle et al. (2004) undertake a more comprehensive examination of the drivers of recycling behavior, but do not address the relationship between municipal incentivization and recycling performance (as it does not exist in jurisdictions outside of Canada). Assuming that municipal recycling behavior responds to changes in program funding transfers, municipalities can promote household waste diversion by serving as both internal and external facilitators of recycling (through increased promotion and education, increased frequency of recyclable collection etc.). If no material relationship exists between municipal funding payments and recycling performance, we assume that changes in recycling rates are explained by factors unrelated to municipal incentivization.

5.1.3 Empirical Results and Discussion

To fully elucidate the relationship between funding transfer payments, municipal recycling performance and program costs, the results have been separated into an analysis of good performers and poor performers (where good performers are defined as recipients of a funding transfer and poor performers are defined as programs who have funds transferred away). Tables

35 and 36 below summarize the results from a random effects panel regression for "good and poorly performing" municipalities[11].

Table 36: ***Relationship between changes in year over year recycling rate and municipal funding transfers***

Instrumental Variable (2SLS) regression
Number of observations (Good performers) =996
Number of observations (Poor performers) =1011

	Good Performers (RR%)	Std. Error	Z Score	Poor Performers (RR%)	Std. Error	Z Score
TP	0.00021	.0002	0.09	0.00019	.0003	0.07
CURB	5.81	.5868	9.90	6.17	.5099	12.1
PAYT	2.11	.2847	7.41	2.44	.2618	9.32
P&E	0.005	.0026	0.19	0.001	.0083	0.12
INC	0.001	.0009	0.11	0.001	.0090	0.11
AGE	0.053	.0071	1.72	0.025	.0747	1.01
EDUC	0.072	.0380	1.89	0.069	.0247	1.81
DEN	0.044	.0283	1.55	0.049	.0308	1.59

R^2 =0.245 (Good Performers)

R^2 = 0.284 (Poor Performers)

[11] Regression results and output were calculated using StataCorp's Stata 13.

Table 37: ***Relationship between changes in year over year program costs and municipal funding transfers***

Instrumental Variable (2SLS) regression
Number of observations (Good performers) =996
Number of observations (Poor performers) =1011

	Good Performers (PC)	Std. Error	Z Score	Poor Performers (PC)	Std. Error	Z Score
TP	121.8	21	5.8	111.4	.0003	14.3
CURB	11586.4	493.03	23.5	9887.5	.5099	19.6
PAYT	2484.3	142.77	17.4	2798.1	.2618	15.8
P&E	1.21	.2520	4.8	1.05	.3260	3.22
INC	0.000	.0000	0.00	0.000	.0000	0.00
AGE	0.000	.0000	0.00	0.000	.0000	0.00
EDUC	0.000	.0000	0.00	0.000	.0000	0.00
DEN	-57.86	16.29	-3.55	-44. 49	17.24	-2.58

R^2 =0.269 (Good Performers)

R^2 = 0.313 (Poor Performers)

The above results did not demonstrate an association between municipal transfer payments and recycling rates for either well or poorly performing municipalities. For every $1000 increase or decrease in municipal transfer payments, recycling rates would change by .00021% and .00019% respectively. There is no evidence to suggest that municipalities are incentivized to continue or improve their performance in order to be a net recipient of funding transfers.

While municipal transfer payments were found to have a statistically significant impact on program costs, they were shown to have the opposite of their intended effect. For every $1000 increase in municipal transfer payments, "good" performing municipalities would experience a $121.8 increase in program costs (despite being a net recipient of funding transfers). Conversely, for every $1000 transferred away, program costs for" poor" performing municipalities would increase by $111.4.

Implementation of curbside recycling collection was found to have a significant impact on this model, increasing the recycling rate by 5.81% (good performers) and 6.17% (poor performers).This result is consistent with what is found in the literature (see work by Sidique et al. (2009), Callan and Thomas (2006), the USEPA (1994), Kinnaman and Fullerton (2000), Oskamp et al., (1991) and Vicente and Reis (2008)). Model estimates did not find a statistically significant relationship between the models other independent variables (income levels, promotion and education investments, population density, age, education levels) and municipal recycling rates.

It should be noted that the effects of income, age and population density on recycling rates have been largely inconclusive in the literature. While work by Sidique et al. (2009) and Yang and Innes (2007) have all pointed to these variables being negatively associated with recycling rates, research by Hage and Söderholm (2008) and Jenkins et al. (2003) find the opposite to be true.

5.1.4 Survey Results and Discussion

Semi structured interviews and surveys were developed in an attempt to gauge the attitudes and opinions of recycling stakeholders regarding existing and future policy initiatives. Please refer to Chapter 3, section 3.7.9 for a full elaboration on how municipal waste manager and packaging producer surveys were conducted.

Tables 38 & 39 below provides the respective responses from both municipal waste managers and packaging producers, as well as the most coded terms/phrases from the semi structured interviews.

Table 38: ***Municipal Waste Manger Survey Results (Economic Incentives)***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I think that that the WDO municipal incentivization methodology helps improve household recycling	8.7%	11.8%	15.1%	40.8%	24.6%	2.11	1.31
The municipal incentivization methodology influences my decisions when planning and managing my recycling program	6.8%	9.5%	15.9%	43.8%	24%	2.04	1.26
The municipal incentivization methodology is a fair way to distribute municipal funding	4.1%	8.5%	16.6%	44.9%	25.9%	2.03	1.21
The municipal incentivization methodology should be promoted as a recycling best practice	5.5%	8.9%	20.3%	37%	28.3%	2.09	1.19
The municipal municipal incentivization methodology should be eliminated	25.9%	31.5%	20%	14.6%	8%	4.11	1.29

Coded Comments from Interviews
"Unfair" - 27 "Does not result in increased recycling performance" -14 "Does not affect budget decisions" - 15 "Difficult to plan in the long term" - 13 "Favors packaging producers" - 7

Table 39: ***Packaging Producer Survey Results (Economic Incentives)***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I think that that the WDO municipal incentivization methodology helps improve household recycling	29.8%	24.4%	16.8%	15.1%	13.9%	3.6	1.21
The municipal incentivization methodology is an effective mechanism for minimizing Blue Box program costs	24.9%	30.1%	14.8%	17.7%	12.5%	3.81	1.28
The municipal incentivization methodology is a fair way to distribute municipal funding	27.6%	33%	19.8%	11.5%	8.1%	3.84	1.18
The municipal incentivization methodology should be promoted as a recycling best practice	29.4%	24.5%	11.5%	17.3%	17.3%	3.11	1.15
The municipal municipal incentivization methodology should be eliminated	7.8%	12.2%	18.5%	34.3%	27.2%	2.44	1.31

Coded Comments from Interviews
"Equitable" - 17 "Encourages recycling performance" -13 "Keeps wasteful behavior by municipalities in check" - 13 "Continued Best Practice" - 6

5.1.5 Analysis of Survey Responses

Effectiveness

(1)" I think that that the WDO municipal incentivization methodology helps improve household recycling"

The responses of municipal waste managers differed significantly from those provided by packaging producers. The majority of municipal waste mangers disagreed (or strongly disagreed) with the statement "I think that the municipal incentization methodology improves household recycling rates". This is in stark contrast to packaging producers, who viewed the policy quite favorably (54.8% of packaging producers felt that municipal incentivization encouraged residential recycling). Comments provided during the semi-structured interview with municipal waste managers indicated that the policy was fundamentally broken, and did not feel it lead to increases in municipal recycling rates. An interesting point raised by some municipal waste managers was that given the way the funding is distributed (with a one year lag), it was difficult for them to design a recycling system that responds to financial incentives. Given that there is no guarantee of continued performance (either good or bad), and that funding transfers are distributed after municipalities have already set their budgets for the upcoming year, incentivization plays very little role in how recycling services are designed and delivered. While some municipal waste managers indicated that they try and factor in historical funding transfers when setting program budgets, they also said that there are too many variables beyond their control to affect household recycling rates in any meaningful way. Conversely, packaging producers felt that in the absence of incentivization, municipalities would have little impetus to either increase household recycling or encourage cost containment.

(2) "The municipal incentivization methodology is an effective mechanism for minimizing Blue Box program costs"

Once again, there were significant differences observed between responses provided by packaging producers and those provided by municipal waste managers. The majority of municipal waste managers disagreed (or strongly disagreed) with the municipal incetivization methodology's ability to encourage cost containment. Conversely, 55% of packaging producers felt that municipal incentivization could minimize Blue Box program costs. Results from the statistical models in section 5.1.3 support the views held by municipal waste managers - there is no evidence to suggest that the municipal incentivization methodology is capable of reducing program costs for municipalities. During the semi structured interviews with municipal waste managers, many felt that municipal incentivization played no role in their ability to contain program costs. Funding transfers were seen as being independent of program budgets - in some years it may be considered an unexpected boon or cost depending on whether municipalities were good or poor performers. Municipal waste managers said that they have minimal year over year control of operating and maintenance budgets - contracts with service providers are often set years in advance and are only subject to review/revision periodically. As such, the ability of waste managers to respond to municipal incentivization is constrained, as budget and program planning have multi-year time scales.

Fairness

(3) "The municipal incentivization methodology is a fair way to distribute municipal funding"

A recurring theme from the waste manager and packaging producer surveys is that there is marked disconnect in how each respective stakeholder perceives the effectiveness and fairness of the municipal incentivization methodology. Municipal waste managers largely view the policies as being inequitable, impairing their ability to manage municipal waste programs effectively. Given that waste management policy involves forward looking planning, funding transfers can result in unexpected shocks that may impair program delivery. Waste managers also felt they should not be compared with other municipalities, as each program has unique characteristics and conditions that affect program costs and recycling performance. Anecdotes provided by waste managers suggested that the WDO group classification system (that divides municipalities by geographic region) needed to be revised. Many municipalities felt they belonged in other groups/regions, and that they were being unfairly compared to cities that were fundamentally different in infrastructure and demography.

Packaging producers directly opposed this view, and see the municipal incentivization methodology as an important tool to ensure municipalities operate efficiently and that industry does not bare an inordinate share of Blue Box program costs. The general sentiment expressed by packaging producers was that it would be unfair if they had to pay for municipalities to operate "bloated" and "inefficient" recycling programs. The issue surrounding what constitutes "fairness" in administering and funding the Blue Box program has been a particularly contentious issue among stakeholders. In 2014, the municipalities and packaging producers entered into formal arbitration to negotiate system costs and the level of funding transfers provided to municipalities.

Continued use moving forward

4) "The municipal incentivization methodology should be promoted as a recycling best practice"

5) " The municipal municipal incentivization methodology should be eliminated"

A majority of municipal waste managers (65.3% and 57.4% respectively) feel that the municipal incentivization methodology should be eliminated and no longer be promoted as a recycling best practice. Packaging producers felt quite differently, with more than 60% indicating that the incentivization methodology is a recycling best practice and, as such, should remain in place. These results are not entirely unexpected - packaging producers and municipal waste managers have competing interests and objectives. Packaging producers strive to minimize their financial obligations to municipalities, and as such, are generally in favor of policies that encourage cost containment and program efficiency. Conversely, municipalities want to recuperate as much of their reported program costs as possible - while the incentivization methodology technically enables municipalities to receive more than 50% of net system costs, it is contingent on factors that many municipal waste managers indicate as being beyond their control (i.e. household recycling rates and participation and program performance relative to other like municipalities). Interestingly, municipal waste managers recognize that there is a need to develop programs and policies that increase recycling efficiency (both with respect to cost and overall waste diverted). However, there is almost a universal consensus among waste managers (during the semi structured interviews) that the current policies in place do not work, and should consequently be repealed.

5.1.6 Conclusion

The findings from this study raise some serious questions regarding the efficacy of Ontario's municipal funding methodology. The modeling in this study indicates that municipal funding transfers have no effect on recycling rate performance or cost containment. There is no evidence that suggests that municipal incentivization encourages waste diversion or reduces program costs. The disconnect in the results and the intended function of municipal funding transfers calls into question the appropriateness of Ontario's municipal funding methodology.

Stakeholder perceptions regarding the perceived efficacy of the municipal incentivization vary between municipal officials and packaging producers. Municipal officials often viewed the policy as unfair and ineffective. A majority of survey respondents representing the municipal sector also indicated that funding transfers had little bearing on waste management decisions and planning. Furthermore, a majority of municipal respondents indicated that the incentivization methodology should be eliminated as Blue Box "Best Practice". These results were in stark contrast to the attitudes and opinions expressed by packaging producers, who felt that the municipal incentivization methodology was both effective and equitable and should remain as a best practice initiative.

This study's findings would suggest that changes in recycling rates and program costs are dictated almost entirely by factors unrelated to municipal incentivization. An alternative explanation for the study's results is that municipalities, and the households within then conform to behavioral inertia, wherein certain practices are engrained and take years to change. Thus, the full effects of incentivization may not be fully realized until a future period, as the attitudes, opinions and actions of households need time to adjust to any policy measures undertaken by municipalities. However, based on anecdotes provided by municipal waste managers, municipalities make waste management decisions independent of funding transfers, operating waste diversion programs to the best of their abilities within a specified budget. They are seemingly unable or unwilling to respond to changes in funding levels.

Despite these findings, these results are nevertheless significant, necessitating that Ontario's funding methodology be revisited to ensure its effectiveness in promoting waste diversion. In its current state, the funding methodology fails to promote recycling performance in any meaningful way. Smaller programs operating in the province's rural north should also request a re-examination of how municipal funding is distributed, as funding transfers can radically affect available program budgets (in excess of 50% in some instances).

It is the recommendation of this study that additional research be conducted into the drivers of recycling behavior at the municipal level. Follow up work regarding the efficacy of various municipal policy instruments (i.e. promotion and education investments, pay as you throw systems etc) in promoting household recycling requires further examination. This area is still very much in its conceptual infancy, as the advent of EPR for packaging waste is a relatively new phenomenon in North America. However, as EPR systems are adopted in other provinces and states, an understanding of how municipalities can be encouraged to further promote recycling will be of growing importance.

5.2 Policy #2: Exploring the relationship between municipal promotion and education investments and recycling rate performance in Ontario, Canada

Lakhan, C. (2014) "Exploring the relationship between municipal promotion and education investments and recycling rate performance: An Ontario case study" *Resources Conservation and Recycling*, 11 (92): 222–229

Over the past three decades, declining resource stocks, increased waste generation and a scarcity of available landfill space have made household recycling an imperative in Ontario. The 3R impetus of "Reduce, Re-Use and Recycle" has become a ubiquitous phrase that has led to a watershed in consumer consumption and disposal habits. Demand for recycling services has radically altered municipal waste management practices, necessitating the creation of comprehensive and cost effective waste diversion programs in the province. Recycling is seen as a social and environmental good, and thus is an activity that is promoted as the basis for improved resource stewardship and conservation. While there is significant research indicating that consumer concern surrounding environmental issues, and by proxy, recycling, is growing, household recycling rates and total waste diversion remain low (Minister of the Environment, 2013). This seemingly paradoxical result points to barriers to recycling that prevent consumers from participating in recycling activities despite a desire to do so. This discrepancy between intent and action is often referred to as the "Value-Action" gap (Kollmuss & Agyeman, 2002). This idea illustrates that environmental attitudes are poor predictors of individual behavior, and represent only one dimension of what motivates people to act a certain way (Pelletier et al.,1998). Research by Domina (2002) suggests that when perceived levels of behavioral control are low, (i.e. low levels of convenience, low awareness regarding existing recycling programs) consumers and households may be discouraged from recycling despite favorable intent and attitudes towards waste diversion (Nigbur et al., (2010); Han et al., (2010); Biel & Thogerson (2006). Thus, policy instruments that increase an individual's perceived level of self-efficacy can be seen as a potential mechanism for encouraging consumer recycling and increasing total waste diversion. One such instrument employed by municipalities is investing directly in recycling promotion and education (P&E).

This study examines the effectiveness of P&E expenditures in promoting residential recycling in Ontario, Canada. To assess the effectiveness of P&E expenditures in promoting municipal waste diversion, this research examines the following questions.

1. Do P&E investments lead to increases in municipal waste diversion?

2. Is there an optimal per household level for P&E expenditures?
    a. Is the $1 per household P&E allowance provided by Waste Diversion Ontario appropriate given their mandate to increase recycling at the lowest possible cost?

3. What are stakeholder perceptions and attitudes towards P&E policy?

4. Does geographic location impact the effectiveness of P&E investments?

The last research question is examined because it is unclear how the geographic location of a municipality is (potentially) linked to P&E effectiveness. For information purposes, the province of Ontario spans 1,076,000 square kilometers, approximately nine times the size of England (Statistics Canada, 2005). The characteristics of municipal waste diversion programs in the densely populated southern regions of the province are radically different than those in rural northern communities. This begs the question of whether a "one size fits all" approach to P&E funding is appropriate given regional differences in demography and access to recycling services. This research will explore how, if it all, location impacts the efficacy of P&E investments.

Thus far, there is no literature to support the efficacy of P&E campaigns in areas characterized by a mature recycling system (no research has been conducted in this field). This is a topic that necessitates further academic investigation, particularly in jurisdictions such as Ontario which have operated a curbside recycling program since the early 1980s.

5.2.1 What is recycling promotion and education?

Promotion and education investments are designed to raise levels of consumer awareness regarding municipal recycling initiatives (Read, 1997a). While P&E campaigns vary depending on the intended message and the target audience involved, there is a consensus that communications should clearly specify: 1) why consumers should recycle, including the environmental, economic and community benefits, and 2) how consumers should recycle, including all of the relevant details (what, where, and how) of the program (McKenzie-Mohr, 1995). Research by Callan & Thomas (2006) and Sidique et al., (2009) has shown that areas which invest directly in P&E programs achieve higher levels of waste diversion than those which fail to make such provisions. Given the assumed effectiveness of P&E in promoting recycling, the province of Ontario has characterized P&E investments as a recycling best practice, reimbursing municipalities $1 per household for all P&E related expenses (Stewardship Ontario, 2007). This is done to aid the province in achieving its 60% recycling rate target for all materials found in the residential Blue Box bin (newsprint, office paper, telephone directors, magazines, cardboard, boxboard, aluminum, steel, PET & HDPE bottles, mixed plastics and glass) (Stewardship Ontario, 2012).

5.2.2 An Overview of Recycling Promotion and Education in Ontario

Waste Diversion Ontario municipal groupings (please see Chapter 3, section 3.68) are used to facilitate program performance comparisons and are an important consideration when devising provincial recycling policy (Waste Diversion Ontario, 2012b). Generally, extensive efforts are made to ensure that waste management policies are tailored to meet the specific needs of a given area. With respect to P&E planning, the WDO provides all municipalities with communication planning tools such that they can develop clear and effective P&E strategies. A specific program exists for smaller communities (defined as municipalities with less than 30,000 people) to assist them in devising P&E campaigns in the absence of abundant economic or staffing resources (Waste Diversion Ontario, 2012c). While P&E strategies are designed to be site specific, the province's P&E funding provision of one dollar per household makes no allowance or consideration for differences in municipal groupings. All municipalities receive the same level of per household funding, regardless of size, location or collection type. Policy planning decisions have been made predicated under the assumption that the current approach to P&E investments in Ontario improves the recovery of household recyclables. The effectiveness of this approach is evaluated in this paper.

5.2.3 Materials and Methods

5.2.3.1 Data Sources

Please refer to chapter 3, section 3.6 for details on the data used in this study.

5.2.3.2 Waste Diversion Ontario Promotion and Education Funding Methodology

Funding of municipal recycling P&E initiatives can be divided into two categories:

1) Direct municipal investments in P&E

2) Promotion and education funding provisions made by the province to municipalities

Each municipality in Ontario is given full discretion over how much of their budget they would like to allocate towards recycling P&E initiatives. Per household expenditures in recycling and education range anywhere from $0 to $47.50 per household, as each program may choose to prioritize recycling P&E differently. However, regardless of what municipalities report spending on recycling P&E, they are reimbursed no more (and no less) than $1 per household for all P&E related expenses (Waste Diversion Ontario, 2012a).

The promotion and education provision of $1 per household is assumed to be the optimal investment level for municipalities in encouraging consumer recycling behavior. This figure was arrived at using findings from a 2004 study commissioned by Stewardship Ontario exploring P&E expenditures among medium and large municipalities (Stewardship Ontario, 2007). The study found that on average, programs that obtained a 60% recovery rate tended to spend approximately $1 per household on P&E expenses. Given the province's 60% recycling rate target for all residential recycled material at the time, the P&E provision of $1 per household was deemed a recycling best practice. While the Stewardship Ontario study provided some useful insights into the effectiveness of P&E, the scope of the research was limited. Only one data year (i.e., 2004) was considered in the analysis, and a small sample size was used (the study was confined to medium and large municipalities). Further to this point, in 2011, the Minister of the Environment signalled their intention to change the province's recycling target from 60% to 70% (MOECC, 2011). These factors necessitate that the P&E funding provision be revisited in an attempt to determine whether the $1 per household allowance remains appropriate.

The recycling and P&E expenditure data collected by the WDO for each of Ontario's 223 municipalities between 2003 and 2012 are analyzed in this study. Data pertaining to best practice P&E provisions have been calculated and made available for public use by WDO staff. Due to the nature in which investments in promotion and education are reported into the WDO data call (municipalities report total expenditure on all promotion and education activity in a given year), this study is confined to exploring the linkage between general levels of P&E investments and recycling rates. However, promotion and education initiatives can take many forms and range in both implementation and efficacy. While it is beyond this study’s scope to evaluate the effectiveness of different types of promotion and education initiatives, it is useful to highlight some of the P&E projects undertaken by municipalities in Ontario over the past decade.

Recycling promotion and education through signage

Several municipalities in the province have chosen to promote recycling promotion and education through public signage. This approach has proven to be popular in northern/rural communities and public spaces. Signs are used to communicate what are acceptable Blue Box materials, when materials will be picked up (or in the case of depot systems, where to bring recyclable material) and what not to place in recycling bins (this is an issue in public spaces, where recycling bins have high levels of organics contamination). Signs are designed to communicate messages simply and effectively, using high impact colors and recognizable symbols. Despite the popularity of signage as a promotion and education strategy, there has been little feedback from provincial municipalities as to whether they have been effective in driving diversion.

Promotion and education initiatives in multi residential buildings

Multi-residential dwellings (apartments, condos etc.) in Ontario recycle at 1/3rd the rate of single family dwellings in Ontario (22% Recycling Rate Multi Residential vs. 68% Recycling Rate Single Family) (Stewardship Ontario, 2012). As such, significant investments in recycling P&E initiatives specific to multi-residential buildings have been undertaken by municipalities throughout the province. These initiatives engaged multi-res households using a variety of measures, including: pamphlets, posters, signage and door to door campaigns. While individual projects have demonstrated some successes using P&E to promote multi residential recycling, it is assumed that the biggest impediment to improved multi-res diversion remains one of access and convenience (CIF, 2014).

Promotion and education initiatives through direct engagement

Perhaps the most successful (and costly) promotion and education strategy used in Ontario is directly engaging the public to educate and inform them about Blue Box recycling. Direct engagement can take many forms, including: door to door campaigns, visiting local schools and holding special events (barbeques, activity days etc.) Many municipalities utilize some (or a combination) of these strategies to foster awareness about recycling initiatives and educates the community about the Blue Box program, its importance, and "what goes in the bin". These types of initiatives have demonstrable and immediate effects on improving household recycling (at least in the short term), but it remains unclear as to whether these successes can be sustained over the long run – particularly if direct engagement initiatives cease (CIF, 2014). Direct engagement campaigns also tend to be the most costly type of P&E initiative, as it requires significant municipal resources and staff time.

A worthwhile study to consider in the future would be to compare the effectiveness and costs of the different types of recycling promotion and education initiatives. Unfortunately, at this time, the data used in this study does not allow for that type of analysis.

5.2.4 Data Analysis

To determine whether recycling P&E investments are achieving their intended objective, municipal recycling rates are modeled as a function of per household P&E investments, waste management policy, income and demographic variables. This is done to establish whether a statistically significant relationship exists between P&E related expenditures and recycling rates. This is then followed by an examination of the marginal effect of per household P&E expenditures on municipal recycling rates at levels below, at and above the $1 P&E best practice threshold. The relationship between P&E expenditures and municipal recycling rates for each of the municipal groups classified by the WDO is also examined. This is required to determine whether geographic location affects the potential efficacy of P&E investments.

Table 40 below defines the variables to be included in the analysis

Table 40: ***Definition of variables included in each regression (P&E)***

Definition of Variables

RR = Recycling Rate (%)

PE = Municipal promotion and education expenditures (per household) ($)

PAYT = 1 if municipality implements pay as you throw scheme (0 otherwise)

CURB = Percentage of households with access to curbside recycling collection (%)

INC = Median income Per Capita ($)

AGE = Median Age

EDUC = Percentage of Population with College education or higher (%)

DEN = Population Density per square kilometer

Municipal recycling rates are calculated by dividing the amount of recyclables collected and marketed by municipalities by the amount of total recyclable waste generated in the municipality. It should be noted that the amount of recyclables generated and recycled in municipalities are aggregated across all Blue Box material types to arrive at a final municipal recycling rate.

PAYT is the dummy variable representing whether a municipality implements some form of volume/weight based pricing for garbage disposal. Since data on the actual amount charged by the municipality was unavailable, by necessity, PAYT was coded as a dummy variable. CURB measures the percentage of a municipalitie's population with access to curbside recycling pickup. Municipal Promotion and Education (PE) expenses are expressed on a per household basis. This is the total amount spent by a municipality in promoting household recycling initiatives divided by the number of households in the municipality. INC, AGE and DEN refer the median income, age and density levels for a municipality.

Table 40 provides summary statistics for the variables included in the study.

Table 41: ***Summary statistics of variables (P&E)***

Variable	*Mean*	*Std. Dev*	*Min*	*Max*
RR	.4850	.2262	.0052	100.00
PAYT	.4890	.5000	0	1
PE	.8518	2.263	0	47.5
CURB	.4107	.1921	0	1
INC	47780	4011	38006	57993
AGE	38.40	2.906	32.00	41.996
EDUC	.2929	.0778	.1377	.5242
DEN	14.141	132.90	.1411	1127.7

5.2.5 Results and Discussion

5.2.5.1 Relationship between promotion and education expenditures and recycling rate - Province Wide

To determine whether recycling P&E investments are achieving their intended objective, municipal recycling rates are modeled as a function of per household P&E investments. The linear econometric specification of the municipal recycling rate function is:

Equation 3 RR = β0 + PEitβ1 +PAYTit β2 + CURBit β3 + INCitβ4 +AGEitβ5 + EDUCit β6 +DENit β7 + TIMEt β8 +ai +uit

Time is the dummy variable for each year except for the first year, and ai and uit are the components for the unobserved disturbance for municipality i at time t.

Consistent with the methodology employed by Sidique et al, (2009) and Lakhan (2014), a Hausman test was conducted to see whether the models' unique errors (ui) were correlated with the regressors. This was done to determine whether a fixed or random effects model should be used. The results show that cross-sectional variance components are zero, thereby confirming the null hypothesis. Hence, given the characteristics of the data used in this study, a random effects regressive model is considered the best available choice. A pooled OLS model is also estimated for the purposes of comparison, as the random effects model assumes strict exogeniety between the explanatory variables and disturbance term. If this assumption fails, a pooled OLS regression would produce more consistent results (Sidique et al, 2009). The results of this analysis are shown in Table 41.

Table 42: ***Relationship between municipal recycling rate and per household P&E funding expenditures***

Dependent variable = municipal recycling rates
Number of observations =2007

	Random Effects	Std. Error	Z score	Pooled OLS	Std. Error	T score
PE	0.0014	0.021	0.54	-0.004	0.003	-1.45
PAYT	2.4145	0.588	4.10	2.014	0.225	8.94
CURB	6.1122	0.700	8.73	4.838	0.368	13.14
INC	0.0002	0.123	0.44	1.38e-06	9.22e-08	0.96
AGE	0.1892	0.095	1.99	0.200	0.088	2.27
EDUC	0.1281	0.077	1.66	0.127	0.006	1.97
DEN	0.0144	0.008	1.77	0.014	0.001	2.14

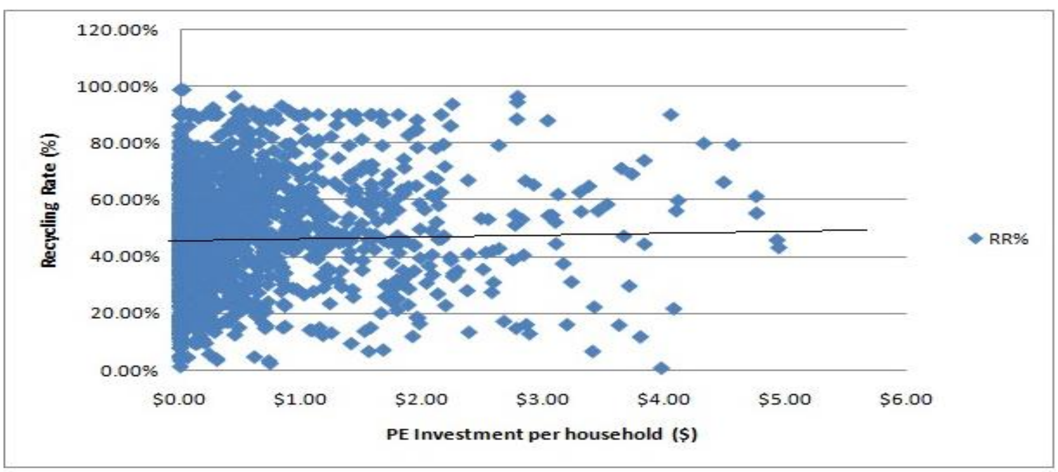
$R^2 = 0.2941$ $R^2 = 0.2497$

Using the random effects model, no statistically significant relationship is observed between municipal per household P&E expenditures and recycling rates. This result is not supportive of the findings of previous investigators (for example, Jurczak et al., 2006; Simmons and Widmar, 1990; Reams and Ray, 1993; Tucker, 1999; Mee et al., 2004) who reported that P&E investments lead to increases in the recovery of household recyclables. The findings of this study were substantiated with the use of pooled ordinary least squared regressions, which yielded a P&E coefficient value of -0.004%.

Implementation of curbside recycling collection and variable rate pricing were found to have a significant impact in both the random effects and pooled OLS models, increasing the recycling rate by 6.11%, 4.10%, 2.41% and 2.014% respectively. Population density, age and education levels were also found to positively affect municipal recycling rates, although to a lesser degree. Income levels were not found to affect municipal recycling rates.

A scatter plot comparing municipal recycling rate and per household P&E funding is shown in Figure 48. Applying a best fit linear trend line indicates that no distinguishable trend exists – municipalities who make investments in per household P&E beyond the $1 provision provided by Waste Diversion Ontario do not recycle more than those that don't .

Figure 48: ***Scatter Plot Comparing Municipal Recycling Rates to Per Household P&E Investments***



5.2.5.2 *Relationship between municipal recycling rate and promotion and education investments at different funding levels*

The analysis in this section focuses on how municipal recycling rates are correlated with P&E investments at funding levels at, above, and below the $1 per household P&E provision. Each municipality from this research data set is grouped according to their reported per household P&E costs. Municipalities are organized using the following categories:

- Municipalities with per household P&E expenditures less than or equal to .50
- Municipalities with per household P&E expenditures between .51 and $1.00
- Municipalities with per household P&E expenditures between $1.01 and $2.00
- Municipalities with per household P&E expenditures between $2.01 and $3.00
- Municipalities with per household P&E expenditures between $3.01 and $5.00
- Municipalities with per household P&E expenditures greater than $5.00

Unlike the statistical methodology employed above, this section does not utilize random effects panel regression. By grouping municipalities according to their per household PE funding level, the time dimension is removed from the analysis. As such, the linear specification of the regression is now:

Equation 4 $RR = \beta 0 + PE_{PEFLi}\beta 1 + PAYTi\ \beta 2 + CURBi\ \beta 3 + INCi\beta 4 + AGEi\ \beta 5 + EDUCi\ \beta 6 + DENi\ \beta 7 + ai + ui$

Note that the independent variable now becomes (β_{PEFLi}), which indicates P&E at specified funding levels (i.e, between 0 and $.50)

A simple regression is, therefore, used to define the relationship between P&E per household funding level and municipal recycling rate. Each funding category is analyzed separately to identify an optimal per household P&E level. The results of this analysis are summarized in Table 43.

Table 43: ***Relationship between P&E Funding Level and Municipal Recycling Rates***

Dependent variable = municipal recycling rates

PE Funding Levels ($)	P&E	T Stat	PAYT	T Stat	CURB	T Stat	INC	T Stat	AGE	T Stat	EDUC	T Stat	DEN	T Stat
<0.5	0.011	1.24	1.86	8.42	5.16	8.25	0.001	0.93	0.114	2.08	0.118	1.97	0.011	1.93
0.5 to 1	0.006	1.15	2.01	8.37	4.14	11.33	0.001	0.97	0.149	1.90	0.178	1.95	0.013	2.21
1.01 to 2	0.004	1.22	2.77	8.15	6.17	11.64	0.004	0.93	0.201	1.94	0.174	2.00	0.017	2.13
2.01 to 3	-0.004	-1.29	2.56	7.83	6.77	9.42	0.002	0.90	0.184	2.03	0.111	1.90	0.012	2.01
3.01 to5	0.007	1.12	1.07	7.54	5.14	11.73	0.001	0.95	0.155	2.02	0.114	1.94	0.014	2.16
5+	0.001	1.16	0.53	8.32	2.11	8.53	0.001	0.97	0.174	1.99	0.0887	1.93	0.021	2.09

As shown in Table 43, there is no statistically significant relationship between municipal P&E investments and recycling rates. The effect of P&E investments on municipal recycling rates range from 0.0013% at P&E funding levels exceeding $5.00 per household to 0.0113% for municipalities investing less than $0.50 per household in P&E related expenses. This is the exact opposite result of the expected relationship between P&E investments and recycling rates (it is assumed that recycling rates will increase as P&E investments increase). Of note, the weighted average recycling rate of programs that report P&E expenditures of less than $0.50 cents per household (46%) is greater than programs with P&E expenditures in excess of $5 per household (40.67%) (Waste Diversion Ontario, 2012a).The results of this study suggest that P&E funding levels have little effect with respect to municipal recycling rates.

5.2.5.3 Relationship between promotion and education expenditures and recycling rate - by municipal group

In assessing the potential effects of municipal location on the effectiveness of promotion and education investments, this study uses the WDO's municipal groupings. The data set for the municipalities is organized into nine groups that represent different geographic regions within the province. To test the relationship between municipal per household P&E investments and recycling rates, the following regression equation is used:

Equation 5 $RR = \beta 0 + PE_{PEMGi}\beta 1 + PAYTi\ \beta 2 + CURBi\ \beta 3 + INCi\beta 4 + AGEi\ \beta 5 + EDUCi\ \beta 6 + DENi\ \beta 7 + ai + ui$

It should be noted that the independent variable now becomes (β_{PEMGi}), which indicates P&E investments for each of the municipal groups classified by the WDO.

Given that the time dimension has been removed from the analysis, a pooled OLS regression is used to test for any correlation between location and P&E efficacy. To ensure meaningful comparisons across groups, P&E expenses are expressed on a per household basis. The results of the analysis are summarized in Table 44.

*Table 44: **Relationship between municipal recycling rate and per household P&E funding expenditures (By municipal group)***

Dependent variable = residential recycling rate per annum

Municipal Group	P&E	TStat	PAYT	T Stat	CURB	T Stat	INC	T Stat	AGE	T Stat	EDUC	T Stat	DEN	T Stat
Large Urban	0.003	1.25	2.974	9.74	6.574	13.1	0.004	1.09	0.118	1.99	0.297	2.09	0.192	2.18
Urban Regional	0.012	1.24	3.011	9.20	5.716	12.3	0.001	0.96	0.121	2.14	0.211	1.98	0.178	2.00
Medium Urban	0.006	1.27	2.459	8.47	5.417	10.1	0.001	0.90	0.098	2.09	0.178	2.07	0.182	2.20
Rural Regional	0.007	1.15	2.731	7.83	6.779	11.4	0.001	1.17	0.134	2.03	0.144	1.88	0.144	2.28
Small Urban	-0.006	-1.11	2.014	7.94	4.484	11.8	0.000	1.14	0.125	2.16	0.121	2.09	0.112	2.22
Rural Collection - North	0.025	1.17	1.985	7.33	4.841	10.6	0.000	1.12	0.184	2.19	0.127	1.99	0.094	2.15
Rural Collection- South	0.006	1.13	2.021	7.74	4.992	11.2	0.001	1.18	0.114	1.97	0.114	1.89	0.091	1.98
Rural Depot - North	0.013	1.23	-	-	-		0.000	1.21	0.125	2.28	0.156	1.95	0.104	2.27
Rural Depot - South	-0.006	-1.22	-	-	-		0.000	1.11	0.099	2.06	0.138	2.03	0.119	2.013

The above results suggest that there is not a significant relationship between P&E effectiveness and municipal location. These results could be attributed to P&E investments as a whole having minimal effects on municipal recycling rates. Of interest, increased levels of education and income appear to have a greater effect on recycling rates in municipal groups characterized by greater population density in the southern regions of the province. These statements require further investigation, because "locality" is generally omitted from analysis surrounding determinants of recycling behavior and performance.

5.2.6 Survey Results and Discussion

The qualitative component of this study was divided into two main areas: 1) Semi structured surveys and interviews with households, and 2) Semi structured surveys and interviews with municipal waste managers and packaging.

5.2.6.1 Household Survey and Interviews

Please refer to Chapter 3, section 3.7.8 for a detailed description of how household surveys and interviews were conducted.

Note: This survey was designed to address a broad range of issues, of which recycling P&E are a part of. For the purposes of this study, only questions related to recycling P&E are examined. Table 45 below summarizes household responses to survey questions.

Table 45: ***Household Survey Results (P&E)***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I am aware that the city has recycling promotion and education campaigns	10.4%	15.2%	18.4%	37.1%	19.9%	2.23	1.14
I see signs, flyers, advertisements etc telling me to recycle regularly	9.7%	12.3%	15.7%	40.9%	21.4%	2.09	1.28
I recycle more because of the promotion and education initiatives under taken by the city	2.4%	5.8%	22.4%	47.2%	22.2%	2.02	1.14
I think recycling promotion and education campaigns are an effective way to get me to recycle more	19.2%	24.6%	14.6%	18.5%	23.1%	3.11	1.47

5.2.6.2 Analysis of Household Survey Responses

Awareness

1) " I am aware that the city has recycling promotion and education campaigns"

2) " I see signs, flyers, advertisements etc. telling me to recycle regularly"

Survey results indicate that household awareness regarding promotion and education campaigns remains low. 25.7% of respondents agreed (or strongly agreed) with the statement "I am aware that the city has recycling promotion and education campaigns". Only 22% of respondents recalled seeing flyers, advertisements and other P&E material telling them to recycle. Despite significant investments on the part of municipalities in promoting recycling initiatives (particularly in densely populated urban areas), the results from the survey suggest that the outreach and delivery of P&E messaging needs to be revisited and refined.

Results and Effectiveness

3) I recycle more because of the promotion and education initiatives under taken by the city

4) I think recycling promotion and education campaigns are an effective way to get me to recycle more

Results from the household survey suggest that only a very small percentage of respondents (8.2%) recycle more as a result of municipal promotion and education initiatives. This could be, in part, due to the lack of awareness regarding P&E on the part of survey respondents. What was less conclusive was whether households felt that P&E are effective tools for promoting waste diversion. 43.6% of respondents agreed (or strongly agreed) with P&E being a (potentially) effective method for getting them to recycle. Conversely, 41.6% of respondents disagreed (or strongly disagreed) when read the same statement. It would appear that households recognize the importance of being educated about recycling initiatives (i.e. where to recycle, what constitutes appropriate recyclable material etc.), but are not being effectively engaged by municipalities.

5.2.6.3 *Analysis of Municipal and Packaging Producer Survey Responses*

Tables 46 and 47 below summarize the distribution of Likert scale responses for both packaging producers and municipal waste managers. The most commonly coded phrases/terms from the semi structured interview are also included.

Table 46: ***Municipal Waste Managers (P&E)***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I think that recycling promotion and education is an effective way to increase recycling rates	39.4%	32.4%	11.5%	12.1%	4.6%	4.13	1.19
Recycling promotion and education is an easy policy to implement	20.9%	21.7%	15.8%	24.2%	17.4%	2.61	1.17
The $1 per household provision for recycling promotion and education is fair	9.8%	12.7%	20.4%	40.7%	16.4%	2.02	1.14
Recycling promotion and education campaigns should continue to be a recycling best practice	33.1%	37.1%	12.6%	7.8%	9.4%	4.14	1.39
Coded Comments from Interviews							
"Effective" - 25							

"It has worked in my community" -22 "$1 provision not enough" - 20 "First step when implementing recycling program" - 17 "The most effective campaigns are the most costly" - 12

Table 47: ***Packaging Producers (P&E)***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I think that recycling promotion and education is an effective way to increase recycling rates	35%	35.4%	14.5%	8.1%	6.6%	4.11	1.43
Recycling promotion and education is an easy policy to implement	29.6%	31.5%	10.8%	14.2%	13.9%	4.01	1.31
The $1 per household provision for recycling promotion and education is fair	26.3%	29.5%	16.1%	10.7%	17.4%	3.89	1.19
Recycling promotion and education campaigns should continue to be a recycling best practice	30.1%	34.4%	10.3%	16.4%	8.8%	4.01	1.36
Coded Comments from Interviews							
"Effective" -15 "Best Practice" -12 "More money should be spent on P&E" - 8							

Perceived Effectiveness

1) "I think that recycling promotion and education is an effective way to increase recycling rates"

There is a general consensus among both municipal waste managers and packaging producers that recycling promotion and education is an effective method for increasing household recycling rates. More than 70% of both waste managers and packaging producers agreed (or strongly agreed) with the effectiveness of recycling P&E. Of note, anecdotes provided during the semi-structured interviews suggested that there were numerous examples of successful promotion and education initiatives - several municipalities reported observing significant increases in both household recycling rates and participation levels post implementation of a P&E campaign. This is a particularly interesting result, in that the results from our statistical modeling suggest that there is no statistically significant relationship between promotion and education investments and recycling rates. While it is difficult to discern why there is an inconsistency between the survey and regression modeling results, it is possible that there are isolated and situation specific instances of successful P&E campaigns. Despite investments in P&E being shown to have no effect on recycling rates for the province as a whole, individual P&E initiatives may prove to be successful given sufficient enabling conditions (i.e. promoting recycling in communities that have historically low levels of recycling participation and awareness, direct engagement with the public etc).

Ease of Implementation

2) " Recycling promotion and education is an easy policy to implement"

In hindsight, this question may have been poorly worded (despite significant questionnaire pre-testing). There appeared to be little consensus among stakeholders regarding what constituted "ease of implementation". Stakeholders seemed to recognize that promotion and education initiatives differ both with respect to the resources required (time, money etc) and efficacy. Anecdotes provided by waste managers during the interview process suggested that conventional P&E investments in things like recycling pamphlets and mailers were both easy to implement and relatively cost effective. However, any initiative that required direct engagement with the public (going to school, visiting households etc.) were highly effective, but too onerous and costly to implement on a wide scale. With this in mind, a majority of survey respondents from both the municipal and private sector indicated that relative to other waste management operations, P&E campaigns were easy to implement (more than 60% of both waste managers and packaging producers agreed (or strongly agreed) with the statement "Recycling promotion and education is easy to implement"). It should be noted that enumerators did require clarification regarding what was meant by "easy" when prompted by survey participants.

Fairness

3)"The $1 per household provision for recycling promotion and education is fair"

More than 50% of both packaging producers and municipal waste managers felt that the $1/per household provision provided by Stewardship Ontario was unfair. This is a particularly interesting result, in that packaging producers have a vested interest in keeping municipal investments (of any kind) low. The $1 provision was meant as a cost containment measure to prevent unnecessary expenditures on the part of municipalities while ensuring continued investments in P&E initiatives. Anecdotes provided by packaging producers during the semi structured interview suggested that while cost containment was important, educating households about what constitutes appropriate recyclable material should take precedence. This may seem like a peculiar position on the part of industry, but they too have a vested interest in keeping material specific recycling rates high. The fees assigned to each packaging type (under Ontario's shared producer responsibility model) is partially attributed to a materials recycling performance. The more households recycle of a particular packaging type, the lower the fee paid by packaging producers.

During the interview process, many municipal waste managers felt the $1 P&E reimbursement was not enough to adequately fund effective promotion and education campaigns. Many respondents recognize that different P&E campaigns yield different results, but generally speaking, there is a corollary between expense and effectiveness. The $1 provision only allows for very basic investments in recycling promotion and education. Municipal waste managers felt that if this value was increased, they would have more latitude and flexibility to incorporate more targeted and effective initiatives.

Best Practice

4)"Recycling promotion and education investments should continue to be a recycling best practice"

Despite the perceived "unfairness" of the existing P&E funding model, 70.2% of municipal waste managers and 64.5% of packaging producers felt that P&E investments should continue to be promoted as a recycling best practice. As noted in survey question #1, the overwhelming majority of stakeholders felt that P&E initiatives were an effective method for increasing household diversion. During the semi structured interviews, some participants expressed that P&E might be the only legitimate best practice currently in place in Ontario (coming out of the KPMG Blue Box best practices report). With this in mind, interview participants also recognized that there is room for improvement with respect to P&E messaging and outreach. Most municipalities expressed a strong desire to invest additional resources in direct engagement P&E initiatives, but are unable to do so due to budgetary constraints.

5.2.7 Conclusion

This study highlights findings regarding the efficacy of Ontario's recycling P&E best practice. In all scenarios tested, no statistically significant relationship was observed between municipal per household P&E expenditures and recycling rates. This result was unexpected, given the extensive literature (Read, 1999a, 1999b, Mee et al., 2004; Sidique et al., 2009) supporting the use of P&E in increasing municipal waste diversion. Here it should be noted that previous investigations reported that municipal recycling rates are positively correlated with P&E expenditures. Given the fact that the findings of this research do not support those of previous investigations, it is worthwhile to consider why these findings are different. The question could be raised as to whether P&E investments are genuinely ineffective in Ontario.

The answer to this question requires considering many factors related to Ontario's recycling history, policy and infrastructure. In 2011, Ontario reported a residential recycling rate of 67.6% for all printed paper and packaging (Stewardship Ontario, 2012). This figure is significantly higher than any program considered in the existing research on recycling promotion and education. Ontario has an established residential recycling program dating back to 1981, with the blue box serving as a recognizable symbol of recycling within the province (Stewardship Ontario, 2012). Thus, one could contend that consumer awareness regarding recycling initiatives is already high, and as such, additional investments in P&E have a negligible effect in modifying consumer behavior.

Looking at the recycling rate of individual materials that are traditionally considered "recyclable" (i.e. newsprint, cardboard and glass bottles), it is observed that recycling rates range from 87.2% to 97% (Stewardship Ontario, 2012). This suggests that consumers are already recycling material that they readily recognize as being recyclable. The recycling rate of "fringe" materials (such as composite containers and plastic film packaging) is significantly lower, with recycling rates of 9.7% and 6.4% respectively (Stewardship Ontario, 2012). While P&E campaigns are increasingly attempting to encourage consumers to expand the range of materials that they recycle, many municipalities lack the requisite infrastructure to recover fringe materials. As such, recycling rates for these materials will remain low until the necessary capacity is implemented to economically collect and recycle them. Further to this point, P&E investments are unlikely to increase the recycling rate of “fringe” materials in any meaningful way until such capacity exists.

No statistically significant relationship was observed between recycling P&E investments and program costs. While Ontario's P&E initiative is not specifically designed to encourage cost containment (as it is actually a cost incurred by the municipality), most municipal planners feel that long term savings can be achieved indirectly. Educating consumers about what constitutes appropriate recyclable material reduces contamination in the Blue Bin and decreases sorting and processing time at a material recycling facility. This will ultimately result in lower material management costs for the municipality over time, as baled material that is marketed to reprocessors is of a higher value. This study did not find any evidence to support this claim. It is also worthwhile highlighting that the estimation strategy used in this study may be misspecified in the event that habit persistence with respect to recycling is important.

Stakeholder perceptions and attitudes towards P&E initiatives were largely mixed. Household respondents often indicated that they did not know recycling P&E campaigns existed in their communities. The majority of respondents had limited to no exposure to municipal P&E initiatives, and few felt that P&E campaigns were likely to influence their recycling behavior. These results are in stark contrast to the attitudes and opinions held by municipal waste managers and packaging producers. Both of these stakeholder's viewed recycling P&E policy quite favorably, and felt P&E was an important tool in encouraging household waste diversion. Municipal waste managers in particular felt that P&E campaigns were both effective and easy to implement, but few felt the $1 per household provision stipulated as a provincial best practice was fair. This disconnect between the perceived effectiveness of the program among stakeholders is a cause for concern that necessitates additional investigation. If decisions made by policy planners do not effectively engage households or address their needs/concerns, their effectiveness is greatly diminished.

With the above in mind, should Ontario's current approach to promotion and education investments continue to be characterized as a recycling best practice? Given that this study finds that the existing P&E funding model does not meaningfully impact recycling rates, the short answer is no. However, despite these results, one should not be quick to dismiss promotion and education as a tool to promote residential recycling. Different types of promotion and education initiatives may yield different results (varying in their effectiveness). What initiative to use (if any) and when to use it depend on site and situation-specific factors. It would be prudent of municipalities to investigate which type of P&E initiatives is most appropriate for a specific situation (i.e. signage in public spaces) and determine whether there are differences in an initiative's ability to increase recycling rates (i.e. are flyers more effective than signs). A more targeted and situation specific approach towards promotion and education investments may prove more effective in increasing residential recycling rates relative to the existing "one size fits all" approach.

There is little need to further stress the importance of recycling - the message is already out in Ontario. With that being said, it is time to update and refine the message to reflect specific situations (multi-residential buildings and public spaces) and address key issues (changing demographics, i.e. how do you effectively communicate the why/how/where of recycling programs to ethnic minorities). Over time, through a combination of P&E and improved recycling capacity, Ontario may be able to achieve higher recovery rates for the full spectrum of materials found in the residential recycling stream.

5.3 Policy # 3: Evaluating the effects of unit based waste disposal schemes on the collection of household recyclables in Ontario, Canada

Lakhan, C. (2015) "Evaluating the affects of unit based waste disposal schemes on the collection of household recyclables" *Resources Conservation and Recycling*, 2(95):38-45

In North America, pay as you throw and unit based pricing of residential waste has become an increasingly popular mechanism for financing residential solid waste management and encouraging household waste reduction. Under this scheme, households are charged based on the amount of waste they put out for collection as opposed to paying a fixed fee for service. The U.S Environmental Protection Agency estimates than 26% of all communities in the United States implement some form of unit based pricing (USEPA, 2007). The intuition behind PAYT systems is that households will recycle more, compost more and reduce the demand for landfill and incineration services. Further to this point, unit-based pricing ensures that municipalities do not bare an inordinate share of the costs in managing residential waste generation.

Conventional economic reasoning would support these claims, as pay as you throw pricing promotes the efficient use of waste management services. Under a fixed fee system, once the initial fee has been paid, the household marginal cost of increased waste disposal is the effort expended in sorting, storing and setting out more waste for collection. The marginal cost to the municipality as a whole is much greater, as provisions must be made for increases in waste generation (adequate landfill infrastructure, curbside collection of waste etc.) (Fullerton and Kinnaman, 1996). This disequilibrium in the marginal cost of waste disposal gives rise to inefficiency, as households will overuse waste management services relative to the true operating cost of the system.

This research concerns itself with the effect of PAYT systems on residential recycling rates in Ontario, Canada. Currently, 125 provincial programs implement pay as you throw systems for residential waste disposal. As demonstrated by Callan and Thomas (2006), in the presence of a curbside recycling program, increases in the cost of waste disposal reduce the relative cost of recycling, thereby incentivizing source separation of recyclables. While there is significant research supporting the efficacy of PAYT systems in increasing household recycling, this paper investigates whether the effectiveness of user pay schemes changes in the presence of recycling legislation and/or limits on household recycling. Using a combination of panel and semi structured survey data from provincial municipalities, this research explores the following questions:

1) Do municipalities that implement PAYT systems recycle more than those that do not?

2) Does mandatory recycling legislation enhance or detract from the effectiveness of PAYT systems (as a tool to promote waste diversion)?

3) Does the provincial provision of one recycling bin per household provide sufficient recycling capacity for households in areas with PAYT systems?

4) Does the presence of PAYT systems significantly modify household waste disposal behaviour?

Of note, this study does not explore how PAYT schemes in Ontario affect household waste generation. The data used in this study pertains only to the quantities of printed paper and packaging waste recycled - at this time, information on household waste generation by municipality was not available. While a rich scholarship exists that specifically explores the effects of PAYT systems on quantities of household waste generated (see Park, 2009; Folz and Giles, 2002 ; Bauer and Miranda, 1996), it is recommended that additional research in this area be conducted in an Ontario context.

This study does not attempt to provide any definitive guidance regarding the appropriateness of PAYT systems as a waste diversion strategy. However, it does build upon the existing discourse by exploring conditions that may impact the effectiveness of PAYT in promoting household recycling. To date, this is the only study of its kind to explore the relationship between recycling legislation, recycling bin capacity and PAYT effectiveness. A further unique aspect of this research is the use of both community and household level data. This is advantageous for two reasons: 1) Using community level data allows for an easier comparison of communities with user pay and flat fee systems, and 2) The use of household level data allows for the capture of local characteristics that may impact waste disposal and diversion. A combination of both data types enables meaningful and credible analysis related to effects of PAYT and user pay systems on waste diversion.

5.3.1 Materials and Methods

Please refer to chapter 3, section 3.6 for details on the data used in this study.

5.3.1.1 What's being tested and expected results

To determine whether recycling PAYT systems are achieving their intended objective, weighted average recycling rates and net program costs for municipalities with PAYT were compared against those without user pay systems. Weighted averages are used to reflect the relative contribution of tonnages for each municipality. These results were then graphed and shown in figures 49 and 50 respectively. Data from each of Ontario's 223 municipalities (over the 10 years included in the data set) were aggregated and subsequently analyzed in Microsoft Excel. Of note, this study makes no distinction between bag limits and pay as you throw schemes. Based on the way the data was presented in the WDO data call summary files, how municipalities choose to implement restrictions on waste disposal could not be determined. Municipalities with PAYT policy have a Y in the PAYT column in the WDO summary file, while those that don’t have an N. No rationale is provided as to why this information is summarized in this fashion, although one may posit it may have to do with the potential sensitivity surrounding revealing what individual municipalities charge for bag limits (if any). As such, the terms bag limits and PAYT are used interchangeably, though there is a distinction between the two policies in and of themselves. Our expectation was that municipalities that implement volume/weight based pricing for waste disposal will achieve higher recycling rates than those that do not (as noted in the literature by Podolski & Siegel (1998), Jenkins (1993) and Hong (1999). Conversely, we also expect that program costs for municipalities who implement PAYT programs will be higher due to the additional resources required in administering and enforcing bag limit policy. Revenues received by municipalities in receipt from PAYT programs could not be calculated as the WDO data call does not quantify this amount. This revenue may be sufficient to offset part, or all of the administrative costs of implementation and administration of PAYT policy. It is the recommendation of future studies that an effort be made to evaluate how PAYT revenues affect recycling program costs.

To provide further context to these results, survey data from recycling stakeholders was analyzed to see how they perceive the implementation and effectiveness of PAYT systems. Survey results were broken down into separate sections to represent differences in stakeholder responses (households, municipal waste managers and packaging producers). Surveys were administered in communities that implement some form of PAYT policy. We first begin by exploring the effects of recycling bin capacity, mandatory recycling legislation and bag limit enforcement on self-reported recycling behavior among householders. This is then followed by a review of how municipal waste managers and recycling stakeholders perceive PAYT policies and their effectiveness to date.

While there is no precedent in the literature to indicate how factors such as bin capacity and recycling legislation impact the efficacy of PAYT systems, we can intuit the following:

1) In the absence of sufficient recycling bin capacity, residents will place more recyclable material in the waste stream. In the presence of a garbage bag limit, residents may be more inclined to dump excess material illegally.

2) In the presence of mandatory recycling programs (where all households are legally obligated to source separate recyclables from the waste stream), the efficacy of PAYT systems is indeterminate.

Arguably, PAYT schemes can be seen as a complimentary policy to existing waste management legislation. Conversely, given that the intended objective of PAYT and mandatory household recycling is the same, PAYT systems may prove ineffective due to the redundancy of the policy effect.

3) The efficacy of PAYT systems is highly dependent on whether it is actually enforced by municipal officials. If households are able to exceed the designated bag limit without facing a penalty for doing so, the effectiveness of PAYT systems greatly diminishes.

Further to this analysis, survey data was used to determine the prevalence of illegal dumping and garbage "switching" in communities with garbage bag limits. An analysis of household survey responders. A potential limitation of this study is that it does not take into account the types of PAYT schemes implemented by municipalities in Ontario. Due to the nature in which data is submitted to the WDO data call, municipalities only respond “Yes” or “No” when indicating whether they implement some form of unit based pricing on garbage disposal. The amount that households are charged for excess waste, and the number of allowable bags, is set at the discretion of the municipality, and may change from year to year. A worthwhile future study would be an examination of how different fee schedules and bag limits affect household recycling behavior.

An elaboration of the empirical methodology is done in the results and discussion section in order to explain how the aforementioned relationships are examined and analyzed.

5.3.2 Results and Discussion

5.3.2.1 Relationship between PAYT systems and municipal recycling rates

As noted earlier, the purpose of this study was to determine the effect of PAYT systems on municipal recycling rates. To do so, weighted average recycling rates for programs with and without PAYT systems were calculated and compared. This was done on both a system wide (all 223 municipalities in Ontario) and region specific (using the 9 municipal groupings specified by the WDO) basis. These results have been graphed and are illustrated in figures 49 and 50 respectively.

*Figure 49**: Comparison of Recycling Rates Between Programs With and Without PAYT (System Wide)***

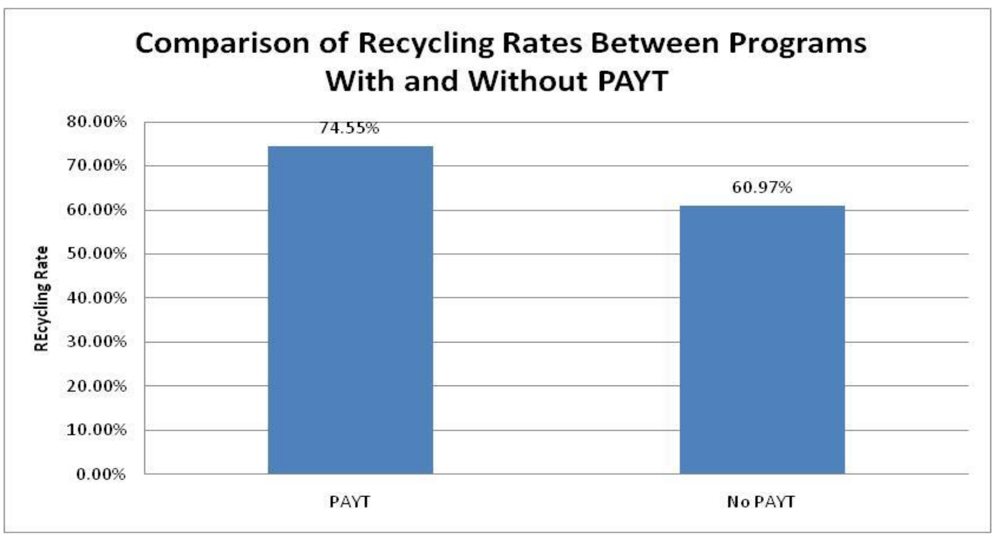
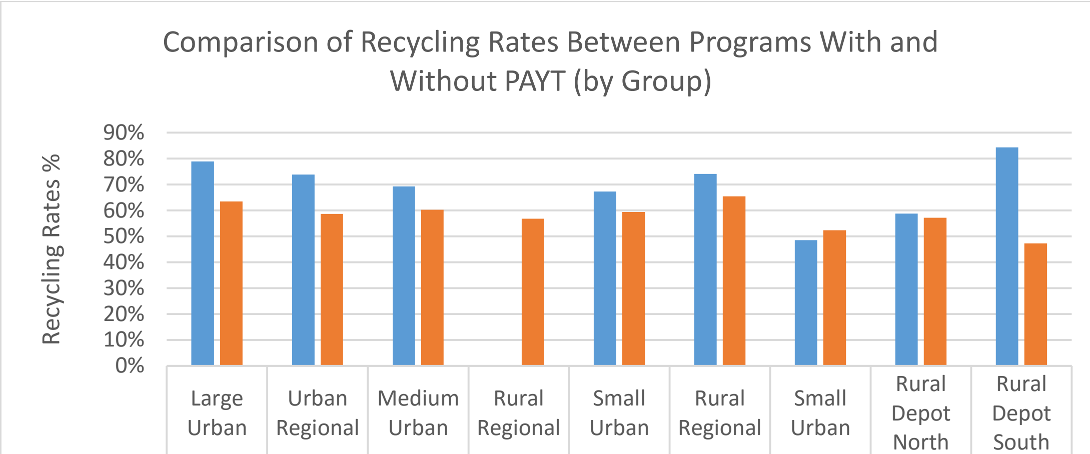


Figure 50: ***Comparison of Recycling Rates Between Programs With and Without PAYT (By municipal group)***



	Large Urban	Urban Regional	Medium Urban	Rural Regional	Small Urban	Rural Regional	Small Urban	Rural Depot North	Rural Depot South
PAYT	79%	74%	69%		67%	74%	49%	59%	84%
NO PAYT	63%	59%	60%	57%	59%	65%	52%	57%	47%

As shown in figure 49, weighted average recycling rates for programs with PAYT systems are, on average, ~13.5% higher than municipalities without unit based garbage pricing schemes. This is consistent with previous findings from the literature (see Hong, 1999 and Fullerton and Kinnaman, 1997), although the magnitude of the differences in recycling rates was larger in this study. When looking at differences in recycling rates by regional group (shown in figure 50), we observe an interesting phenomenon - the effectiveness of PAYT schemes diminishes the further you go outside major urban areas. It should be noted that we must be cautious when attempting to generalize these results. While moving outside of large urban areas does suggest that PAYT programs diminish in their efficacy, group 9 (Rural Depot south) does indicate that PAYT programs enjoy higher recycling rates than non PAYT programs. In Group 1 (Large Urban) differences in recycling rates between PAYT and non PAYT municipalities was 15.5%. However, as you move from Large Urban to Medium Urban and then Rural Regional groups, the gap in recycling rates narrows. For municipal groups 7 (Small Urban) through 8 (Rural Depot North), there is no appreciable difference in recycling rates between municipalities who choose to implement PAYT systems and those that don't. While it is difficult to isolate the reason for why this occurs, results from surveys with householders in section 5.4 may, in part, shed light on this issue. Enforcement of garbage bag limits by the municipality tends to be much higher in urban areas. There are also fewer opportunities for households to illegally dump garbage in densely populated communities. As you move outside of Ontario's major urban centers, the effect of PAYT on household recycling decreases, as it is not perceived as being enforced consistently.

Table 48 below summarizes the results of a two tail t test to determine whether differences in municipal recycling rate values are explained by chance, or measurable differences between PAYT and non PAYT municipalities. For all groups (with the exception of Rural Regional, which does not have a PAYT program), differences in recycling rates are statistically significant.

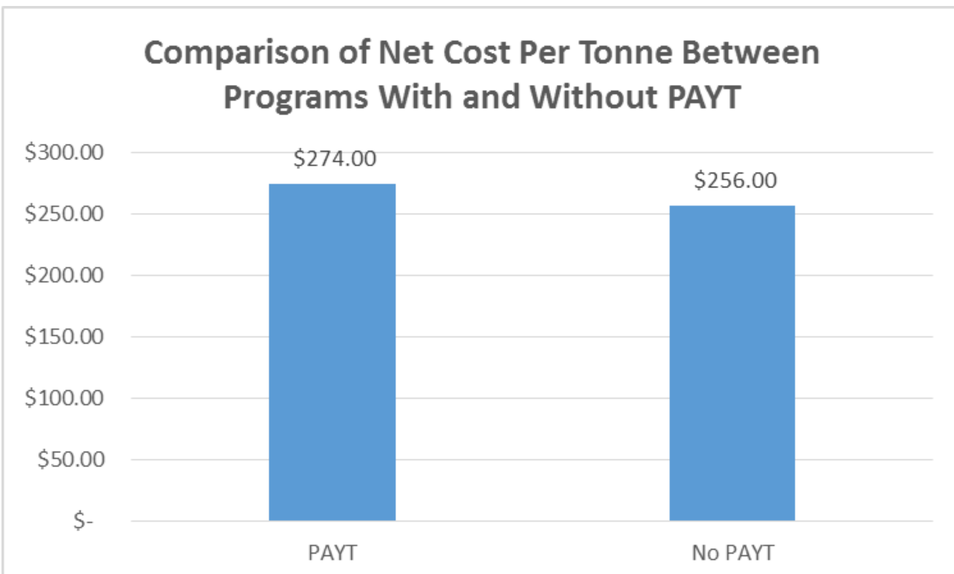
Table 48: ***Two Tail T Test (Municipal Recycling Rates)***

Municipal Group	t	p	DF
Large Urban	4.015	0.001*	60
Urban Regional	4.073	0.001*	60
Medium Urban	3.819	0.001*	70
Rural Regional			140
Small Urban	3.707	0.001*	230
Rural Regional	3.659	0.001*	320
Small Urban	3.646	0.001*	630
Rural Depot North	3.195	0.001*	460
Rural Depot South	3.232	0.001*	330

5.3.2.2 Relationship between PAYT systems and municipal program costs

A secondary objective of this study is to determine the effect of PAYT systems on municipal program costs. Weighted average net costs (expressed on a per tonne basis) for programs with and without PAYT systems were calculated and compared (Note: Net cost is calculated by taking the gross cost of material management reported by the municipality and subtracting revenues received from the sale of recyclable material). This was done on both a system wide (all 223 municipalities in Ontario) and region specific (using the 9 municipal groupings specified by the WDO) basis. These results have been graphed and are illustrated in figures 51 and 52 respectively.

Figure 51: ***Comparison of Weighted Average Net Cost Per Tonne for Programs With and Without PAYT (System Wide)***



As shown above, the net cost of material management (on a per tonne basis) is approximately 8 percent higher in municipalities that implement some form of unit based pricing for weight disposal. This is once again consistent with our understanding of the costs incurred for administering, maintaining and enforcing PAYT systems in a community. Additional resources are required for waste collectors to "ticket/fine" households for setting out more than the designated limit of garbage bags. However, when looking at material management costs by municipal group (as shown in figure 52), we notice that PAYT municipalities classified as "Large Urban" actually have lower material management costs than those that don't. At this time, it is unclear as to why this is result occurred - there may be certain infrastructural and operational characteristics for PAYT municipalities in group 1 that result in lower material management costs on the whole. Densely populated urban areas tend to enjoy cost advantages relative to other areas on the whole – independent of PAYT policy. Collection costs, on average, tend to be lower in urban areas as a greater quantity of households can be serviced per trip (due to population density). Urban areas also tend to generate a "critical mass" of recyclables that are required to make curbside collection an economically viable waste management option. An analysis of groups 2 through 9 produced results more in line with our previous expectation. PAYT municipalities, on average, face higher material management costs than municipalities who do not impose bag/volume limits on household waste. However, as observed in section 5.3.2.1, the implementation of PAYT systems in groups 6 through 9 fails to result in appreciably higher recycling rates. Given that these programs are facing higher material management costs (in part due to the administrative burden of implementing PAYT schemes), it calls into question whether garbage bag limits are an appropriate policy for encouraging household waste diversion.

Figure 52: ***Comparison of Weighted Average Net Cost Per Tonne for Programs With and Without PAYT (By municipal group)***

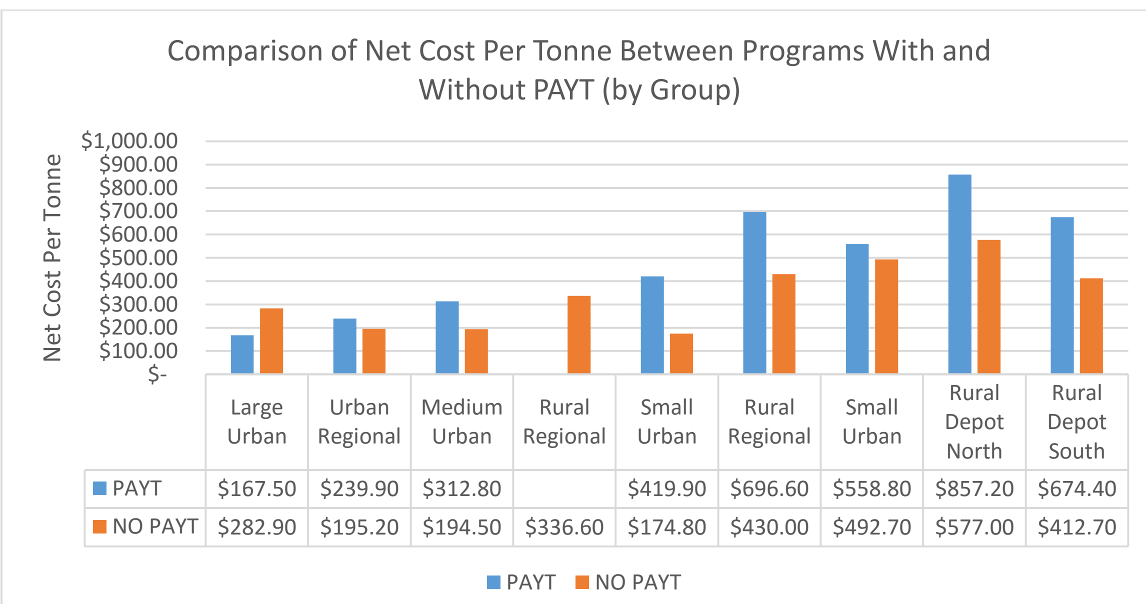


Table 49 below summarizes the results of a two tail t test to determine whether differences in municipal net cost per tonne values are explained by chance, or measurable differences between PAYT and non PAYT municipalities. For all groups (with the exception of Rural Regional, which does not have a PAYT program), differences in net cost per tonne are statistically significant.

Table 49: ***Two Tail T Test (Net Cost Per Tonne)***

Municipal Group	t	p	DF
Large Urban	3.837	0.001*	60
Urban Regional	4.197	0.001*	60
Medium Urban	3.828	0.001*	70
Rural Regional			140
Small Urban	3.396	0.001*	230
Rural Regional	3.421	0.001*	320
Small Urban	3.551	0.001*	630
Rural Depot North	3.837	0.001*	460
Rural Depot South	3.745	0.001*	330

5.3.2.3 Analysis of Household Survey Responses

7 geographical regions (as specified by Waste Diversion Ontario) were targeted to complete questionnaires pertaining to daily household recycling activity. Geographic regions are defined by population density, geographic location and collection type (curbside collection vs. depot systems). Note: Groups 8 and 9 were excluded from the analysis, as these regions are serviced by depot based programs.

These groups include:

1) Large Urban (Toronto, Peel Region)

2) Urban Regional (Barrie)

3) Medium Urban (Windsor)

4) Rural Regional (Peterborough)

5) Small Urban (Orangeville)

6) Rural Collection – North (Timmins)

7) Rural Collection – South (North Glengary)

These groups were selected on the basis that they adequately represent the geographic differences in the province. Survey data surrounding household perceptions of and response to PAYT schemes is summarized based on the answers provided by respondents.

Table 50 describes the statements that were used in the survey to elicit household's experience, knowledge and attitudes towards pay as you throw policy along with the respective distribution of Likert scale responses. A five point Likert scale was used to measure respondent's answers (Strongly Disagree, Somewhat Disagree, Neither Agree or Disagree, Somewhat Agree, Strongly Agree). A total of 228 household survey responses were collected. The results of household surveys are shown in figure 53.

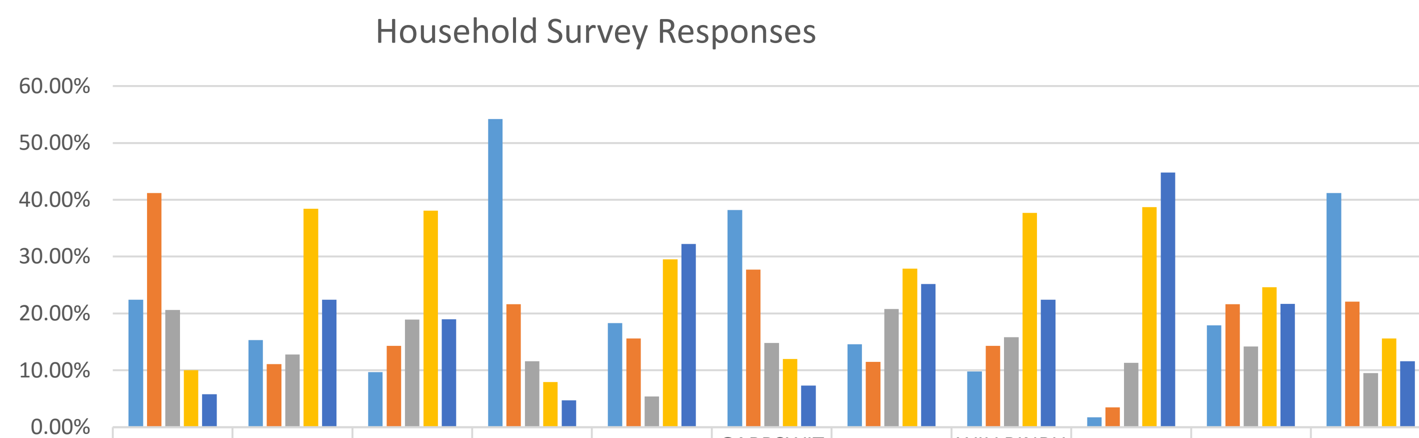
Table 50: ***Description of Household Survey Statements (PAYT)***

Survey Code	Survey Statement
LIMIT	"I am aware that the city imposes limits on how much garbage I can place on my curb"
FEE	"I pay a fee for putting out more garbage bags than the city allows"
ENFORCE	"The city enforces their garbage bag limit policy"
ULIMIT	"I put out more garbage on days where the city has unlimited garbage pickup"
BINCAP	"My recycling bin has enough space for the amount of recyclables my house generates"
GARBSWITCH	"I put my recyclables in the garbage bin because I don't have enough space in my recycling bin"
BINBUY	"I know that I can purchase additional recycling bins and bags from the city"
WILLBINBUY	"I am willing to purchase additional recycling bins to store my recyclables"

IDUMP	"I illegally dump garbage to avoid paying the bag limit fee"
NDUMP	"I notice my neighbors illegally dumping garbage to avoid paying the bag limit fee"
AWARER	"I know that recycling is mandatory in Ontario"

*Figure 53: **Household Survey Responses (PAYT)***

Number of Observations: 228



	LIMIT	FEE	ENFORCE	ULIMIT	BINCAP	GARBSWITCH	BINBUY	WILLBINBUY	IDUMP	NDUMP	AWARER
Strongly Agree (5)	22.40%	15.30%	9.70%	54.20%	18.30%	38.20%	14.60%	9.80%	1.75%	17.90%	41.20%
Agree (4)	41.20%	11.10%	14.30%	21.60%	15.60%	27.70%	11.50%	14.30%	3.50%	21.60%	22.10%
Neither Agree Nor Disagree (3)	20.60%	12.80%	18.90%	11.60%	5.40%	14.80%	20.80%	15.80%	11.30%	14.20%	9.50%
Disagree (2)	10.00%	38.40%	38.10%	7.90%	29.50%	12.00%	27.90%	37.70%	38.70%	24.60%	15.60%
Strongly Disagree (1)	5.80%	22.40%	19.00%	4.70%	32.20%	7.30%	25.20%	22.40%	44.80%	21.70%	11.60%

*Table 51: **Mean Score and Standard Deviation of Household Survey Responses (PAYT)***

Survey Statement	**LIMIT**	**FEE**	**ENFORCE**	**ULIMIT**	**BINCAP**	**GARBSWITCH**	**BINBUY**	**WILLBINBUY**	**IDUMP**	**NDUMP**	**AWARER**
Mean	3.64	2.12	2.58	4.13	2.61	3.78	2.62	2.51	1.79	2.89	3.84
Standard Deviation	1.12	1.24	1.18	1.35	1.51	1.27	1.36	1.25	0.89	1.43	1.44

Awareness and enforcement of PAYT systems

Awareness

Survey statement:

(1)"I am aware that the city imposes limits on how much garbage I can place on my curb"

63.6% of respondents indicated they either agreed, or strongly agreed with the above statement. Differences in awareness were observed among the seven communities targeted in the study. Communities situated in densely populated urban areas demonstrated higher levels of awareness than those located in rural or northern areas.

Of the 36 respondents who indicated that they either disagreed or strongly disagreed with the statement, all were from regions classified as rural.

Enforcement

Survey Statement:

(1)"I pay a fee for putting out more garbage bags than the city allows"

(2)"The city enforces their garbage bag limit policy"

60.8% of respondents disagreed or strongly disagreed when read the statement regarding fee payment. The majority of respondents indicated they rarely or never pay fees for placing excess garbage on the curbs. This result was reinforced when the follow up statement regarding enforcement was asked, where only 24% of respondents agreed that their city enforces garbage bag limit policy.

Once again, regional differences were observed in the perceived level of PAYT enforcement, with 37.5% of survey respondents from urban communities answering that PAYT schemes were enforced to some degree. This is compared to only 17.2% of respondents in rural and northern communities who felt that garbage disposal limits were being enforced. This disparity in the perceived level of enforcement among urban and rural/northern areas may also explain the difference in PAYT awareness. Generally speaking, there is very little communication on the part of the municipality in informing residents that PAYT systems are in effect in a given area. Thus, policy awareness becomes a function of whether bag limits are being enforced - unless households observe the policy in effect, they are ignorant to its existence.

<u>Capacity of Recycling Bins</u>

Survey Statement:

(1)"I put out more garbage on days where the city has unlimited garbage pickup"

(2)"My recycling bin has enough space for the amount the recyclables my house generates"

(3)"I put my recyclables in the garbage bin because I don't have enough space in my recycling bin"

(4)"I know that I can purchase additional recycling bins and bags from the city"

(5)"I am willing to purchase additional recycling bins to store my recyclables"

The above group of questions were asked to respondents to gauge whether there was sufficient recycling bin capacity given the amount of waste/recyclables generated by households. Gauging whether there is sufficient recycling capacity is of particular importance in PAYT systems, as PAYT systems are only effective if recycling bins have sufficient capacity to allow for recyclable material that would otherwise be placed in the waste stream.

Overwhelmingly, respondents indicated that there was insufficient recycling bin capacity (61.7%) with a majority of respondents indicating that they were forced to put items they identified as recyclable in the garbage due to insufficient space in the recycling bin (65.9%). Respondents also indicated that they stockpiled garbage due to bag limit policy, waiting for "Unlimited"* garbage days by the city before placing all material out on the curb. *Some municipalities have special days where they remove the limits on the number of garbage bags set out by households.

Despite the dearth of recycling bin space for households, a majority of survey respondents indicated that they were unaware that they could purchase additional recycling bins or bags (53.1%) and were seemingly unwilling to do so (with 60.1% of respondents indicating that they disagreed or strongly disagreed with the statement "I am willing to purchase additional recycling bins to store my recyclables").

This suggests that while households are generally in favour of recycling, they are unwilling to incur additional costs beyond the time it takes to source separate recyclables.

<u>Illegal Dumping of excess garbage</u>

Survey Statement:

(1)"I illegally dump garbage to avoid paying the bag limit fee"

(2)"I notice my neighbours illegally dumping garbage to avoid paying the bag limit fee"

5.25% of respondents admitted to illegally dumping waste generated by their households (i.e. in neighbours garbage bins, community dumpsters, public space garbage bins etc). This number may be under reported, as 39.5% of respondents said that they witnessed other members of their community illegally dumping garbage. Given the potentially sensitive nature of the question (households are fined for the act), it seems likely that respondents are unwilling to divulge their propensity to illegally dump material. Of note, of the 12 respondents who admitted to illegal dumping, all lived in areas classified as either rural or northern communities. As noted by the USEPA (2007), illegal dumping is more likely to take place in remote areas where access to recycling services are limited. Further to that point, rural communities provide more opportunities to dispose of material in a clandestine manner relative to densely populated urban areas.

5.3.2.4 Open Ended Analysis

For open ended survey questions, all survey responses were recorded, transcribed and reviewed to identify thematic categories and codes. Respondents were asked to answer two open ended questions related to PAYT schemes: 1) Do you think garbage bag limits are a good thing? Please explain your answer, and 2) Would you still recycle if your city eliminated limits on the amount of garbage bag you could put out? Please explain your answer. Respondents were asked to answer freely, and did not receive any additional input or instructions from the enumerator (beyond issues of clarification).

After a careful review of the interviews with each of the 228 respondents, nine and eight coding categories were identified for open ended questions one and two respectively. These findings have been summarized in table 52 below:

Table 52: ***Coded Responses (PAYT)***

Do you think garbage bag limits are a good thing?	
Positive Attitudes (Yes)	Negative Attitudes (No)
"Good for the environment" – 57 “Less garbage goes to the landfill” - 34 “Reduces pollution” -15 "Promotes recycling" - 63 "Stops wasteful behavior" – 84 “Less garbage goes to the landfill” - 54	"Should be eliminated" - 97 "Inconsistent enforcement" - 55 "Unfair" - 112
Would you still recycle if your city eliminated limits on the amount of garbage bag you could put out?	
Positive Attitudes (Yes)	Negative Attitudes (No)
"I am legally obligated to" - 178 "It's the right thing to do" - 91 "It's good for the environment" - 29 "Reduces litter" - 16 "Sets a good example" - 10	"Saves me time" - 34 "Don't care" - 14 "Doesn't make a difference" - 11

Codes have been organized into two additional container categories indicating positive/negative attitudes towards pay as you throw policy and recycling as a whole.

A "best fit" approach was utilized to categorize respondent's answers. For example, "It makes people throw away less garbage" was coded under the stops wasteful behavior category. The results from our analysis suggest that the majority of respondents viewed garbage bag limits unfavorably. 57% of respondents (130 of 228) thought that PAYT schemes should be eliminated, citing reasons such as being unfair, inconsistently enforced and time consuming. Many respondents viewed bag limits as a form of tax grab by the city, and did not understand why they were being forced to pay both a property tax and bag fee. Anecdotes such as "my neighbor throws away more than two bags nearly every week, but never pays a fee" were noted during the interviews. For these respondents, the objection to bag limits was not attributed to the policy itself, but its lack of enforcement. Respondents indicated that bag limits were a waste of time if the policy was not going to be consistently and uniformly enforced.

Conversely, 98 respondents felt that bag limits should not be eliminated, and served a role in promoting recycling and environmental wellbeing, while serving as a deterrent to wasteful behavior. 14.9% of respondents felt that bag limits reduced the amount of material being sent to the landfill, which in turn was good for the environment. 6.5% of respondents felt as though bag limits reduced pollution (it was unclear as to what respondents meant by pollution), while 25% felt that it was good for the environment. The general opinion of respondents who viewed bag limit policy favorably was that it prevented unnecessary excess. More than 36% of respondents felt that bag limits prevented wasteful behavior.

Overwhelmingly, survey participants indicated that they would continue to recycle even if PAYT policy was eliminated. The primary reason given by respondents was that recycling was legally mandated by the province, so the threat of penalty remained even with bag limit fees removed. As per Ontario regulation 101/94, every municipality in the province with a population greater than 5000 people must implement a residential recycling program. This result, coupled with the findings from our statistical analysis, indicate that there is a synergistic effect between mandatory recycling legislation and bag limit policy. While most people recycle because of a legal obligation, they will recycle more because of garbage bag limits. Moral imperative and personal concern for the environment also ranked highly on reasons for continued recycling among respondents, as many indicated that recycling was "the right thing to do" and "good for the environment". Of the 48 respondents who said they would stop recycling if PAYT systems were eliminated, 14 indicated that they did not care about recycling, while the remaining 34 said that recycling required too much time to sort through the garbage and store recyclable material separately.

Table 53 provides the summary statistics for responses provided by the 228 survey respondents. Age and Gender are included as demographic variables, while Income and Education are used as socioeconomic controls. Education was coded as a four point categorical scale, with higher values indicating greater levels of educational attainment. For the income variable, respondents were asked to select from five income ranges that best represents their earnings, not actual values. Gender is coded as a dummy variable, 1 = male, 0 = female.

Table 53: ***Summary Statistics of Survey Participants (PAYT)***

Variable	Mean/Percent
Gender	49.2%[1]
Age	41.2
College	51.5%[2]
Income	$45,000-$60,000

[1]Percentage of respondents who identified as being male (else female)

[2]Percentage of respondents with college education or higher

An ordered logit model is used to test for any relationships between the survey responses and socioeconomic/demographic variables, as well as locality.

Table 54 presents the ordered Logit results for the 11 dependent variables taken from the survey data.

As can be seen, municipal group (municipality's location) has the greatest bearing on attitudes towards and perception of PAYT policy among study participants. In 9 of the 11 dependent statements taken from the survey data, municipal grouping had a statistically significant influence. Consistent with our expectation, municipalities classified as rural and/or northern reported inconsistent enforcement of PAYT policy, higher incidences of illegal dumping and less awareness surrounding the implementation of said policy. Of note, there was an inverse relationship between stated income levels and the survey statement "My recycling bin has enough space for the amount of recyclables my household generates". Respondents with higher levels of income reported having insufficient space for recyclables in their Blue Bin. This would suggest a positive relationship between income and household waste generation, a finding that has mixed empirical support (see studies by Studies by Sivakumar and Sugirtharan (2010); Dyson et al. (2005)). Other salient findings gleaned from Table 13 indicate that awareness of Ontario's mandatory recycling policy is a function of both age and education. Generally speaking however, age, income and gender had little bearing on how study participants responded to survey statements.

Table 54: ***Ordered Logit Model of Demographic/Socioeconomic variables on Attitudes towards PAYT Policy***

VARIABLE	**LIMIT**	**FEE**	**ENFORCE**	**ULIMIT**	**BINCAP**	**GARBSWITCH**	**BINBUY**	**WILLBINBUY**	**IDUMP**	**NDUMP**	**AWARER**
GENDER	0.380	-0.021	-0.144	0.875*	0.011	0.644	0.244	-0.142	0.141	0.021	0.004
AGE	0.727	0.061	0.191	0.884	0.445	0.122	0.412	0.754	0.143	0.174	0.947*
INCOME	-0.019	0.015	0.087	-0.215	-1.794**	-0.248	0.341	0.633	-0.054	-0.782	0.874
EDUCATION	0.083	-0.002	0.004	-0.045	-0.244	-0.211	0.774	0.716	-0.035	-0.225	1.133*
MUNICIPAL GROUP	YES***	YES***	YES**	YES**	YES*	YES**	YES*	YES	YES	YES***	YES**

***P = 0.1; **P = 0.05, ***P = 0.01**

5.3.2.5 Analysis of municipal waste manager and packaging producer survey responses

Survey data surrounding municipal waste managers and packaging producers' perception of PAYT policy and their effectiveness are summarized in Tables 55 and 56. Much like the household surveys, municipal waste managers and packaging producers were read a series of statements regarding PAYT policy, and asked to indicate their level of agreement/disagreement with the statement. A five point Likert scale was used to measure respondent's answers (Strongly Disagree, Somewhat Disagree, Neither Agree or Disagree, Somewhat Agree, Strongly Agree). These results from the respective stakeholders (municipal waste managers and packaging producers) were compared and contrasted to elucidate any differences in their responses. Given that these two groups traditionally have competing interests and policy objectives, I thought it might be useful to measure differences (if any) in how they perceived policies such as PAYT. The most frequently coded responses from municipal waste managers during the semi structured interviews are also included. It should be noted that interviews conducted with packaging producers regarding PAYT policy and experiences resulted in limited feedback. Packaging producers acknowledged that were not overly familiar with how such policies were implemented, or the challenges associated with them. Beyond comments with respect to the perceived effectiveness of PAYT policy, most declined to offer any additional commentary or provide any personal anecdotes.

Table 55: ***Municipal waste managers PAYT survey***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I think that pay as you throw schemes are an effective way to increase household recycling	32.7%	35.8%	12.4%	14.1%	5%	4.14	1.11
Pay as you throw policies are an easy policy to enforce	10.3%	13.7%	20.8%	33.8%	21.3%	2.54	1.21
Pay as you throw policy requires significant administrative and staffing resources	28.9%	40.7%	11.4%	6.6%	13.4%	4.19	1.25
Pay as you throw policy results in households illegally dumping garbage	27.8%	22.5%	19.7%	20.8%	9.2%	2.61	1.17
Pay as you throw schemes should be promoted as a recycling best practice	22.7%	30.6%	12.7%	20.6%	13.4%	4.12	1.28
Coded Comments from Interviews							
"Effective" - 25 "Costly" - 18 "Illegal Dumping" - 14 "Administrative Burden" - 14 "Best Practice" - 9							

Table 56: ***Packaging Producers PAYT Survey***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I think that pay as you throw schemes are an effective way to increase household recycling	24.8%	26.1%	15%	18.3%	15.8%	3.92	1.22
Pay as you throw schemes should be promoted as a recycling best practice	28.5%	31.5%	14.7%	18.6%	6.7%	3.98	1.25

The vast majority of both municipal waste managers and packaging producers agreed (or strongly agreed) with PAYT schemes being an effective way to increase household recycling (although municipal waste managers indicated higher levels of agreement (68.5% vs 50.9%). Only 16% of municipal waste managers did not believe PAYT schemes were an effective method for improving diversion (compared to 34.1% of packaging producers). Despite municipal waste managers viewing PAYT policy as more effective than packaging producers, they expressed lower levels of agreement when read the statement "Pay as you throw schemes should be promoted as a recycling best practice" (53.3% vs. 60%). This result was surprising, particularly given the perceived efficacy of PAYT in promoting household recycling among municipal waste managers. To understand this unexpected result, we turn to examining the additional survey responses provided by municipal waste managers.

Despite the effectiveness of PAYT policy, most municipal waste managers felt PAYT schemes were difficult to administer and implement (with more than 50% of all municipal waste managers disagreeing (or strongly disagreeing) with the statement "Pay as you throw policies are easy to implement"). Survey respondents also indicated that PAYT policy posed an administrative burden, with 69.6% of municipal waste managers feeling PAYT policy required significant staffing resources. Anecdotes provided by municipal waste managers during the semi structured interview suggested that PAYT policies were only effective if they were being enforced (a result that is confirmed during interviews with households). Some municipalities, particularly those in rural and northern areas, lack the necessary resources to ensure households are complying with bag limit policy. Several participants from the waste manager survey also indicated that enforcement of bag limit policy actually encouraged disposing of waste illegally among households. 53.3% of municipal waste managers felt PAYT policies gave rise to illegal dumping of garbage in their communities. Illegal dumping of garbage in public space areas result in additional costs incurred by the municipality - costs that they are unable to recover under the province's existing producer responsibility model. In Ontario, municipalities are only eligible to receive reimbursement for waste collected from households. When waste is illegally disposed of in places like parks, dumpsters etc, the municipality must bear the entire cost for managing that material.

The concerns expressed by municipal waste managers in this study's survey echo the sentiments expressed by others in the existing literature on PAYT policy. While few dispute the effectiveness of PAYT schemes in promoting diversion, there remains considerable debate as to whether such policies are worth the accompanying administrative challenges.

5.3.3 Conclusion

While the results of this paper further substantiate the efficacy of PAYT systems in promoting waste diversion, the findings from the survey study suggest there are opportunities for further improvement.

Municipalities need to make greater efforts in making the community aware that PAYT systems are being enforced in their areas. Further to that point, municipalities must be sure to enforce penalties for exceeding the designated bag limit to ensure the continued efficacy of user pay garbage systems. Additional efforts should also be made to increase the capacity of recycling bins, or alternatively, make provisions for more than one bin per household. The results from our survey suggest that recyclable material is ending up in the waste stream due to insufficient recycling bin capacity. Furthermore, most household survey respondents indicated that they would be unwilling to purchase additional Blue Bins or recycling bags. As such, recycling rates may further be improved by providing additional storage for recyclables. It should be noted that municipalities must weigh any potential benefits in increasing waste diversion against the costs of providing additional recycling bins.

Of note, the findings of this study were not supportive of previous investigations examining household attitudes towards PAYT policy. As noted by both Brown and Johnstone (2014) and Dunne et al. (2008), households living in PAYT communities viewed the policy favourably over time. This study found the opposite to be true, with majority of households expressing displeasure with both the efficacy and fairness of PAYT schemes. This could be due to the perceived inefficiencies of PAYT implementation (lack of Blue Bin space, lack of enforcement) in Ontario. While exposure to PAYT policy has been shown to positively affect attitudes towards user pay garbage systems, public support for such policies is a function of a multitude of factors - including a broad range of environmental and economic considerations (Brown and Johnstone, 2014). It seems plausible that sentiment towards PAYT policy in Ontario may change if municipalities can improve upon policy implementation.

Additional research needs to be done in the above areas (particularly surrounding the effects of PAYT policy on household waste generation in Ontario), as the effectiveness of PAYT schemes may be further improved with modifications to how such systems are enforced, implemented and financed.

5.4 Policy # 4: A comparison of single and multi-stream recycling systems in Ontario, Canada

Lakhan, C. (2015) "A Comparison of Single and Multi-Stream Recycling Systems in Ontario, Canada" *Resources*, 4:384-397

The management of municipal solid waste remains at the forefront of policy planning debate and discourse in North America. Increases in urban waste generation, coupled with decreases in available landfill space, necessitate the implementation of comprehensive and cost effective waste diversion programs. However, the terms comprehensive and cost effective are often (but not always) dichotomous with one another. Recycling is an enormously costly waste management strategy for municipalities, particularly when compared to conventional land filling and incineration options. As such, many jurisdictions have chosen to implement policy measures designed to increase both waste diversion and the operational efficiency of household recycling programs.

One such policy is the implementation of single stream recycling, a recycling system in which household recyclables are collected in a single commingled container. Waste generators (primarily households) are asked to place all eligible recyclables in a designated bin/cart provided by the municipality. Collection vehicles then collect and transport commingled recyclables to a material recycling facility (MRF) that is specially configured to sort and process commingled loads of recyclables. Single stream collection is an alternative to the more conventional multi-stream recycling, where recyclables are source separated into their respective material types at the point of generation (paper fibers, glass, plastics etc.). There is an increasing trend by municipalities in Ontario, Canada to move towards single stream systems, as it is seen as a means to:

- Reduce material management costs - collection costs are reduced, as collection vehicles only have to pick up one container per pickup, reducing stop times
- Increase recycling convenience for households, and by proxy, recycling participation - the time investment on the part of households is reduced, as they are not required to source separate recyclables into their respective material types
- Process greater quantities of material at the MRF. The increased levels of mechanization at single stream MRFs allow more material to be sorted in a shorter period of time.

In 2012, Waste Diversion Ontario, in association with the Continuous Improvement Fund and Reclay StewardEdge, published a study touting single stream recycling as a preferred waste management system. In this study, it was recommended that any future MRFs constructed in Ontario be configured as a single stream system. Municipalities are also increasingly making the transition to single stream recyclable collection - for example, the region of Peel (Ontario's second most populous region) abandoned multi stream collection in favor of single stream collection for the reasons listed above. This study seeks to test these assumptions, examining whether single stream recycling is a more cost effective approach for managing recyclables in Ontario. This study also examines whether single stream collection promotes residential recycling more so than multi stream systems.

Using comprehensive panel data from 223 municipalities spanning a ten year period, this study examines the following:

1) Are material management costs for municipalities that implement single stream collection less than those that implement multi stream collection?

2) Are recycling rates for single stream municipalities higher than municipalities with multi stream collection?

3) Do municipalities with multi stream collection realize higher revenues from the sale of recyclable material?

As far as can be ascertained, this is one of the few studies of its kind to examine the differences in material management costs and recycling performance between single and multi stream recycling systems. This topic is of increasing importance, as single stream recycling is being touted as preferred waste management option in both Ontario and abroad.

5.4.1 What are single and multi-stream recycling systems?

Single stream recycling is a system where household recyclables are collected in a single commingled container. Waste generators (primarily households) are asked to place all eligible recyclables in a designated blue box/cart provided by the municipality. Collection vehicles then collect and transport commingled recyclables to a material recycling facility that is specially configured to sort and process commingled loads of recyclables. Single stream MRFs rely on increased levels of mechanization to sort commingled material. Investments in processing technology such as optical sorters (to sort mixed plastics), corrugated cardboard and mixed paper screens and glass breakers are often required in single stream material recycling facilities to ensure commingled material is appropriately sorted.

Multi stream recycling is a collection method in which waste generators are required to source separate recyclables in to two (or more) separate bins (generally, paper fibers are placed in one bin and all other containers (plastics, aluminum etc.) are placed in other bins). Multi stream collection vehicles (that have separate compartments for each bin) then collect and transport recyclables to a multi stream MRF that is specially configured to sort and process source separated recyclables. Multi stream MRFs do not require the same level of mechanization as a single stream MRF, as materials have already been pre-sorted into their respective categories by households. As such, there is a tendency to rely more on manual sorting which requires fewer investments in processing technology.

Both recycling types have their respective advantages and disadvantages. While which system to implement is largely contingent on site specific conditions, single stream recycling often requires significant investments in capital and results in higher levels of recycling contamination and reduced commodity prices as a result of contamination. Manufacturers have reported problems with single stream recycling created by poor quality materials being shipped to their downstream processors (Morawski, 2010). Conversely, multi stream collection is generally seen as having much lower levels of contamination and requiring fewer capital investments at the MRF to sort material. However, multi stream recycling systems are assumed to have higher collection costs, reduced levels of household participation (as a result of households having to take additional time to source separate recyclables into their respective streams), and limited capacity to process large quantities of recyclable material (SWANA, 2007).

5.4.2 Materials and Methods

For the purposes of this study, community level data for Ontario's residential recycling system was obtained from the Waste Diversion Ontario municipal data call. For a full elaboration of the materials used in this study and a description of how surveys were administered, please refer to section 3.67 in Chapter 3.

To compare material management costs between single and multi-stream recycling systems, municipal cost data was extracted from the WDO data call and organized in Microsoft Excel to facilitate program performance comparisons.

Data for each of Ontario's 223 municipalities was organized by recycling system type (single vs. multi stream), collection costs, processing costs, revenue from sale of recyclable material and net recycling costs (calculated as total cost of material management minus revenue). This data was then aggregated for each of the 10 years for which data was made available by the WDO. A total of 2007 data points were included in the cost analysis. Of note: Not all municipalities had entries for every data year. This could be due to the following: 1) some municipalities failed to report costs into the WDO data call, 2) municipal amalgamations over time.

Weighted average collection costs per tonne, processing costs per tonne, revenue per tonne and net costs per tonne were calculated for both single and multi-stream recycling systems. These results were then graphed (shown in figure 54) to illustrate differences in cost for municipalities with single vs. multi stream recycling. The results and discussion section summarizes and elaborates on these findings.

5.4.2.1 Evaluating the recycling performance of single and multi-stream recycling systems

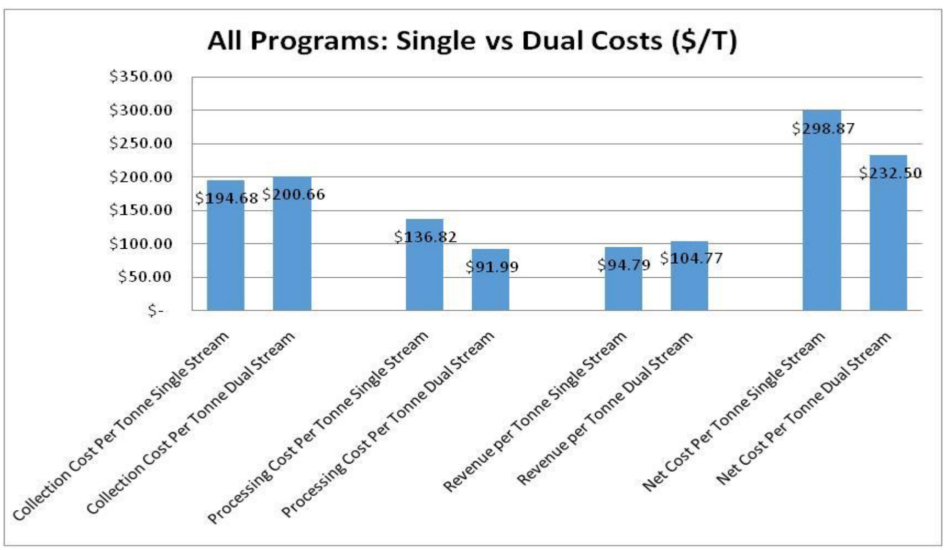
To determine whether single stream recycling systems result in higher municipal recycling rates, weighted average recycling rates were calculated for both single and multi-stream recycling systems. These results were then compared and contrasted to identify any differences in recycling rate performance between the two recycling types. This analysis was done on both a system wide (all 223 municipalities) and region specific (as specified by Waste Diversion Ontario) basis. Our expectation is that municipalities that implement single stream recycling systems will achieve higher recycling rates than those that do not (as noted in the reports by Kinsella and Gertman (2007), Tim Goodman and Associates (2006) and RW BECK (2005).

5.4.3 Results and Discussion

5.4.3.1 Comparison of costs between single and multi-stream recycling systems

Figure 54 compares the collection and processing costs, realized revenues and total net costs for single and multi-stream recycling systems in Ontario, Canada.

Figure 54: ***Comparison of costs between single and muti stream systems (sourced and adapted from WDO (2013))***



Municipalities that implement single stream recycling face higher material management costs when compared to those who opt for multi stream systems. This is contrary to our expectation that single stream recycling is cheaper than multi stream systems. While collection costs for single stream collection are lower when compared to multi stream municipalities, this savings is offset by significantly higher processing costs (48.7% higher) and lower realized revenue from sale of recyclable material (9.6% lower).

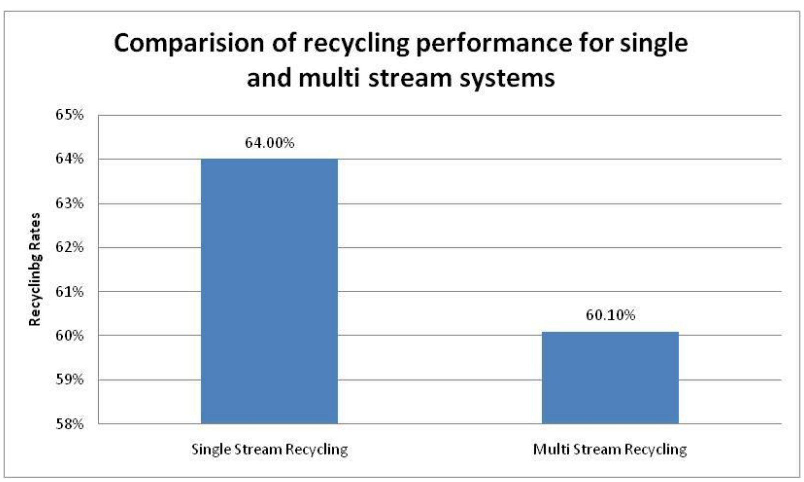
There is a general assumption held by municipal waste planners that the reduction in single stream collection costs will compensate for increased capital investments at the MRF. However, the analysis in this study found that the difference in collection costs between single and multi stream systems was only 3%. Investigating this issue further, SWANA found that collection stop times are 13% longer for multi stream single dwelling households compared to single stream single dwelling households (17 vs. 15 seconds stop time per house) (SWANA, 2007). While stop times per pickup have been found to contribute to collection costs, distance and time between pickups are the primary determinants of collection costs (SWANA, 2007). Given that distance between stops and total distance travelled per trip are identical in both single and multi-stream collection systems, the observed differences in collection costs are explained entirely by differences in stop time per pickup - which, based on the available literature, is between 10 and 15% (SWANA, 2007). The types of collection vehicle (side loaders vs. rear loaders, single manned collection vehicles vs. two manned vehicles etc.) can also contribute to overall collection costs.

Differences in processing costs between single and multi-stream systems was significant, which was consistent with previous findings from the literature. Additional investments in single stream MRF equipment (corrugated cardboard screens and optical sorters) inflate municipal processing costs. The general intuition behind increased mechanization at single stream MRFs is that greater volumes of material can be processed, reducing the per tonne cost of material management (costs are distributed across a greater quantity of material). While this study found that single stream MRFs are capable of processing more tonnes relative to multi stream MRFs, the difference in processing capacity was insufficient to offset additional costs from investments in sorting technology. Furthermore, the quality of the recycled materials being processed in single stream materials is inferior when compared to multi stream MRFs (due to higher levels of contamination) resulting in lower realized revenues. While proponents of single stream recycling recognize that contamination and residue are higher in single stream systems, there is the assumption that savings in collection costs will more than compensate any loss in revenue (this study found that this was not the case).

5.4.3.2 Relationship between Single Stream Recycling systems and municipal recycling rates

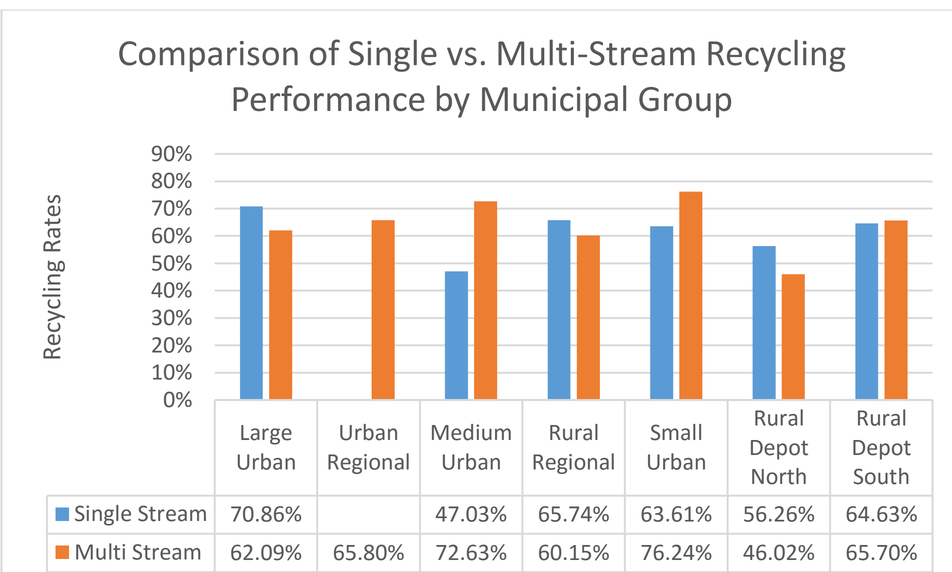
As noted earlier, a goal of this study was to determine the effect of single and multi-stream recycling systems on municipal recycling rates. To do so, weighted average recycling rates were calculated for single and multi -stream municipalities and compared. This was done on both a system wide (all 223 municipalities) and region specific (all 9 municipal groups as specified by the WDO) basis. These results have been graphed in figures 55 and 56 respectively.

*Figure 55: **Comparison of recycling performance between single and multi-stream systems (System Wide)***



As shown in figure 55, the presence of single stream recycling was found to have a statistically significant effect on municipal recycling rates. On average, the presence of a single stream recycling system increased recycling rates by approximately 4% relative to communities who implemented multi stream recycling. This result is consistent with our expectation that single stream recycling systems recycle at a higher rate than multi stream systems, as it is more convenient for households to place all recyclables in one bin. In an examination of recycling performance by municipal group (shown in figure 56), a different picture emerges. Outside of large urban municipalities, the recycling rate performance of single stream recycling is mixed. If we were to omit large urban municipalities from our analysis, the weighted average recycling performance of single and multi-stream systems are virtually identical (59.8% Single Stream and 59.3% multi stream). In medium urban and small urban municipalities, multi stream recycling programs have demonstrably higher recycling rates than single stream municipalities. There is no readily apparent cause for the performance drop off of single stream recycling programs outside of group 1.

Figure 56: ***Comparison of recycling performance between single and multi-stream systems (By Municipal Group)***



5.4.3.3 An Analysis of Municipal Waste Manager and Packaging Producer Survey Results

In this section, we examine how municipal waste managers and packaging producers perceive the effectiveness of single stream recycling systems. Survey data surrounding stakeholder perceptions of single/multi stream recycling systems is summarized based on the answers provided by respondents. Participants were read a series of statements regarding the effectiveness of single stream recycling systems, and asked to indicate their level of agreement/disagreement. Both municipal waste managers and packaging producers were read the same series of questions. Their responses are compared and contrasted to identify whether there are differences in attitudes towards the performance of single stream recycling systems among different stakeholder groups. Survey participants were also asked to comment freely on the perceived effectiveness of single/multi stream recycling and the potential advantages/disadvantages between the two respective systems. As noted in Chapter 3, municipal waste managers and packaging producers often have competing interests and opinions with respect to how recycling programs should be implemented, managed and financed.

Tables 57 and 58 describe the statements that were used in the survey to elicit respondent's experience, knowledge and attitudes towards single stream recycling systems with the respective distribution of Likert scale responses. A five point Likert scale was used to measure respondent’s answers (Strongly Disagree, Somewhat Disagree, Neither Agree or Disagree, Somewhat Agree, Strongly Agree).

Table 57: ***Likert scale responses from municipal waste managers (Single vs Multi Stream Recycling)***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
I think that single stream recycling is effective in promoting household recycling	24.2%	27.7%	16.4%	15.8%	15.9%	3.8	1.17
Single stream recycling is cheaper compared to multi stream recycling	25.5%	24.8%	18.3%	16.1%	15.3%	3.55	1.15
Single stream recycling is convenient for both municipalities and households	35.6%	31.4%	10.5%	8%	14.5%	4.12	1.28
Single stream recycling results in lower revenues from the sale of recyclable material	18.8%	20.1%	15.8%	28.5%	16.8%	3.02	1.22
Single stream recycling should be promoted as a recycling best practice	28.4%	31.2%	11%	18.8%	10.6%	3.72	1.19
Coded Comments from Interviews							

"Cheaper" -37 "More convenient for households" -32 "More efficient at the MRF" -25 "Common knowledge that single stream is cheaper" - 14 "Less administrative burden" - 6

Table 58: ***Likert scale responses from packaging producers (Single vs. Multi Stream Recycling)***

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
Single stream recycling is cheaper compared to multi stream recycling	28.4%	27.5%	13.8%	15.6%	14.7%	3.8	1.33
Single stream recycling is convenient for both municipalities and households	22.8%	31.7%	11.4%	18.5%	15.6%	3.9	1.28
Single stream recycling results in lower revenues from the sale of recyclable material	14.2%	17.5%	19.8%	26.8%	21.7%	2.3	1.38
Single stream recycling should be promoted as a recycling best practice	24.8%	26%	17.4%	16.3%	15.5%	3.4	1.35
Coded Comments from Interviews							
"Cheaper" -15 "More convenient for both households and municipalities" - 13 "Fewer administrative obstacles and resources" - 7							

Survey Statement (1) "I think that single stream recycling is effective in promoting household participation in recycling"

Both municipal waste managers and packaging producers agreed (or strongly agreed) that single stream recycling was an effective method for promoting household recycling. Of note, packaging producers actually indicated higher levels of agreement than municipal waste managers (59.1% vs 51.9%). This is an interesting result, in that packaging producers are generally removed from the management of recyclables, and rely on second hand information regarding the performance of municipal recycling programs. As such, I would have expected a greater proportion of packaging producers to select "Neither Agree nor Disagree". This result suggests that there is a sector wide consensus regarding the perceived effectiveness of single stream recycling systems (despite this studies' evidence to the contrary).

During the semi structured interviews with municipal waste managers, many felt that increases in household recycling rates were attributed to the convenience of single stream recycling. Many participants commented that there was a need to make recycling as easy as possible for the average household, as convenience was seen as being a primary determinant of recycling participation (a position that is supported by the literature).

Survey Statement (2) "Single stream recycling is cheaper compared to multi stream recycling"

Once again, the majority of municipal waste managers and packaging producers agreed (or strongly agreed) with the statement "Single stream recycling is cheaper compared to multi stream recycling". Though this result is consistent with our expectations of what recycling stakeholders would say, it raises some serious concerns regarding whether municipal waste managers undertake the necessary cost/benefit analysis when choosing between waste management systems. While waste managers were not specifically asked whether they had undertaken any cost comparison studies, waste managers suggested that it was "common knowledge" that single stream recycling was cheaper. In 14 instances, the terms "common knowledge and/or understanding" were coded during semi structured interviews. A review of the municipal cost data provided by Waste Diversion Ontario quickly reveals that municipalities with multi stream recycling manage material at a lower cost than single stream municipalities. This disparity in cost is observed in every year that the WDO has maintained records on municipal Blue Box costs. What is unclear at this time is where this assumption surrounding the cost competitiveness of single stream recycling in Ontario originates. While experiences in other jurisdictions does suggest that single stream recycling may be cheaper than multi stream recycling, it seems perplexing that municipal waste managers in Ontario did not undertake their own studies.

Survey Statement (3) "Single stream recycling is convenient for both municipalities and households"

More than 65% of both packaging producers and municipal waste managers felt single stream recycling was more convenient for both municipalities and households. This was an expected response, as collecting recyclable material in a single commingled container requires less time on the part of households in sorting recyclables, and reduces stop times by collection vehicles. Furthermore, municipalities can rely on faster mechanical sorting at material recycling facilities, enabling them to process larger quantities of material in a shorter period of time. Most municipal waste managers and packaging producers cite the convenience (coded 32 times) of single stream systems as being the primary driver of increased household participation in recycling programs (relative to multi-stream systems)

Survey Statement (4) "Single stream recycling results in lower revenues from the sale of recyclable material"

Of note, neither packaging producers nor municipal waste managers felt that single stream recycling resulted in lower realized revenues or quality of marketed recyclable material. Despite significant evidence to the contrary (in both the literature and measured results from the WDO data call), the majority of survey participants disagreed (or strongly disagreed) with the statement "Single stream recycling results in lower revenues from the sale of recyclable material". Anecdotes provided by survey respondents during the interview process suggested that modern sorting technology used at MRFs could overcome contamination issues that were previously associated with single stream systems. This assertion is not supported by our understanding of where contamination occurs in single stream collection. When all recyclables are placed in the same bin and collected in a single compartment collection vehicle, paper based fibers will often become contaminated with residual liquids left in bottles, jars and cans. The material entering the MRF is already of a lower quality - something that cannot be overcome by investments in additional sorting technology.

Survey Statement (5) "Single stream recycling should be promoted as a recycling best practice"

A majority of packaging producers and municipal waste managers indicated that single stream recycling should continue being promoted as a recycling best practice. This is despite significant evidence refuting the cost competitiveness and recycling efficiency of single stream recycling (as noted above). During the semi-structured interviews with stakeholders, increased convenience, cost competitiveness and ease of implementation were cited as the most common reasons for why single stream recycling should be promoted as a recycling best practice.

5.4.4 Conclusion and Recommendations

This study highlights the differences in cost and recycling performance between single and multi-stream recycling systems in Ontario, Canada. Using data from 223 provincial municipalities over a 10 year period, it was found that municipalities that implement single stream recycling face higher material management costs than those that opt for multi stream recycling. To date, municipal policy planning decisions have been predicated on single stream recycling being cheaper than multi stream recycling. This study found the opposite to be true, with single stream recycling, on average, being 28.5% more expensive than multi stream recycling. As such, the assertion that single stream recycling is a preferred waste management system needs to be revisited, as single stream recycling is demonstrably more costly for municipalities in Ontario.

Given that these findings not only contravene conventional wisdom, but directly contradict findings from previous investigations in this area, it begs the question as to why? Canada, and specifically Ontario, have unique infrastructural and operational characteristics that may result in differences in material management costs relative to other jurisdictions. The most salient of which are the inclusion of 23 materials in the residential recycling program. Many of these materials cannot be sorted at conventional MRFs (namely composite packaging, plastic laminants, polystyrene and plastic film), and often require significant investments in mechanized equipment/technology in order to sort/bale said materials. Such investments include optical sorters, plastic resin guns and air sorters. Given that these investments are often exclusive to single stream facilities (as multi stream facilities tend to rely more heavily on manual sortation), processing costs tend to be much higher. Further to that point, the revenue realized for the "difficult to manage" material is negligible – for example, one tonne of baled plastic film has a revenue of less than $10 a tonne. As such, there is very little return on investment for sorting technology at single stream MRFs. While these facilities are diverting more material, that material has little to no value on the open market. This upwards pressure on processing costs is sufficient to offset whatever savings are realized on the collection side.

This study also found that municipalities that implement single stream recycling divert more material than those that do not. The results from our analysis found that the presence of single stream recycling increased municipal recycling rates by 4.11% . This finding is consistent with previous expectations that single stream recycling increases recycling convenience for households, subsequently encouraging household participation in recycling activity. However, increasing recycling convenience for households does not necessarily result in increased levels of recycling awareness. As noted by Waukesha County (2007), one of the issues associated with single stream recycling is that households may use recycling bins as a "catch all" container. Non recyclable items may be erroneously placed in the recycling bin under the presumption that the items in question are accepted by the Blue Box program. Given that households are not expected to source separate recyclables into their respective material streams, awareness of "what goes in the bin" remains low. This results in greater quantities of contaminated material entering the MRF, and lower realized revenues for municipalities.

Results from the survey section of this study suggest that there is a disconnect between the perceived effectiveness of single stream recycling and actual observed results. A lack of evidence based policy is one of the major issues facing Ontario's waste management sector. Too often decisions are made based on what has worked in the past, or what has worked in other jurisdictions. While these are certainly important considerations when devising policies, it is critical that the effectiveness of these policies be periodically reviewed to ensure that they are achieving their intended objectives. In the case of single stream recycling in Ontario, municipal waste managers - and to a lesser degree, packaging producers, continue to promote a system that is both more costly and results in inferior bales.

While this study is reluctant to offer guidance regarding which approach (single vs. multi stream recycling) is more effective, some general recommendations are offered. These include:

1) Single stream recycling is most appropriate in densely populated urban areas where there are large quantities of recyclable material generated. The mechanization of single stream MRFs allow for significant material processing capacity. The greater the number of tonnes entering the MRF, the lower the processing costs per tonne will be. Having a critical mass of recyclable material available for collection and processing is integral in realizing the potential cost efficiencies of single stream recycling.

2) In areas where single stream recycling is offered, significant efforts should be made in educating households about what constitutes acceptable Blue Box materials. This is done to minimize levels of contamination at the MRF level and increase processing efficiency.

3) Municipalities with single stream recyclable collection should provide households with bins/carts that have sufficient space to accommodate for the generation of recyclables. Given that all recyclable materials are being placed in one bin/cart, there is a risk that there may be inadequate capacity for household recyclables.

4) Multi stream recycling may be appropriate for municipalities which lack the requisite financial resources to invest in additional sorting technology. Alternatively, municipalities that wish to minimize costs at the expense of overall diversion may find multi stream recycling preferable.

While there is no one "right approach" when choosing between single and multi-stream recycling, the results of this study find that municipalities should be cautious when touting single stream recycling as a preferred waste management strategy. As noted above, long held assumptions surrounding the cost competitiveness of single stream recycling are largely unfounded. There are site and situation specific factors that ultimately impact the effectiveness of both single and multi-stream recycling. These factors need to be carefully considered by municipalities when choosing which recycling system to implement.

5.5 Conclusion

This chapter undertook a comprehensive review of four provincial best practices in Blue Box recycling, applying a three factor framework to gauge their effectiveness (where effectiveness was evaluated based on recycling performance, cost containment and positive stakeholder perceptions). Table 58 summarizes the results from each case study and whether the policies were able to achieve their intended objectives. (Where Yes = Successfully achieves goal, No = Does not achieve goal, Positive = Positive Stakeholder Perception and Negative = Negative Stakeholder Perception).

Table 59: ***Summary of Results using 3 factor evaluative criteria***

Policy Type	Diversion	Cost Containment	Stakeholder Perceptions
Municipal Incentivization	No	No	Packaging Producers: Positive Municipal Waste Managers: Negative Households: N/A
Recycling Promotion and Education	No	No	Packaging Producers: Positive Municipal Waste Managers: Positive* Households: Positive*
Pay as you Throw	Yes	No	Packaging Producers : N/A Municipal Waste Managers: Mixed Households : Negative
Single Stream vs. Multi Stream Recycling	Yes	No	Packaging Producers: Positive Municipal Waste Managers: Positive

As shown above, no single policy was successfully able to satisfy all three of the evaluative criteria (diversion, cost containment and positive stakeholder perceptions). In fact, no policy was able to contain costs in any meaningful way, as all were linked to increases in municipal program costs. Stakeholder attitudes and perceptions also appeared to be mixed, an expected result given the competing interests of stakeholder groups. However, there does appear to be consensus among study participants regarding the perceived efficacy of recycling promotion and education and the benefits of single stream recycling systems. The former is a particularly interesting result, in that recycling P&E was not shown to increase either diversion or encourage cost containment. There appears to be an understanding among stakeholders, particularly municipal waste managers, that P&E is an important tool, but that the current funding model is too restrictive to encourage any meaningful change. The two major "take away" findings from the case study analysis is that a) diversion and cost containment are seemingly incompatible pursuits, and b) there is a disconnect between what stakeholders think is working, and what is actually working. These issues are explored in greater detail in Chapter 6.

Chapter 6: Discussion

This chapter undertakes a detailed discussion of the results and themes that emerged from the evaluation of each of Ontario's recycling best practices examined in Chapter 5. This chapter is largely divided into three main areas (each corresponding to a theme identified from the case study analysis). The first section explores the disconnect between policy intent and outcome, including the discrepancy between what stakeholders think is working, and what is actually working. The second section examines regional differences in the costs of recycling, highlighting the challenges of recycling in rural and northern communities. This section considers a hypothetical system in which mandatory recycling programs are eliminated in these areas, exploring the implications for provincial recycling rates and Blue Box costs. Lastly, this chapter concludes by questioning Ontario's decision to prioritize increased diversion for all Blue Box materials. As noted in Chapters 1 and 2, Blue Box system costs have almost doubled since the program's inception under the Waste Diversion Act in 2002. A cost model was developed to evaluate the impacts of removing high cost, difficult to recycle material from the Blue Box program, and quantify the resulting effect on system costs and diversion levels. This cost model also attempted to optimize the mix of material found in the Blue Box program, testing to see whether it was possible to increase provincial recycling rates while simultaneously lowering system costs. Ultimately, this chapter evolved from two central questions: What now? and What if ? The results chapter (Chapter 5) seem to suggest that there is little evidence to support that Ontario's recycling policies (in their current form) are working. This chapter then asks readers to consider scenarios where radical (and potentially contentious) changes to the Blue Box system are proposed - namely, eliminating recycling programs in Ontario's rural and northern communities and removing certain packaging types from the Blue Box program.

6.1 Rethink, Revisit and Recycle: The disconnect between policy intent, stakeholder perceptions and outcome

This section briefly extends and elaborates on the findings from Chapter 5, which evaluated each of Ontario's recycling best practices using three criteria: 1) a policy's ability to increase diversion 2) a policy's ability to minimize recycling costs and 3) positive stakeholder perceptions (whether affected stakeholders view the policy favorably). In summary, no policy was able to successfully achieve all three objectives. What is particularly interesting, is that despite the demonstrable failure of these policies at an aggregate level, stakeholder perceptions still tended to be fairly positive (the notable exception being municipal incentivization, which divided stakeholder opinion among municipalities and packaging producers). This begs the question as to why? Is it that these policies don't work and need to be done away with? Why is there a disconnect between stakeholder perceptions and the measured effectiveness of a given policy?

To answer these questions, we need to understand how these policies are designed to work, and highlight the barriers that may impede their effectiveness. The following section explores these issues in greater detail.

6.1.1 Diversion and Cost Containment – Mutually exclusive pursuits?

Ontario's best practice mandate is to "increase diversion and encourage cost containment" – in other words, to divert more material at a lower cost. The entire municipal funding system is predicated on this principle – municipalities who increase year over year diversion while lowering net system costs will have a greater proportion of their material management costs subsidized under Ontario's shared responsibility model (see Chapter 5, section 1 for a detailed description of Ontario's municipal funding model). However, is such a scenario even possible? Based on anecdotes provided by municipal waste managers, the answer is no. The truth is more complicated and requires an understanding of the costs associated with increasing diversion.

By definition, increased diversion will result in additional costs. Of the 23 Blue Box materials presently accepted in the program, only one (aluminum) has a negative net cost per tonne (where in recycling generates positive revenue for a municipality) (Stewardship Ontario, 2013). As such, in order for municipalities to increase diversion, they will need to incur additional costs for managing every incremental tonne managed. This is generally the argument made by municipal waste managers when they criticize the cost containment measures used as a guiding Blue Box best practice. Given that they cannot increase diversion while simultaneously decreasing cost, focus should be placed on one objective (either diversion or cost containment), but not both. However, while adding incremental tonnes to the system will almost always increase cost, savings can be realized by making the existing system (the management of material already in the system) more efficient.

Packaging producers have historically accused municipalities of operating inefficient recycling programs. Unless they have an incentive to minimize costs (through performance based funding), municipalities will have little vested interest in designing the most cost efficient system possible. They can either pass their costs onto the municipal tax base or packaging producers. While the veracity of this assertion has not been tested (although it seems unlikely that municipalities will unduly inflate costs), it does highlight that municipalities have a certain degree of control over how they design their recycling programs – including the costs associated with material management. For example, municipalities who employ private contractors to collect their recyclables have collection costs that are 24% lower than those who use municipal employees (Waste Diversion Ontario, 2014). Investments in sorting infrastructure at the MRF, collection vehicles, roll off carts and recycling containers etc. are all potential options for municipalities to identify ways to reduce year over year costs. There is historical precedent for municipalities in Ontario to decrease recycling program costs (while simultaneously increasing diversion) through investments in collection and/or processing technology. At the time of thesis preparation, there were 13 projects listed in the Ontario Continuous Improvement Fund archives that listed municipal initiatives that resulted in decreased program costs and improved recycling performance (CIF, 2014). However, these projects are generally seen as "one off" initiatives – something to address a site or situation specific issue that will result in a one-time increase in diversion/cost reduction (e.g. investing in an eddy current at a MRF to improve sorting rates and recovery of aluminum). While these benefits would continue to be realized moving forward, any additional improvements (relative to the previous year) in net cost/diversion would have to come from a new project/initiative.

With the above in mind, despite the potential difficulties in increasing diversion at a lower net cost, it seems prudent that some measure of "incentivization" be used when allocating municipal funding. Municipalities that are able to increase the year over year performance of their recycling programs should be rewarded for doing so (in the form of funding in excess of 50% of recycling program costs). However, should the converse ("punishing" poor performing municipalities by giving them less than 50% of their program costs) remain? As discussed in Chapter 5, section 1, Ontario's current municipal incentivization methodology appropriates a smaller share of funding for municipalities who have higher net costs/lower recycling rates relative to their peer group. This is designed to incent these municipalities to improve recycling performance such that they can become a net recipient of funding transfers in the future. However, the notion of doing "more with less" seems counterintuitive – a concern expressed by municipalities during the surveys and interviews. Even initiatives that are designed to decrease costs/improve recovery require an initial capital outlay. Using the eddy current example used above, while installing an eddy current at a MRF will increase aluminum recovery and decrease material management costs (as aluminum has a negative net cost per tonne), it requires an upfront investment of approximately $30,000 (for the cost of equipment, installation and retrofitting the sorting line) (CIF, 2014). Assuming a municipality has their recycling budgets reduced via the municipal incentivization model (due to poor recycling performance), it seems unlikely that they will be able to make additional investments in recycling programs.

Reducing a municipality's budget (by transferring funds away) has the opposite of its intended effect – these municipalities tend to perform worse in the subsequent year (resulting in further reductions in their funding). While there remains considerable debate as to the degree to which municipalities can directly influence household recycling rates or program costs, reductions in funding (through incentivization) demonstrably limit the tools available to them. Municipalities cannot be expected to make the necessary investments that may lead to improved recycling performance if their budgets are being continually reduced. This problem is particularly acute in smaller municipalities (normally rural and northern communities), where funding transfers can radically affect recycling budgets. Given that access to recycling and household participation in these areas are already lacking relative to urban areas, reductions in budgets will further impede delivery of waste management services.

So what is the take away message from this study's findings? First, I think it is reasonable to say that while diversion and cost containment are not necessarily mutually exclusive pursuits, they are difficult to achieve alone or together. As shown in the Blue Box best practice initiatives, none of the policies currently in place in Ontario achieve the objectives of diversion and cost containment – this is actually quite telling, as these policies were designed with these intentions specifically in mind. This begs to the question as to whether municipalities can be reasonably expected to design and implement initiatives that can do what the Blue Box best practices fail to do. While municipalities should continue to be encouraged to pursue cost containment measures, the Blue Box program should provide the necessary resources and training to ensure that municipalities are equipped to achieve this goal. The municipal incentivization methodology has not (and apparently does not) encourage cost containment and diversion for provincial municipalities.

6.1.2 Disconnect between what stakeholders think is working, and what is actually working

As noted in Chapter 5, given the competing interests of the main stakeholder groups (packaging producers and municipal waste managers), it would be virtually impossible to receive universal consensus regarding the purpose and effectiveness of all policies. The most salient example of this is the municipal incentivization methodology, which saw a clear divide among stakeholders with respect to its perceived efficacy and whether it should remain a best practice initiative (see Chapter 5, section 1 for additional details). However, for policies such as recycling promotion and education investments, pay as you throw, and single stream recycling, there was a relative consensus among stakeholders with respect to their effectiveness and status as a best practice (as the nature of the policies is neither divisive or designed to affect only one particular stakeholder). Despite the relative dearth of empirical evidence supporting the use of best practice initiates, recycling stakeholders were in general agreement that PAYT, single stream recycling and P&E investments are effective in promoting diversion (and should remain a best practice). While there are some caveats to the above statement (i.e. households tended to have a negative view of PAYT policy due to inconsistent enforcement and inadequate recycling bin capacity), at a high level, there is a significant disconnect between what people think is working, and what is actually working. This begs the question as to why?

6.1.2.1 Do past successes guarantee positive results moving forward?

Much of the intuition that underpins the Blue Box best practices is rooted in past experience (from within Ontario and in other jurisdictions) that have proven to be successful. When KPMG drafted the 2007 Best Practice Report, they undertook a comprehensive review of initiatives that had been shown to improve diversion (and/or cost containment) in recycling systems similar to Ontario (Stewardship Ontario, 2007). Investments in promotion and education, pay as you throw systems, single stream recycling etc. had significant empirical support with respect to their ability to improve household diversion (see Chapter 2 for discussion of relevant literature in detail). Many of the policies deemed recycling best practices seemed intuitive in nature – i.e. recycling promotion and education raises household awareness with regards to recycling initiatives, thereby encouraging participation. All past evidence – including anecdotal experiences provided by municipal waste managers, support the use of certain policies in promoting diversion. There is a conventional wisdom among recycling stakeholders that policies such as PAYT, recycling P&E and single stream recycling work (albeit with certain challenges) – very few (if any) have challenged this position. To do so would require questioning decades of waste management experience. However, past successes do not necessarily guarantee positive results moving forward.

The recycling system is rapidly changing - from the demography of Canadian households to changes in the packaging mix and waste management infrastructure. Simply adhering to the status quo seems neither appropriate nor prudent in light of the changes occurring in Ontario. For example, in the past decade, the ethnic minority population in Ontario has more than doubled (from 9.4% to 19.3% between 2001 and 2011) (Statistics Canada, 2012). Many of these individuals come from countries that lack integrated waste management systems and, as such, their attitudes towards recycling, the environment and stewardship may be radically different that native Ontarians. A thorough understanding of the motives and barriers to recycling for ethnic minorities in Ontario is critical in ensuring that their participation in recycling schemes is encouraged. Given the changing demography of recyclers in Ontario, we cannot assume what has worked in the past will continue to work in the future. Communication, messaging and methods of household engagement need to be updated and refined. As noted in Chapter 5, recycling P&E initiatives do very little to engage ethnic minorities in any meaningful way. A failure to design policies that are both culturally sensitive and relevant may impede provincial recycling rates, particularly in light of Ontario's burgeoning ethnic population.

As a recycling system evolves and matures, so should the policies that are used to encourage diversion and cost containment. P&E and PAYT are critical “first step” measures that work when a recycling system is in its infancy. Policies that raise recycling awareness and incent households to participate in recycling programs have been demonstrably successful in increasing diversion during a program’s onset. However, once recycling behavior becomes habitual, these policies diminish in their efficacy – people who are going to recycle, will do so independent of policies encouraging them to do so (a result that is supported by the findings in Chapter 5). As such, the policy focus should be shifted to encouraging incremental diversion – the message about the importance of recycling is already out in Ontario. The question now becomes, how do we get households to: a) Recycle more of the materials they are not already recycling? And/or b) Encourage non recyclers to participate? The tools municipalities have at their disposal to achieve this end are limited – beyond mandatory recycling programs and penalties for non-compliance (a policy that has proven to be very successful), the ability to directly influence household recycling behavior is minimal. With that being said, refinements to existing policies, or alternatively, abandoning the status quo in favor of a radically different recycling system (see sections 6.2, and 6.3 for an examination of alternative scenarios) need to be considered if Ontario hopes to improve municipal recycling performance (with respect to diversion and cost containment). Targeted P&E messaging, tiered/discretionary PAYT pricing, and additional resources for municipalities (with respect to training and investments in new infrastructure) are all potential options for increasing recycling performance that necessitate further investigation. While there is no way of knowing whether these changes will result in the desired change recycling stakeholders are seeking, what is known is that staying the course is not a suitable solution moving forward. It should be noted that Ontario has achieved some amazing things with the Blue Box program and continues to be a global leader in residential recycling. However, the province needs to be able to glean from previous experiences, and be adaptable, flexible and willing to embrace change. The landscape of recycling in Ontario has changed, and with it, so should the policies.

6.2 North of 46^{o} : Obstacles and challenges to recycling in Ontario's rural and northern communities

Lakhan, C. (2015) "North of the 46 Parallel: Obstacles and Challenges to Recycling in Ontario's Rural and Northern Communities" *Waste Management*, Accepted: In Press 10.1016/j.wasman.2015.06.044

The implementation and management of recycling programs in Ontario's rural and northern communities has proven to be a particularly challenging issue for policy planners. Low population densities, significant distance between households, seasonal variation in household waste generation and lower (relative) levels of household recycling participation have, in part, contributed to lower recycling rates and high material management costs in these regions. To date, Ontario's Blue Box policy initiatives have either been ineffective (as evidenced in Chapter 5) or alternatively, not designed to specifically address the needs and challenges of rural/northern recycling.

This section identifies some of the salient challenges to recycling in Northern/Rural Ontario, and puts forward potential explanations for why some policies have proven ineffective in these regions. This is then followed by the modeling of a hypothetical scenario wherein recycling programs are eliminated in rural and northern communities, quantifying the subsequent impacts on overall diversion and system costs. While eliminating recycling programs may seem counterintuitive given Ontario's emphasis on sustainability, this section challenges what is currently meant by sustainable in the province's current policy discourse. As noted in Chapter 2, sustainability has multiple dimensions, of which environmental considerations are only one component of. If a system is not considered economically practical or socially desirable, should it continue to be supported or encouraged? It is important to note that this study is not attempting to refute or discredit the merits of recycling. It does however try and highlight that policy planners should not blindly pursue an objective without careful consideration of economic and site specific factors. Chapter 5 highlighted that existing provincial best practices are not effective in promoting waste diversion or encouraging cost containment. If this is the case, it seems prudent that alternative systems be explored.

The decision of whether to implement household recycling programs in remote and rural areas is of particular importance nationally. Manitoba, British Columbia and Alberta are currently exploring mandatory recycling legislation as a means to provide recycling services to households outside of urban areas (Conference Board of Canada, 2014). While this move has largely been embraced by governments at the provincial level, the issue of cost containment needs particular attention and consideration. Ontario has long served as the model for household recycling in other Canadian jurisdictions – provinces such as Manitoba, Alberta etc. look to emulate Ontario's waste management practices and policies (given the province's demonstrated successes in the past) (CCME, 2014). Ontario's cost recovery model for packaging waste and approach to extended producer responsibility (EPR) has also been used as the basis for developing proposed EPR legislation in Chile, Singapore and several American states (Stephenson, 2011). The province's Waste Diversion Act has been used as a reference for the types of material to be included in a recycling program, who should be legally obligated to pay for the recycling system, and the thresholds for who receives and delivers waste management services (Ministry of the Environment, 2013). As such, Ontario has a unique opportunity to set the tone for the rest of the country in terms of developing and operating efficient recycling systems and supporting legislation. Now more than ever, the province needs to ask the question "Is trying to recover every tonne (from everywhere) an appropriate policy goal, particularly in light of rising recycling system costs. If not, what do policy planners need to consider when designing an efficient recycling system (i.e, What materials should be included in the program? Which areas should be serviced? etc.)

6.2.1 Existing Research

There is a relative paucity of literature that specifically examines the challenges of recycling in rural and northern communities, particularly within a Canadian context. This, in part, is attributed to the lack of recycling programs in these areas. The costs associated with developing and operating waste management programs in these regions can be prohibitive to some municipalities. However, as noted by Jakus et al. (1997), in many instances, rural/northern communities are subject to the same federal and state/provincial waste reduction mandates as urban communities, necessitating that viable waste management options be explored in these areas.

However, how do policy planners encourage household recycling in areas that face numerous barriers to recycling participation? Conventional policy approaches for increasing household recycling, i.e. unit based pricing for garbage disposal, the implementation of curbside recyclables collection etc. are often not feasible or practical solutions in rural and northern communities (Jakus et al, 1997). Traditionally, unit based pricing for garbage disposal has been used by local governments to promote household recycling and reduce quantities of waste disposed. This approach has been demonstrably successful in numerous jurisdiction in both Canada and abroad – studies by Lakhan (2015a), Sidique et al. (2009), Allers and Hoebin (2009) and Hong (1999) have all found a positive relationship between the price charged for waste disposal and municipal/county recycling rates. Differences in the price charged for waste disposal have also been used to explain intra-regional variation in municipal recycling rates – both Sidique et al. (2009) and Abbott et al. (2011) found that household recycling rates varied with the price charged for garbage disposal – the areas that recycled the least tended to have the lowest (or no) charge for waste disposed. Pay as you throw schemes have been observed to have some success in a small sample of Manitoba's rural communities – Multi Material Stewardship Manitoba (MMSM) found that household recycling subsequently doubled after the implementation of a two dollar charge on all garbage bags placed curbside (MMSM, 2014). However, as observed by Lakhan (2015a), the effectiveness of PAYT policy in Ontario is largely contingent on whether bag limits are being regularly enforced. In an examination of household responses to unit based garbage pricing in Ontario, respondents indicated that garbage bag limits were not regularly enforced by the municipality. This problem was particularly acute in responses provided by households in rural and northern communities, where 78.5% of respondents indicated that they were not aware bag limit policy even existed (Lakhan, 2015a). In a follow up study by Lakhan (2015d), municipal waste managers from 29 communities in Ontario were asked to comment on the perceived effectiveness of PAYT policy. While 68.5% of respondents indicated that PAYT schemes were an effective method for increasing household recycling, more than half felt that the administrative burden of implementing and monitoring bag limits was sufficient to deter regular enforcement (Lakhan, 2015d). Respondents from municipalities classified as northern and rural reported lower rates of PAYT enforcement relative to urban municipalities (due to budget/resource constraints), lending credence to the responses provided by households in these regions (regarding bag limit enforcement). What remains unclear at this time is why municipalities in rural and northern Ontario seem to face greater administrative challenges for implementing PAYT schemes relative to other like jurisdictions. In Sidqiue et al's examination of household recycling in Minnesota, population density and locality appeared to have no bearing on the effectiveness of PAYT policy with respect to recycling rates. This is despite the fact that much of the state shares similar infrastructural and density characteristics as rural and northern Ontario (2009). Similar findings have been observed in several European countries, where PAYT policy has enjoyed significant success in rural and remote regions (Reichenback, 2008). However, no attempts were made to gauge the effect of PAYT on recycling system costs, or whether these costs change depending on locality. This is a critical consideration, in that an efficient recycling system should not be measured against diversion benchmarks alone.

Curbside collection of recyclables is also a common method employed by local governments to encourage household recycling. Curbside recycling collection is a service provided to households, typically in urban areas, of removing household recyclables on a weekly or by-weekly schedule (Strasser, 1999). Curbside recycling collection is seen as an external facilitator of recycling, increasing the convenience of recycling, and subsequently, increasing an individual's perceived level of behavioral control (PBC) (Taylor and Todd, 1995). Relative to recycling "drop off" sites, curbside collection reduces the "time costs" of participation, as households are not required to transport recyclable material to a drop off/depot site (Nigbur et al. , 2010). As noted by Ajzen, perceived levels of control is often the best predictor when estimating an individual's participation in a given behavior (2002). The evidence gleaned from the literature confirms this result, as a significant number of studies have found that the use of curbside recycling collection increases municipal recycling rates. Sidique et al. (2009), Callan and Thomas (2006), the USEPA (1994), Kinnaman and Fullerton (2000), Oskamp et al., (1991) and Vicente and Reis (2008), represent only a small sample of the research supporting the use of curbside recycling collection. As noted by Noehammer and Byer, the presence of curbside collection is often the most significant determinant of household recycling participation (1997) .

However, the ability for a municipality to implement curbside recycling collection is contingent on a variety of enabling conditions. Sufficient population density, a critical mass of material and road infrastructure are all necessary before curbside collection can be considered a viable waste management option (Noehammer & Byer, 1997). In many rural and northern communities, curbside recycling collection is not economically practical, forcing communities to rely on depots and transfer stations (which generally have much lower levels of recycling participation) (Meneses & Palacio, 2005). In Ontario, rural and northern municipalities who choose to implement curbside recycling systems divert approximately 12% more material than depot based programs (Waste Diversion Ontario, 2014a). However, this increase in recycling comes at an enormous cost - the average collection costs for curbside programs is more than double than those who opt for depot/bring programs (Waste Diversion Ontario, 2014a) . Implementing curbside collection in Ontario's rural/north regions would significantly increase the cost of recycling in communities who already struggle with high material management costs. While curbside recycling systems should continue to be explored as a potential waste management option, municipalities must ensure that they have the appropriate conditions and characteristics to ensure a viable collection scheme.

Of note, bring/depot systems are commonly employed in many European jurisdictions, with many areas achieving similar household participation and recycling rates as North American curbside systems (Gonzalez-Torre et al., 2003). Despite the barriers to recycling participation that depot/bring systems normally pose to households, many EU member states achieve diversion rates that are comparable to, or exceed those achieved in Ontario (van der Werf, 2014). France diverts approximately 12 million tonnes of material through depot/bring sites and achieves a recycling rate of approximately 63% (van der Werf, 2014). The Netherlands divert in excess of 75% of household printed paper and packaging waste using depot/bring programs. By comparison, Ontario's depot/bring programs recycle less than 40% of household generated packaging waste (van der Werf, 2014). While no readily apparent explanations have been offered in the literature for why this disparity in depot/bring performance exists (between Canada and Europe), the answer may have to do with the density of bring/depot sites relative to the local population. In both the France and Netherlands example, there is at least one depot for every 5000 households (van der Werf, 2014). Given that the largest barrier to household participation in depot/bring programs is a lack of convenience, increasing the accessibility of drop off sites would seem like a critical first step in encouraging participation. In a review of Ontario's municipalities with depot/bring programs, many communities are often serviced by a single facility (Waste Diversion Ontario, 2015). Furthermore, there have been anecdotes from these communities that facilities are understaffed, poorly organized and confusing (Continuous Improvement Fund, 2015). This may present an opportunity for the province to improve the recycling rate performance of municipalities in northern and rural communities by addressing the accessibility and operational concerns of depot/bring programs. Depot/bring facilities already enjoy a significant cost savings relative to curbside systems in Ontario (as noted above). By learning from and emulating the experiences of depot/bring systems in Europe, Ontario may have a chance to both improve diversion while simultaneously reducing operating costs – an increasingly rare outcome given the current state of the recycling system.

This study attempts to advance the existing discourse on recycling in northern and rural regions, but shifts the focus away from the predictors of recycling behavior (which has been the focal point of research to date). By examining the economic viability of recycling in these regions, policy planners can make informed decisions with respect to how and where to allocate resources to operate the most efficient recycling system possible. It is important to note that this study does not attempt to offer any definitive guidance regarding the appropriateness of recycling as a sustainability strategy. Instead, it highlights that that any proposed increases in diversion must be weighed against budgetary, resource and administrative constraints on the part of the municipality.

6.2.2 Challenges to recycling in Rural and Northern Communities

As noted in section 6.2, there exist numerous challenges to recycling in Ontario's northern and rural communities - both for municipalities and households. This section explores these challenges in detail, breaking down the infrastructural, operational and behavioral impediments to recycling in these areas.

6.2.2.1 Barriers to recycling: Households

Inconvenience

Households in Ontario's northern and rural communities, on average, have much lower levels of participation in recycling activity when compared to households in urban areas (Stewardship Ontario, 2013). The general consensus in the literature (see Evison and Read, 2001, Mcdonald et al. 1988 and Oskamp et al. 1991), is that lower levels of recycling participation are strongly correlated with perceived levels of convenience. In Ontario, many of the municipalities in northern and rural groups are serviced by depot/bring systems. In a depot/bring system, households are required to collect and transport recyclable material to designated drop off points. In certain instances, households are required to source separate recyclables into their designated material categories (i.e. paper, plastics, metals and glass) before depositing material at a drop off point. While depot/bring systems have been successful in certain European markets (Pro Europe, 2014), in Ontario, municipalities which require residents to drop off material have recycling rates, on average, 21% lower than those with curbside collection systems (Waste Diversion Ontario, 2014). As shown in the case study of pay as you throw systems (see Chapter 5, section 3), households find source separating recyclables to be inconvenient. The effort expended in sorting, storing and setting out recyclables is sufficient to deter participation. When the additional effort of transporting recyclables to a drop off point is imposed on households, they are less inclined to participate. This result is consistent with our understanding of the predictors of environmental behavior as described by Azjen (see chapter 2). If participation in an environmental behavior is moderated by perceived levels of convenience, then the less convenient the activity, the less people are likely to participate. This problem is particularly acute in Ontario's northern communities, where municipalities are often serviced by fewer drop off points. Residents are required to transport material greater distances, further exacerbating the inconvenience of recycling.

Social Norms/Peer Pressure

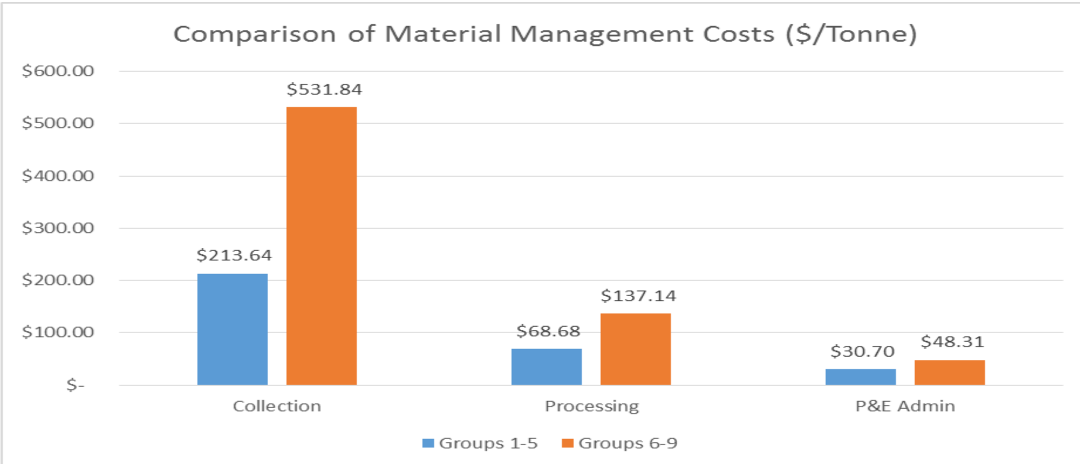
Household participation in recycling programs in Ontario's rural and northern regions are also impaired by a lack of "peer enforcement". How social norms affect household recycling behavior is not as well understood as other lines of recycling research. The general understanding is that households will be more inclined to recycle if they think their neighbors/friends/family will judge them (either positively or negatively) for participating in a pro-social activity such as recycling. Studies by Nigbur et al. (2010) and Pelletier et al. (1998) find evidence to suggest that household recycling is positively correlated with normative beliefs (in areas where recycling is viewed favorably, peer enforcement is shown to positively influence recycling rates). Results from Chapter 5, section 3 lend further credence to these findings, as peer pressure and normative beliefs/behavior were listed as contributing factors to household recycling. However, in Ontario's rural and northern communities, peer enforcement/pressure diminishes due to low population densities and distance between households (it is more difficult for households to determine whether their neighbors are recycling, as households are often kilometers apart). Furthermore, in communities with depot/bring systems, it is virtually impossible to gauge which households are participating in recycling programs. There is no mechanism in place to keep track of who is bringing what to depots/transfer stations. In many ways, there is an "out of sight, out of mind" mentality to recycling in rural and northern regions. Unless households see others actively participating in municipal recycling programs, they are less inclined to do so themselves. This is not necessarily a conscious decision on the part of households, but may simply be attributed to a lack of behavioral reinforcement. Until a recycling behavior becomes habitual through repetition and/or enforcement, participation will remain a function of attitude attachments, social norms/expectations and perceived levels of convenience/self-efficacy (as shown in the TPB model, Azjen (1985)).

6.2.1.2 Municipal barriers

Cost and Funding

One of the foremost challenges facing municipal waste managers in Ontario's rural and northern communities is a lack of funding being allocated to recycling services. On average, rural and northern municipalities spend 58% less on Blue Box program costs than those in urban regions (when expressed on a per household basis) (Waste Diversion Ontario, 2014). This can be, in part, attributed to two factors: 1) Smaller populations mean a lower tax base, resulting in lower revenue streams for municipalities, and 2) As noted in Chapter 5's case study of Ontario's municipal incentivization model, many northern/rural municipalities cross subsidize larger "better" performing municipalities (they transfer a portion of their funding to municipalities with higher recycling rates). The net result is that northern/rural municipalities often face budgetary constraints when managing and operating household recycling programs (a sentiment expressed by municipal stakeholders during semi-structured interviews). While there is an argument to be made that these municipalities require fewer resources as they are servicing a much smaller number of households, northern/rural communities often face higher material management costs when managing an equivalent tonne of recyclables (when compared to urban municipalities). Figure 57 below compares differences in collection/depot costs per tonne, processing costs per tonne and net costs per tonne for municipal groups 1-5(urban) and other groups 6-9 (rural & northern).

*Figure 57: **Material Management Costs (Groups 1-5 vs Groups 6-9)***



- On average, collection costs for groups 6-9 are 248% higher than groups 1-5 (when taken as a weighted average). This is due to the longer distance travelled between households and consolidation points (distance to MRFs, transfer stations etc.). In remote areas, municipal access to household collection points (either households or depots) may be impaired due to seasonal conditions (snow, ice) and road access.
- On average, processing costs for groups 6-9 are 99.6% higher than groups 1-5. Most MRFs operating in rural and northern Ontario are manually operated facilities that manage less than 100TPD per day. Given relatively low population densities and quantities of recyclables being collected, facilities are reluctant to make investments in labor saving sorting technologies. As such, the time it takes to sort and bail material increases significantly, resulting in fewer tonnes processed per hour, and higher processing costs. Some municipalities in remote regions of the province are not serviced by local MRFs. Instead, these communities will ship unsorted commingled recyclables to a transfer station, which will in turn transport it to a MRF located in the southern regions of the province. While this results in more efficient processing of material (recyclables are generally

shipped to "mega MRFs" that aren't operating at capacity), material transport costs increase significantly.

- On average, promotion and education and administrative costs for groups 5-9 are 57.34% higher than groups 1-6. Given lower population densities, it is often difficult for municipalities to successfully promote and/or enforce recycling policies. This inability to ensure household compliance with local policy has diminished the efficacy of certain policies, particularly pay as you throw. As shown in Chapter 5, section 3, both households and municipal waste managers in rural and northern communities felt PAYT policy was not being adequately enforced. Municipal waste managers indicated that the administrative burden in monitoring and enforcing recycling policy was sufficient to deter them from doing so. In the absence of uniform enforcement, households reported being less inclined to participate in recycling programs - a result that was confirmed during the qualitative component of this study.

6.2.3 Material and Methods

6.2.3.1 Description of model

To quantify the full economic and diversion impacts of recycling programs in rural and northern communities, a cost model was developed to achieve the following a) calculate northern/rural municipalities share of overall Blue Box program costs, generation and material recovery, b) model a scenario where the Blue Box program is eliminated in rural and northern communities and observe the impact on system costs, diversion levels and material specific recovery and, c) test to see whether Ontario could increase overall diversion in a scenario where recycling programs were no longer being operated in rural and northern communities.

The cost model developed for this study used data collected from the Waste Diversion Ontario Municipal Pay out model and the WDO data call, and was created in Microsoft Excel. The cost model allows users to model the following:

- Users can alter municipal group tonnes recovered or municipal group revenues to re-calculate impact on Blue Box system costs and diversion rate.
- Users can set a Blue Box system Goal Recycling Rate (currently set at 70%). The model calculates the impact on Blue Box system costs and material recovery rates of achieving the Goal Recycling Rate, based on increasing diversion for municipal groups with the lowest cost.
- Users can select which municipal groups are included in the Blue Box program. The model eliminates municipal groups selected by the user that they wish to exclude from the program. The model then calculates the impact on Blue Box system costs, overall diversion levels and material specific recovery rates.

6.2.3.2 Key model assumptions

All cost and recovery data in the cost model used the values as reported by the WDO in either the municipal pay out model or municipal data call. All reasonable efforts were made to maintain data integrity by performing as little data manipulation as possible. For example, if rural depot north communities (group 8) were targeted for removal, the model would take the group's reported net cost per tonne, multiply it by the number of tonnes reported as recycled, and subtract that total from overall Blue Box costs. The total number of tonnes recovered by group 8 would also be subtracted from total tonnes recovered for the Blue Box program. The model would then calculate how material specific recovery has changed – this is done by multiplying group 8 recovered tonnes by the composition of recovered materials for all municipalities in group 8 (a figure calculated using the WDO data call), and subtracting those totals from material specific recovery for the overall Blue Box program. As far as can be ascertained, the data reported by municipalities into the WDO data call has been checked for accuracy and integrity. As noted in Chapter 3, section 3.81, both the WDO and Stewardship Ontario engage in an annual audit of data call entries (both current and historical) to check for any errors/issues in reporting.

6.2.4 Results and Discussion

6.2.4.1 Breakdown of costs and material recovered by municipal group

As shown in figures 58 and 59, groups 6-9 account for 9.37% of all material generated in the province, but comprise 20.53% of gross program costs. In addition to having higher material management costs (when expressed on a per tonne basis), realized revenue for northern and rural communities is only 1/3rd of what municipalities in urban regions receive for an equivalent tonne of material ($88.66 per tonne for municipal groups for municipal groups 1-5, and $28.61 per tonne for municipal groups 6-9) (Waste Diversion Ontario, 2014b) . Many northern/rural municipalities lack the requisite processing capacity at the MRF to fully realize the value of collected material. In many instances, smaller municipalities will sell recyclables as a single commingled bale (where certain packaging types are mixed together, i.e. all paper fibers, all plastics etc.) to larger municipalities who are able to sort the material (StewardEdge, 2014). Commingled bales are sold at a significant discount relative to presorted bales – As of the December 2014 StewardEdge Blue Box commodities prices sheet, commingled bales are sold at a 60% discount (i.e. commingled fibers vs sorted corrugated cardboard/boxboard) (StewardsEdge, 2014).

Figure 58: ***Distribution of program costs in Ontario (by municipal group)***

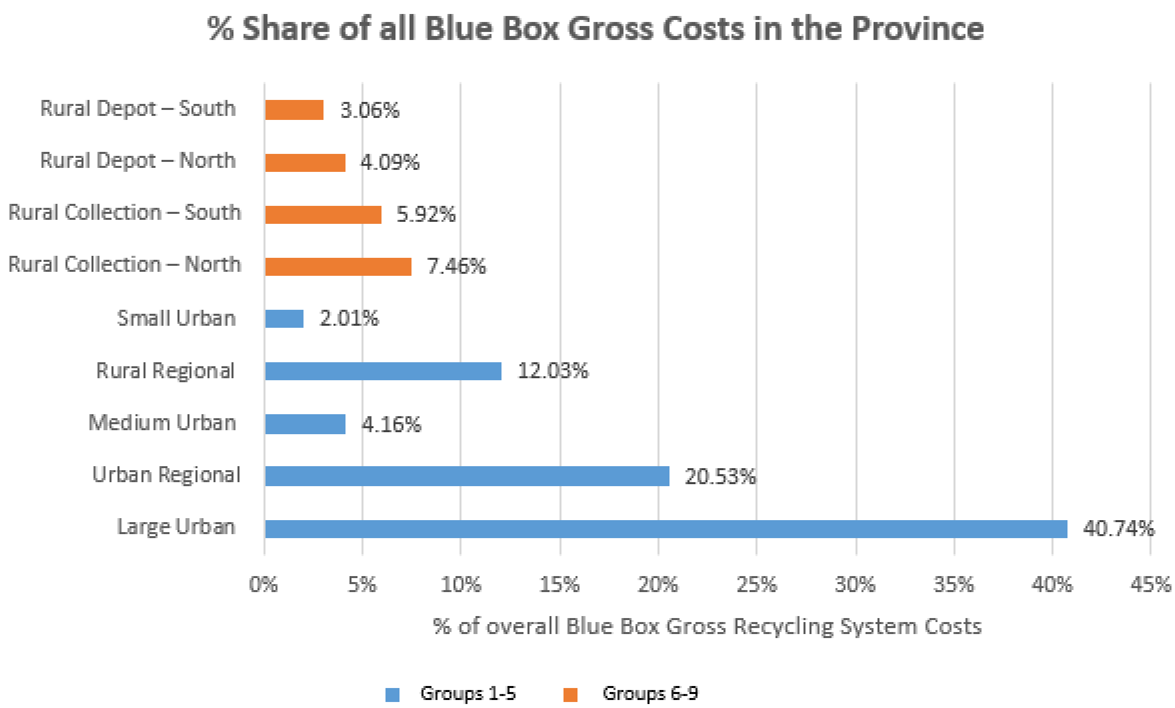
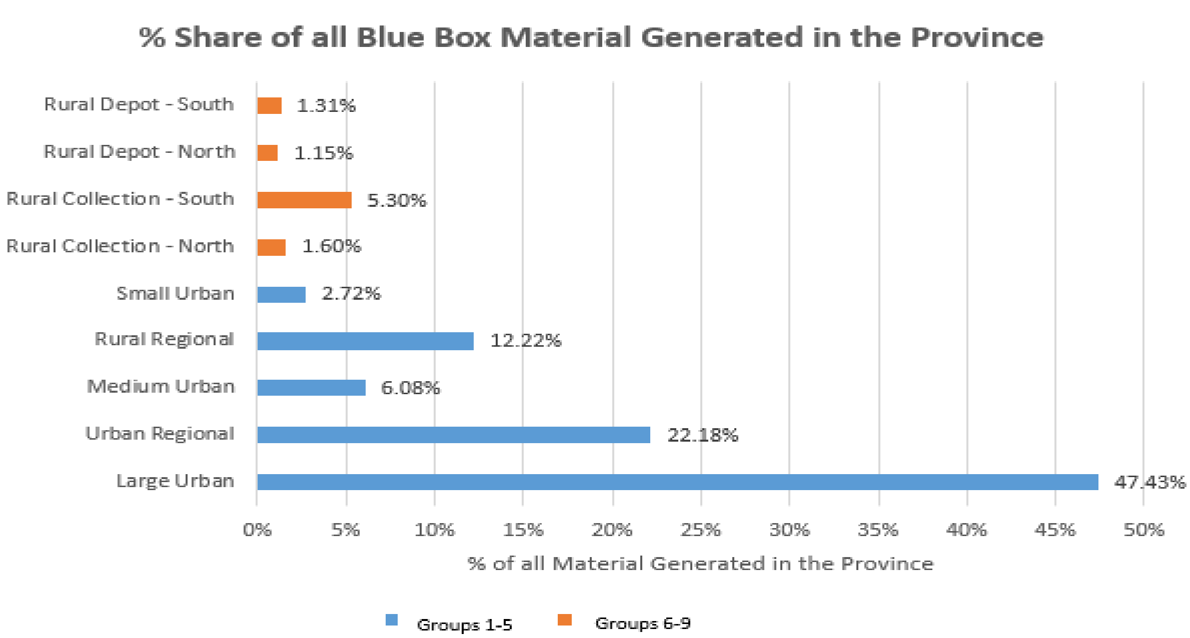


Figure 59: ***Distribution of municipal tonnages in Ontario (by municipal group)***



6.2.3.1 Eliminating recycling programs in groups 6-9

Using the cost model described in section 6.2.4.2, a scenario was modeled that excluded municipal groups 6 through 9 (rural and northern) from the Blue Box program. Rural Collection (North and South) and Rural Depot (North and South) were targeted for removal. Figure 60 below summarizes the results of this test.

Figure 60: ***Model Output (Removing Groups 6-9)***

Model outputs	
Change in Total Material Recovered	**63,030 T**
Change in Total Material Recovered (%)	**-7.06%**
Change in Net Costs	**$60,479,023**
Change in Net Costs (%)	**-20.20%**
Change in Net Cost Per Tonne	**($22.73)**
Change in Collection Costs (%)	**-32.40%**
Change in Processing Costs (%)	**-16.50%**
Change in Depot/TS Costs (%)	**-3.44%**
Change in P&E/Admin Costs (%)	**-2.95%**

By removing groups 6-9 (rural and northern communities) from the Blue Box program, overall diversion falls by 63,030 tonnes (approximately 7.06% of all material recycled in the province). However, net system costs are reduced by $60,479,023, a net savings of over 20%. Expressed alternatively, recovering one tonne of material from rural and northern communities is three times more expensive than recovering an equivalent tonne in urban regions. The greatest savings is observed in collection costs, which are reduced by 32.4%. As noted in section 6.23, collection of recyclables in rural and northern areas poses numerous logistic and infrastructural challenges for municipalities. Curbside collection systems are often costly due to low population densities and transport times to sorting centers. Conversely, depot/transfer stations require municipalities to staff, operate and maintain facilities that suffer from low levels of community participation.

The total potential savings to both municipalities and packaging producers is $30,239,511.50 each (under Ontario's shared producer responsibility model, both municipalities and packaging producers contribute 50% to recycling program costs – as such, any savings would be divided by two, with each party receiving half). However, given that 63,030 tonnes of Blue Box material are no longer being collected, it is assumed that this material will be sent to a landfill (which in turn, will have corresponding costs for transport and tipping fees). Given the variability in the cost of landfilling (costs are a function of both distance to a landfill and individually negotiated contracts with service providers), the cost model used in this study allowed users to select from a range of values using reported landfilling costs from 7 municipalities in the province. On the low end, landfilling fees are $75 a tonne (including transport and tipping fee), which would result in disposal costs of $4,727,250. On the upper end, landfilling fees are $216 a tonne (including transport and tipping fees), resulting in disposal costs of $13,614,480. While these costs are potentially quite significant, they are not enough to offset the savings realized from eliminating recycling programs in these areas.

6.2.3.2 Increasing diversion by targeting specific municipal groups for recovery

The cost model developed for this study also included an optimization function that maximized diversion by targeting specific municipal groups for recovery. Using Excel's solver feature, the cost model maximized system diversion subject to the constraint that net program costs were minimized, and changes in municipal group recycling performance could not exceed 15% of their historical average.

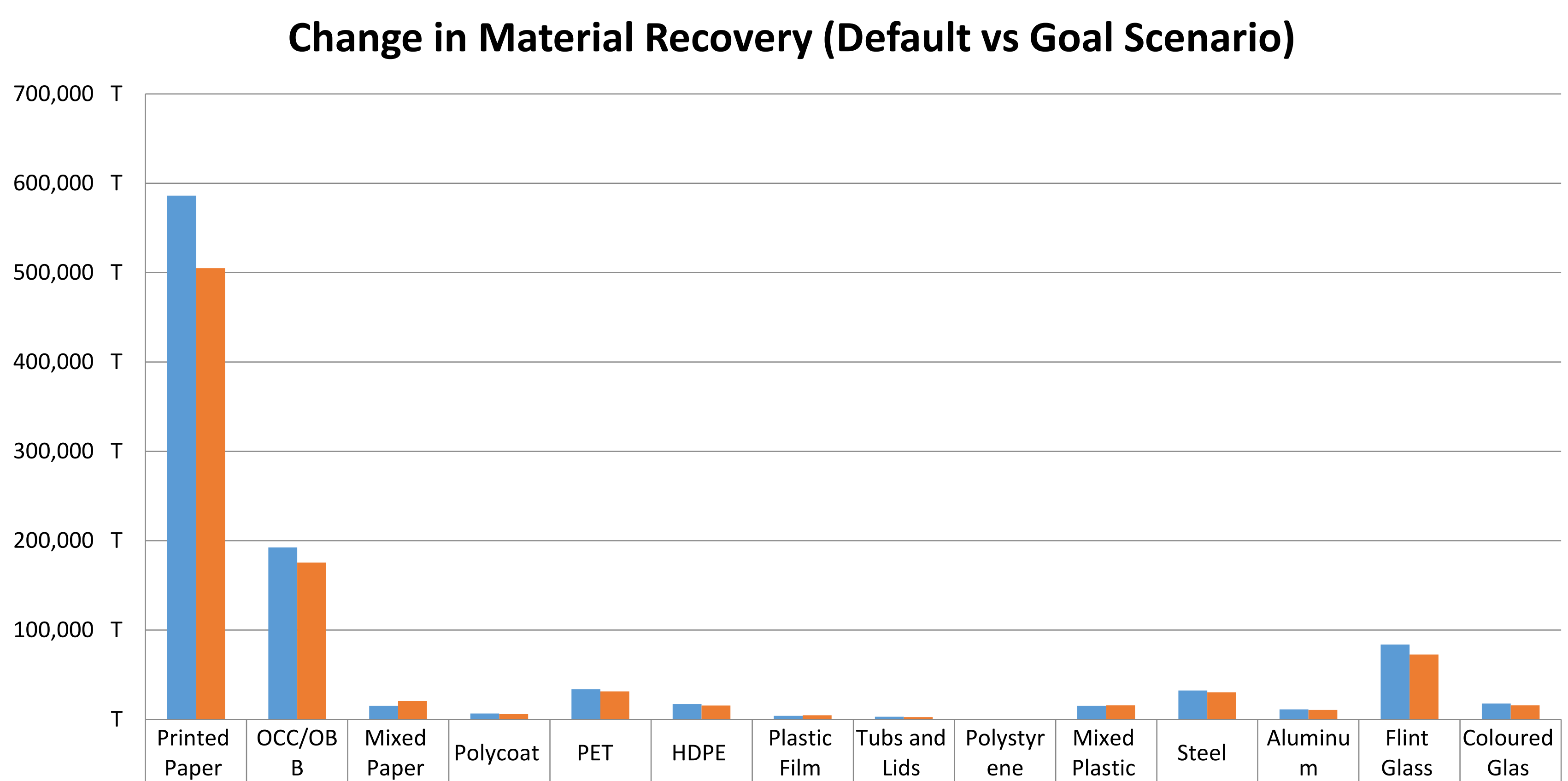
It is important to note that this is largely a theoretical exercise, and does not necessarily reflect what is achievable in practice. A recurring theme throughout this study's evaluation of Blue Box best practices is that municipalities often struggle to have direct control over household recycling rates. As such, simply saying that diversion could be increased in a particular municipal group through additional investments/resources is a bit disingenuous. However, doing so is not entirely without merit. Efficient allocation of resources is a priority for any policy planner. Just because existing policy approaches have yet to achieve desired results doesn't preclude future policies from doing so. If a particular municipal group enjoys cost advantages relative to other regions, additional investments in these areas should be explored. What types of investments remains the critical question.

Figures 61 and 62 show how municipal and material specific tonnages change, as well as the net effect on overall Blue Box program costs. Table 60 below shows how municipal tonnages change under our modeled scenario.

Table 60: ***Change in Municipal Group Tonnages***

Municipal Grouping	Generation	Marketed Tonnes	Modeled Marketed Tonnes	Change in Tonnes
Large Urban	674,291 T	426,543 T	581,321 T	154,778 T
Urban Regional	315,333 T	229,743 T	283,799 T	54,056 T
Medium Urban	86,464 T	51,230 T	77,817 T	26,587 T
Rural Regional	173,662 T	96,391 T	17,366 T	-79,024 T
Small Urban	38,680 T	25,987 T	34,812 T	8,824 T
Rural Collection - North	22,803 T	10,226 T	0 T	10,226 T
Rural Collection - South	75,372 T	40,982 T	0 T	40,982 T
Rural Depot - North	16,415 T	5,043 T	0 T	5,043 T
Rural Depot - South	18,574 T	6,778 T	0 T	6,778 T
Total	1,421,593 T	892,924 T	995,115 T	102,191 T

Figure 61: ***Change in Material Specific Recovery***



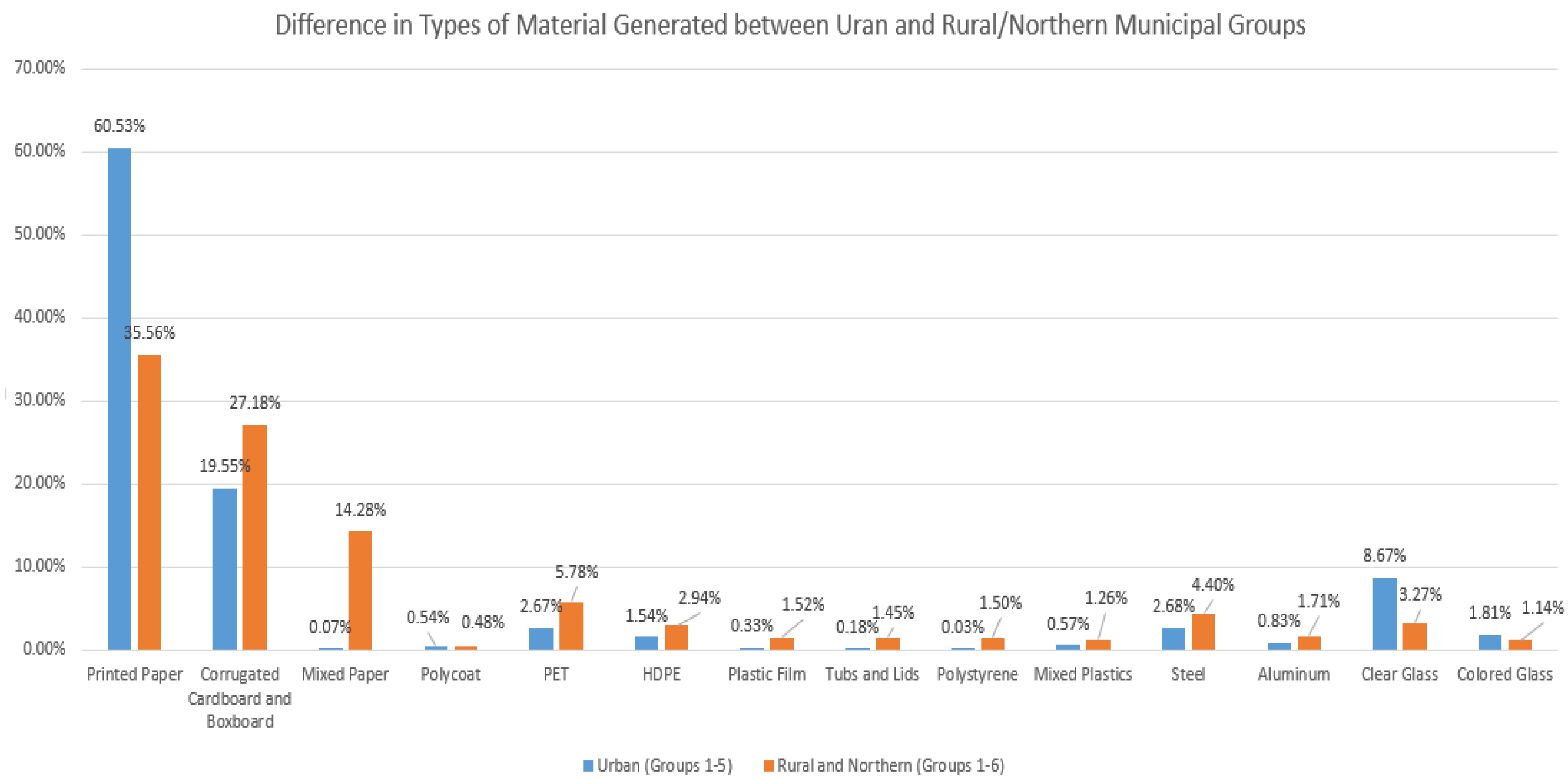
	Printed Paper	OCC/OB B	Mixed Paper	Polycoat	PET	HDPE	Plastic Film	Tubs and Lids	Polystyr ene	Mixed Plastic	Steel	Aluminu m	Flint Glass	Coloured Glas
Goal	586,046	192,460	15,238	6,521	33,633	17,198	3,787	2,933	177 T	15,056	32,420	11,088	83,757	17,604
Default	504,932	175,409	20,577	5,820	31,154	15,339	4,646	2,685	200 T	15,658	30,123	10,462	72,589	15,908

Figure 62: ***Change in Municipal Program Costs***

Default Scenario			Modeled Scenario	
Gross System Costs:	$	326,249,345.59	$	319,047,155.65
Net System Costs:	$	239,481,134.71	$	220,778,898.91
Net Cost Per Tonne	$	268.20	$	155.30
Increase in Recovered Tonnes				102,191 T
Change in Recycling Rate				7.19%
Change in Gross Costs			-$	7,202,189.94
Change in Net Costs			-$	18,702,235.80
Change Overall in Net Cost Per Tonne				-$18.59
Marginal Cost Per Tonne			$	(183.01)

The results shown in figure 62 show that in our modeled scenario, an additional 102,191 tonnes of Blue Box material can be recovered at a net cost of $155.30/tonne (compared to the $268.20 a tonne in the default scenario). By choosing to recover tonnes in lower cost municipal groups (and conversely, eliminating recycling programs in high cost groups), the provincial recycling rate would become 70% (a 7.19% increase relative to the baseline), while net system costs would decrease by approximately $18.2 million dollars. In this hypothetical case, increases in recovery actually decrease overall system costs. Referring to figure 61, most of the additional material diverted would be comprised of relatively low cost/highly recyclable material – the largest increases are observed in printed paper, corrugated cardboard/boxboard and flint glass. An unexpected result is that the overall recovery of composite materials and other plastics (film and polystyrene) actually decrease in the modeled scenario. This would suggest that programs targeted for removal (rural and northern municipalities) generate more of these materials relative to urban communities. While regional variation in household waste generation is expected to some degree, this study cannot offer any ready explanations as to why these specific materials (which are characterized as high cost and difficult to recycle) are generated in larger quantities. Figure 63 provides the composition of materials recycled (by municipal group). This data was calculated using the recovered tonnages reported by municipalities into the WDO data call. Of note, urban municipalities tend to recover greater quantities of “core” Blue Box materials (newsprint, corrugated cardboard and boxboard, aluminum, steel, glass). This, in part, may explain why material management costs are lower in these regions. It is significantly cheaper to recover one tonne of newsprint or cardboard than it is to recover one tonne of plastic film or polystyrene.

Figure 63: ***Differences in the Types of Material Generated Between Urban and Rural/Northern Municipal Groups***



6.2.4.2 Model Applicability

While this model provides useful insights into Ontario's Blue Box recycling system, its applicability to other jurisdictions is somewhat questionable. The costs of recycling are a function of a number of local characteristics and conditions (access to MRF, type of MRF, local labor market, realized commodity prices, maturity of recycling system etc.) that make it difficult to quantify the effects of changes to the recycling system using a generic "one size fits all" approach. With that being said, that was never the intended purpose or function of the model - it was designed with two purposes in mind: 1) to quantify the economic and diversion impact of operating recycling programs in rural and northern Ontario, and 2) to force policy planners to think about, "What is the opportunity cost of incremental diversion?".

Recycling is largely seen as a net social and environmental good. Generally speaking, there is an opinion among stakeholders that "more is better" in conversations surrounding household recycling. However, at what point does increased diversion become undesirable? In Lakhan's study examining the optimal mix of Blue Box materials, it was found that the province could recover 60% of household recyclables, at a cost of $157 million dollars (by focusing on core materials - where core materials are defined as newsprint, cardboard, boxboard, aluminum, steel, PET/HDPE plastics and glass) (2015c). To get to a 62% recycling rate, overall system costs increased by almost $50 million dollars. For every additional tonne recycled, system costs increased by more than $2400 (Lakhan, 2015). The above example highlights a situation where the marginal cost of diversion is significant. This begs the question, "Is it time for both municipalities and packaging producers to question whether a 1% increase in the recycling rate justifies a 9.4% increase in the cost of managing the recycling system" (Lakhan, 2015c). Could these resource be better allocated elsewhere in promoting other environmental and social initiatives? Municipal planners, both in Canada and abroad, must weigh the benefits of recycling against the cost of material management. An efficient recycling system may require focusing on specific materials and geographic regions for recovery. If the situation in Ontario is indicative of what can occur elsewhere, the decision to recycle everything, everywhere, comes at a significant cost.

6.2.5 Conclusion & Policy Implications

This study highlights the obstacles and challenges of recycling in Ontario's rural and northern communities, specifically examining the costs of operating recycling programs in these regions. The findings from the cost model analysis found that operating Blue Box programs in rural and northern regions is a significant contributor to overall system costs, despite comprising a relatively small share of overall material diverted in the province. By removing these programs from the Blue Box system, system recycling costs fell significantly, without negatively affecting the provincial recycling rate in any meaningful way. This study also found that targeting specific municipal groups for recovery could result in a scenario where the province could improve overall diversion while reducing net system costs.

With the above in mind, should recycling programs be eliminated in Ontario's rural and northern municipalities? The answer to this largely depends on one's perspective and what they choose to prioritize from a policy perspective. While increased diversion/recycling, including equal access to environmental programs is largely seen as a social good – at what point is it no longer considered feasible or practical to provide such services? The results from this studies modeling exercise show that the cost of recovering material in rural and northern regions is more than double what it is in urban municipalities. The endemic barriers to recycling in these areas (low population densities, high levels of recycling inconvenience for households, proximity to sorting facilities and depots/transfer stations etc.) are difficult (if not impossible) to overcome. Let's assume for a moment that the province commits to improving recycling rates in these areas - what demonstrably successful tools do municipalities have at their disposal to achieve this goal? As noted in section 6.21, curbside collection and PAYT schemes are popular tools for increasing household recycling, but their viability and effectiveness are contingent on a variety of enabling factors. Population density, a critical mass of material, uniform enforcement, mature collection/procession infrastructure etc. are all required to ensure that these tools are successful in driving diversion, while containing costs. However, Ontario's rural and northern communities lack many of these prerequisites, and as such, the decision to implement them may significantly increase the cost of recycling – largely in communities who already struggle with high material management costs. Unless the financial burden is removed from municipalities, they may be unable or unwilling to expand or improve recycling services. This last point necessitates elaboration, in that the question of "who pays what?" is critical in gauging the viability of a recycling system, particularly if significant initial investments in infrastructure are required.

6.2.5.1 Extended Producer Responsibility: A Potential Solution?

Recycling (at least within the context of printed paper and packaging) is almost always a "losing" proposition. With the exception of aluminum, the value of the recovered material is significantly lower than the costs associated with its end of life management (Stewardship Ontario, 2013). Furthermore, the cost of building, operating and maintaining the requisite infrastructure for successful waste management systems is prohibitive to some municipalities (Munger, 2007). With this in mind, why then do recycling programs even exist? While environmental motives (the desire to conserve resources, promote stewardship and reduce environmental impacts) are certainly critical factors in driving the development and implementation of recycling systems, who ultimately bears the financial burden for building said systems dictates whether they are realized. Studies by Wang (2014), Walls (2006) and Gottberg et al. (2005) have shown that in areas lacking mandatory EPR legislation, communities are less likely to offer household recycling programs. Given the costs associated with integrated waste management systems, many areas opt to landfill recyclable material as a cost savings measure. The likelihood of program implementation is a direct function of how much packaging producers contribute to funding the system. Proponents of EPR legislation often claim that packaging producers should be physically and financially responsible for a product from the point of sale through its end of life (cradle to grave). Unless packaging producers internalize the full costs of managing packaging waste, they will not be incented to design materials that are readily recyclable, reusable and light weight (thereby reducing packaging waste). As an extension of that point, in the absence of financial support from packaging producers, communities may not have the resources to design a system that promotes diversion over disposal.

Under Ontario's shared responsibility model, municipalities and packaging producers each financially contribute 50% to the operation and maintenance of the Blue Box program. While this has allowed for significant proliferation of the Blue Box system, improvements in the service and delivery of the program, particularly in northern and remote regions, will likely require a transition to 100% producer responsible system. At present, municipalities in these areas do not have the resources to improve service delivery in any meaningful way. Attempting to do so will place undue financial strain on municipalities, a cost, they feel, should be borne by packaging producers.

This study is reluctant to offer any insight regarding whether 100% EPR should be encouraged, or if recycling programs should continue to be offered in high cost regions. When looking at the problem through the lens of a "sustainable system", no real clarity is provided either. Promoting recycling in Ontario's rural and northern areas is clearly not economically tenable in the short term – the cost to both municipalities and packaging producers is in the tens of millions of dollars annually, and that is predicated on the assumption that no additional investments in infrastructure will be required (additional material recycling facilities, transfer stations etc.). Conversely, the optics of eliminating recycling programs in these areas would be of extreme detriment to Ontario's sustainability platform. The province has long prided itself on being among a global leader in household recycling, and scaling back these services may be perceived as a step in the wrong direction. Many feel that access to recycling (or any other social) services should be available to all Ontarians, not just those in major urban centers – communities in Ontario's rural and northern areas already feel marginalized and ignored by policy planners. Lastly, an argument can be made that all recycling programs have to start somewhere, and its successful evolution is predicated on time and commitment from all stakeholders. In the late 1980s and early 1990s, many of the same arguments against recycling in Ontario's rural and northern regions could have been used against the Blue Box program (McRobert, 1994). It was expensive, suffered from low levels and household participation and faced significant obstacles and opposition. However, over time, it eventually grew into the most successful residential recycling program in Canada.

6.2.5.2 A tale of two cities: Lessons Learned and Moving Forward

Household recycling in Ontario is largely characterized by two extremes: When it works, it works extremely well. Municipalities in the province's densely populated urban south enjoy regular and convenient curbside service, high levels of household participation and relatively low costs of material management. Conversely, for many of the municipalities located in the province's rural and northern areas, recycling is seen as a burden – from local governments who struggle to operate programs with very limited resources, to households who often must transport recyclable material to remotely located depots and transfer stations. Ontario, and to a degree, other provincial and state jurisdictions, need to decide whether recycling is a right that everyone, irrespective of location, is entitled to, or a privilege that is enjoyed by a select few (who just happen to live in service areas). There is no clear answer to this question – while much of the policy dialogue over the past three decades has been on promoting recycling initiatives, rising recycling system costs may suggest that the most sustainable system is not necessarily the one that diverts the most material.

What ultimately happens to Blue Box recycling in Ontario's rural and northern regions remains uncertain. The current dialogue among stakeholders in the region is largely characterized by frustration and fatigue. The issues highlighted in this study (high cost, low levels of participation etc.) are not new – municipal waste managers and packaging producers recognize that there are significant problems to recycling in these areas, but are fundamentally at odds over what to about it. While the cost model developed in this study shows that a significant savings can be realized by eliminating recycling programs in high cost regions, what is less quantifiable is the social and environmental cost of doing so. Diversion may come at a cost, but the implications of failing to divert need to be carefully considered as well.

6.3 What should go in the bin? Optimizing the mix of material for the province's Blue Box program

Lakhan, C. (2015) "Diversion, but at what cost? The economic challenges of recycling in Ontario" *Resources Conservation and Recycling*, 2(95):133-142

In Ontario, the generation of total recyclable material (per annum) has increased from 1,211,000 tonnes to 1,386,000 tonnes between the periods of 2002 and 2012 (Waste Diversion Ontario, 2012b). The costs of managing this system have increased by 78% during this same period

(Waste Diversion Ontario, 2012b). Both packaging producers and municipalities have expressed extreme concern over the inordinate rise in system costs relative to the increase in waste diversion (Stewardship Ontario, 2007). At this juncture, there remains considerable debate surrounding why material management costs have increased (where material management costs are defined as the costs incurred for collecting, processing and providing administrative support for recycling waste). Increases in costs have been attributed to decreased revenue from the sale of recyclable material, an increasing trend for producers to switch to "light weight" packaging, and inefficiencies in municipal waste collection and processing. However, is it possible that rising system costs are a result of the province's decision to emphasize diversion and recycle the broadest range of materials? In Ontario, 23 packaging types have been classified as acceptable "Blue Box" materials (eligible for inclusion in the residential recycling program). This is done to provide households with the greatest opportunity to recycle, with the intention of increasing the quantity of material diverted from landfills. However, not all materials currently accepted in the Blue Bin have the same costs of material management or levels of recyclability. As noted in Chapter 1, Ontario currently captures most of the easy to recover material (newsprint, cardboard, glass etc.) at a cost of $178 a tonne. However, the cost associated with collecting and recycling non-core materials (where non-core materials are defined as materials with low recyclability and high costs of material management e.g. mixed plastics, composite packaging etc.) exceeds $1200 a tonne (Waste Diversion Ontario, 2012b) .

Using comprehensive panel data for Ontario's residential recycling program (Blue Box), this section explores this question, quantifying the impact of "non-core" material recycling on system costs and diversion levels.

To assess the implications of "non-core" material recycling, this research examines the following questions:

1) How has the generation of "non-core" materials changed in the past decade?

2) What would happen to provincial recycling costs and diversion levels if these items were removed from the Blue Box program?

3) Is it possible to achieve the province's 70% recycling target if "non-core" materials were no longer being collected?

While there is a significant body of literature that examines the economics of recycling, this section models the impacts and viability of recycling on a material-specific basis. A further unique aspect of this study is the use of systems-based modeling to evaluate how system costs and diversion levels change in response to removing one (or more) materials from the Blue Box program.

6.3.1 The costs/benefits of recycling

The economic viability of municipal recycling systems is a subject of contention among researchers (see Kinnaman and Fullerton, 1995; Munger, 2007; Lah, 2002). The costs, benefits and support for recycling range widely across studies. This may be attributed to the site and situation specific factors that ultimately drive the costs of recycling in any given area. Curbside vs. bring/depot systems, regulatory requirements (mandatory recycling schemes vs. voluntary initiatives) and the presence of extended producer responsibility legislation are just some of the factors that affect the costs of recycling.

In an examination of the cost recovery framework used in Portugal's Green Dot recycling system, Da Cruz et al. (2012) found that there were economic benefits to recycling when savings due to material diverted from landfill were accounted for. Bogert and Morris (1992) derive a similar conclusion in a review of recycling costs in Washington State, where recycling was seen as being both economically and environmentally preferable to disposal. In all four sites studied, the outright costs of recycling were actually cheaper than the cost of disposing the same material in a landfill. With this in mind, it is important to note that both the costs of recycling and the costs of land filling change over time. As new technologies or packaging types become available, and as landfill capacity increases/decreases, the cost competitiveness of recycling changes.

While Highfill and McAsey (1997) argue that the cost of recycling decreases relative to disposal over time (as landfill costs will increase as available capacity decreases), this is predicated on the assumption that landfill space is finite. In a review of Ontario's landfill infrastructure and historical pricing undertaken by the Ontario Waste Management Association (OWMA), the exact opposite is actually observed (OWMA, 2013). Due to a trade agreement with the state of Michigan that enabled Ontario to export waste to other jurisdictions, available landfill capacity in the province increased by a factor of 10. As a result, landfill tipping fees decreased by more than 90%, reducing the cost of disposal relative to recycling (OWMA, 2013).

The recyclability and cost of managing specific materials also has a significant effect on the economic viability of municipal recycling systems. The tenability of recycling systems is largely dependent on the type of packaging material recycled (Da Cruz et al., 2012). In studies by Marques et al. (2014) and Lavee (2007), it was found the recycling of packaging with low resale value (and low raw material costs), may not be economically sustainable in the long run. This problem is only exacerbated if the costs of recycling are high, particularly for materials which are also difficult to recycle (e.g. plastic laminants and composite packaging). A notable exception to this issue is metals recycling (aluminum and steel), which has consistently shown positive economic benefits relative to virgin material procurement (Pingsha, 2004).

This study does not attempt to offer any definitive guidance regarding the appropriateness of recycling as a sustainability strategy. Instead, it highlights that not all recycling activities are created equal, and that recycling the broadest range of materials is not necessarily the most efficient choice.

6.3.2 Materials and Methods

6.3.2.1 Definition of Core Blue Box Materials

While there is no formal definition for what constitutes a "core" Blue Box material, for the purposes of this study, we define a core material as possessing the following qualities: 1) High recyclability, 2) Generated in significant quantities by households, 3) Low cost of material management, and 4) Accepted by most municipalities for inclusion in the Blue Box program. Using this criterion, the following eleven materials have been classified as core materials: Newsprint, Magazines and Catalogs, Telephone Books, Other Printed Paper, Corrugated Cardboard, Boxboard, PET Bottles, HDPE Bottles, Steel Packaging, Aluminum Packaging & Glass.

6.3.2.2 Definition of Non- Core Blue Box Materials

Once again, there is little available literature regarding what constitutes a "non-core" material. Generally speaking, the characteristics of a "non- core" material include: 1) Low levels of recyclability, 2) Poorly developed end markets, 3) High cost of material management, and 4) Low realized revenues from sale of material. Of note, inclusion in the Blue Box program was not observed to be a useful method for identifying non-core materials. Most major municipalities tend to accept the full range of Blue Box materials regardless of its levels of recyclability, cost etc. Using these criterion, 7 materials were classified as non-core materials: Gable Top Cartons, Aseptic Containers, Paper Laminants, Plastic Film, Plastic Laminants, Polystyrene and Other Plastics.

6.3.2.3 Comparison of Costs and Recycling Rates Among Blue Box Materials

Figures 66 and 65 compare the net cost of material management and recycling rates for the full range of Blue Box materials. Note: Net cost of material management is calculated by taking the gross cost of material management and subtracting revenue from the sale of marketed material. Revenue for each material is calculated using the twelve month average of the spot price received from the sale of material by provincial municipalities. Recycling rates are calculated by dividing the total quantities of material recovered by the total quantities of material generated.

*Figure 64**: Net Cost Per Tonne for Blue Box Materials)***

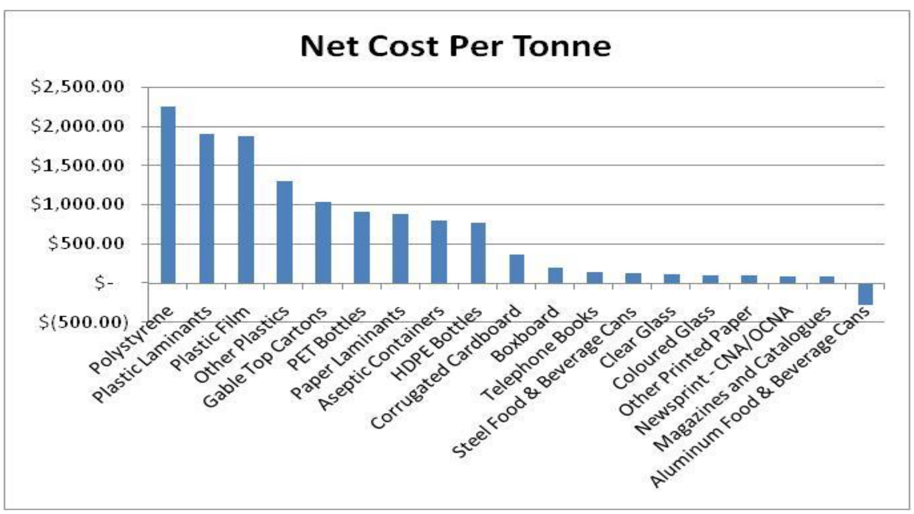
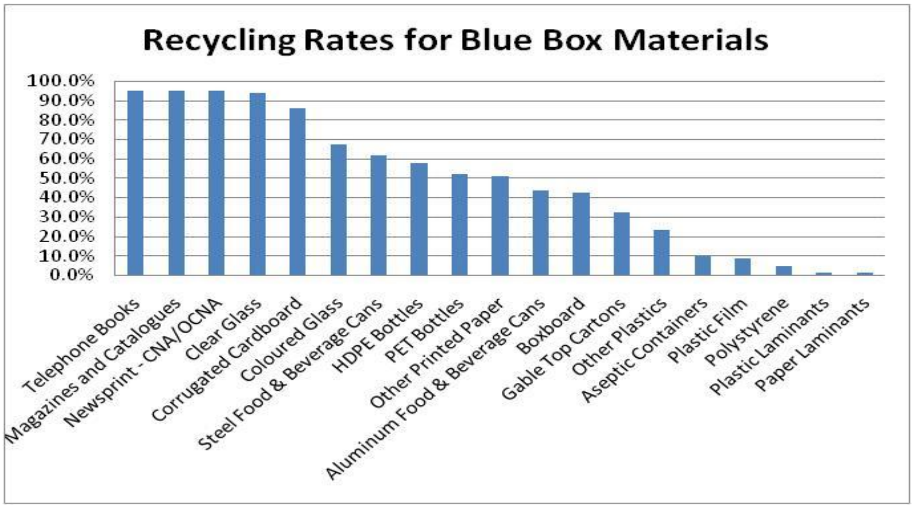


*Figure 65: **Recycling Rates for Blue Box Materials***



Figures 64 and 65 above show that "core" Blue Box materials, on average, tend to have the lowest costs of material management and the highest recycling rates. Conversely, "non-core" materials, on average, have significantly higher net costs and lower recycling rates. This, in part, is attributable to the low recyclability of "non-core" materials. In many instances, these items cannot be sorted at a conventional material recycling facility (MRF) and are subsequently treated as contamination on the sorting line (despite being collected in the Blue Box, they are disposed of at the recycling center) (Stewardship Ontario, 2013). Significant investments in sorting technology and infrastructure are required before non-core materials can be recovered - for example, optical sorters are required to sort many of the materials classified as other plastics (polystyrene crystal, thermoform packaging etc.). However, many MRF operators are reluctant to make these investments as revenues from the sale of sorted non-core materials are often too low to recuperate costs. Reports by StewardEdge (2014) suggest that the poor recyclability of non-core materials is attributable to immature end markets. At this juncture, there are few end-use applications for many non-core materials, and until these markets are developed, investment in non-core sorting technology is likely to remain low.

6.3.2.4 What is being tested and expected results

This section seeks to examine whether increases in the generation and recovery of non-core materials increase the costs of Blue Box recycling. Increases in cost may be attributed to:

- It costs more to recycle non-core materials compared to core Blue Box materials
- The presence of non-core materials increases the cost to recycle "core" Blue Box materials and, in fact, all materials managed by the Blue Box program (Stewardship Ontario, 2012).

The end result is that the cost of recycling each Blue Box material is influenced by the presence of other materials managed within the system.

The following examples illustrate this impact:

Scenario 1: 1 tonne of newsprint and cardboard enters the sorting line at a MRF. It takes a worker on average 10 minutes to sort that material into their respective bins

Scenario 2: 1 tonne of news print and cardboard, plus .1 tonnes of plastic laminants, plastic film and polystyrene enters the sorting line at the MRF. It takes a worker on average 25 minutes to sort the material into their respective bins.

Even though one tonne of newsprint and cardboard is entering the sorting line in both scenarios, a 10% increase in commingled non-core materials drastically increases the sort times at the MRF. The mere presence of material B (commingled plastics) affects both the time and costs of managing material A (newsprint and boxboard).

Now, consider a follow up scenario where the MRF invests in a plastic resin gun to decrease sort times of non-core plastics. The current cost allocation methodology divides the costs of additional equipment across all materials being managed at the MRF, thereby increasing the costs of material management for the newsprint and cardboard as well.

To quantify the full effects of non-core Blue Box materials on system and material specific costs, a cost model was developed to achieve the following: a) calculate how non- core material generation and diversion has changed in the past decade, b) model a scenario where non-core materials were no longer accepted in the Blue Box program and observe the impact on system costs, material specific costs and diversion levels, and c) test to see whether Ontario could meet provincial recycling targets in a scenario where non-core materials were no longer being collected.

The cost model developed for this study used data collected from the Stewardship Ontario PIM model and the WDO data call, and was created in Microsoft Excel. The cost model allows users to model the following:

- Users can alter material tonnes recovered or material revenues to re-calculate impact on Blue Box system costs and diversion rate.
- Users can set a Blue Box system Goal Recycling Rate (currently set at 70%). The model calculates the impact on Blue Box system costs and material recovery rates of achieving the Goal Recycling Rate, based on increasing diversion for the materials with the lowest net cost.
- Users can select which materials are included in the Blue Box program. The model eliminates materials selected by the user that they wish to exclude from collection. The model then calculates the impact on Blue Box system costs and material recovery rates.

6.3.2.5 Key model assumptions

All cost and recovery data used in the cost model used the values as reported by Stewardship Ontario and the WDO in either the PIM model or municipal data call. All reasonable efforts were made to maintain data integrity by performing as little data manipulation as possible. For example, if paper laminants were targeted for removal, the model would take its reported net cost per tonne, multiply it by the number of tonnes reported as recycled, and subtract that total from overall Blue Box costs. Data would need to be recalculated with respect to the distribution of common costs. By removing a material from the program, their share of overall common costs would need to be redistributed among the remaining materials. This was a calculated figure, and was done on the basis of a material's contribution to overall waste generation - For example, if corrugated cardboard constitutes 25% of all material generated in the province (after the removal of paper laminants), it would incur 25% of overall common costs.

6.3.3 Results and Discussion

6.3.3.1 How has the generation and recovery of non-core materials changed over time?

Using historical data from the Stewardship Ontario PIM model, tables 61 through 63 below show how quantities of non-core Blue Box generation and recovery have changed over the past decade. For illustrative purposes, these figures are compared against how the generation and diversion of core materials have changed during this same period. Note: quantities of overall household waste generation in Ontario have actually decreased in the past decade. In 2002, the average Ontarian generated 383kg of waste per year. This is compared to 366kg per capita/per year estimated by the WDO in 2012 (WDO, 2014). Some municipal officials have suggested that decreases in generation are not necessarily attributed to changes in household behavior, but due to the increasing shift towards light weight packaging by packaging producers. There is evidence to support these claims, as a review of steward sales data remitted to Stewardship Ontario indicates that the quantities of packaging waste sold into the market (expressed in terms of unit sales, not weight based metrics, i.e. tonnes) has increased over the past decade (Stewardship Ontario, 2013).

Table 61: ***Changes in generation of core and non-core Blue Box Packaging***

(Source: Stewardship Ontario PIM 2003-2013 PIM Model)

Materials	**2003 Quantity Generated (tonnes)**	**2013 Quantity Generated (tonnes)**
Non-Core Materials		
Gable Top Cartons	14,249 T	42,000 T
Paper Laminants	2,800 T	39,205 T
Aseptic Containers	5,820 T	12,800 T
Plastic Film	53,700 T	54,383 T
Plastic Laminants	35,391 T	35,391 T
Polystyrene	20,400 T	57,400 T
Other Plastics	28,300 T	70,790 T
Core Materials		
Newsprint - CNA/OCNA	264,800 T	217,375 T
Newsprint - Non-CNA/OCNA	136,400 T	148,405 T
Magazines and Catalogues	95,100 T	78,908 T
Telephone Books	15,000 T	8,329 T
Other Printed Paper	127,800 T	128,245 T
Corrugated Cardboard	140,000 T	169,361 T
Boxboard	130,500 T	163,988 T
PET Bottles	36,200 T	56,848 T
HDPE Bottles	23,000 T	27,598 T
Steel Food & Beverage Cans	57,800 T	45,286 T
Steel Aerosols	4,300 T	4,079 T
Steel Paint Cans	4,800 T	5,072 T
Aluminum Food & Beverage Cans	24,100 T	22,552 T
Other Aluminum Packaging	2,408 T	4,521 T
Clear Glass	76,200 T	74,522 T
Colored Glass	6,700 T	25,277 T

Table 62: ***Changes in recovery of core and non-core Blue Box Packaging***

(Source: Stewardship Ontario PIM 2003-2013 PIM Model)

Category	2003 Quantity Recovered	2013 Quantity Recovered
	(tonnes)	(tonnes)
Non-Core Materials		
Gable Top Cartons	420 T	6,833 T
Paper Laminants	268 T	1,264 T
Aseptic Containers	1,222 T	955 T
Plastic Film	2,993 T	4,923 T
Plastic Laminants	574 T	7 T
Polystyrene	541 T	1,448 T
Other Plastics	1,603 T	16,146 T
Core Materials		
Newsprint - CNA/OCNA	224,344 T	203,689 T
Newsprint - Non-CNA/OCNA	109,790 T	139,062 T
Magazines and Catalogues	68,898 T	61,776 T
Telephone Books	11,254 T	7,968 T
Other Printed Paper	49,463 T	57,949 T
Corrugated Cardboard	100,279 T	144,539 T
Boxboard	54,712 T	67,998 T
PET Bottles	18,120 T	32,701 T
HDPE Bottles	11,551 T	16,409 T
Steel Food & Beverage Cans	30,447 T	29,187 T
Steel Aerosols	1,008 T	942 T
Steel Paint Cans	1,128 T	696 T
Aluminum Food & Beverage Cans	9,832 T	10,860 T
Other Aluminum Packaging	282 T	348 T
Clear Glass	40,336 T	70,014 T
Coloured Glass	3,229 T	17,210 T

Table 63: ***Changes in recycling rate of core and non-core Blue Box Packaging between 2003 and 2013***

(Source: Stewardship Ontario PIM 2003-2013 PIM Model)

Category	**2003 Recycling Rate**	**2013 Recycling Rate**
	(%)	**(%)**
Non-Core Materials		
Gable Top Cartons	2.95%	16.27%
Paper Laminants	9.57%	3.22%
Aseptic Containers	21%	7.46%
Plastic Film	5.57%	9.05%
Plastic Laminants	1.62%	0.02%
Polystyrene	2.65%	2.52%
Other Plastics	5.66%	22.81%
Core Materials		
Newsprint - CNA/OCNA	84.72%	93.70%
Newsprint - Non-CNA/OCNA	80.49%	93.70%
Magazines and Catalogues	72.45%	78.29%
Telephone Books	75.03%	95.67%
Other Printed Paper	38.70%	45.19%
Corrugated Cardboard	71.63%	85.34%
Boxboard	41.92%	41.47%
PET Bottles	50.06%	57.52%
HDPE Bottles	50.22%	59.46%
Steel Food & Beverage Cans	52.68%	64.45%
Steel Aerosols	23.44%	23.09%
Steel Paint Cans	23.5%	13.72%
Aluminum Food & Beverage Cans	40.92%	48.16%
Other Aluminum Packaging	11.71%	7.7%
Clear Glass	52.93%	93.95%
Coloured Glass	48.19%	68.09%

From the above tables, we see that the both the generation and recovery of non-core materials has increased significantly over the past 10 years. Expressed as a percentage of overall

Blue Box generation, non-core materials have increased from 7% to 11% of all material generated in the province. Conversely, the relative contribution of core materials, both with respect to overall generation and diversion (expressed as a % of the total number of tonnes being managed within the system) is decreasing. While it is uncertain as to whether these trends will continue into the future, we can intuit the following:

- The generation and recovery of printed paper (newsprint, magazines and telephone directories etc.) is trending down (expressed in absolute tonnes). This is consistent with the prevailing opinion by packaging producers that printed paper is a dying medium increasingly being replaced by electronic media. Given that printed paper comprises a significant portion of the existing Blue Box recycling stream (and is classified as a core material), it seems plausible that the generation and recovery of core materials will decrease over time.

- There is an increasing trend for producers to select light weight packaging to decrease transportation and logistics costs. Given that most light weight packaging is comprised of "non-core" materials (i.e. PET thermoform packaging, polystyrene crystal etc.), it is likely that the generation of non-core materials will continue to increase.

It should also be noted that there are a series of complex patterns and trends with respect to how material generation and recovery has changed in the past decade. While some of the possible causes for these changes are briefly explored in Chapter 4, this topic is deserving of additional scholarly investigation.

6.3.3.2 What is the effect of removing non-core materials?

Using the cost model described in section 6.3.2.5, a scenario was modeled that removed non-core materials from the Blue Box program. Gable Top Cartons, Aseptic Containers, Paper Laminants, Plastic Film, Plastic Laminants, Polystyrene and Other Plastics were targeted for removal. Figure 66 below summarizes the results of this test.

*Figure 66**: Summary results of cost model analysis***

Baseline			Modeled Scenario			Difference	
Current Recycling Rate:		62.81%	Current Recycling Rate:		60.59%		-2.22%
Total Tonnes Recovered		892,924 T	Total Tonnnes Recovered		861,348 T		-31,576 T
Gross System Cost	$	313,552,566.56	Gross System Cost	$	269,937,347.06	-$	43,615,219.50
Net System Cost	$	198,032,184.82	Net System Cost	$	157,751,401.23	-$	40,280,783.59
Revenue	$	115,520,381.74	Revenue	$	112,185,945.83	-$	3,334,435.91
Industry Share of Cost		50%	Industry Share of Cost		50%		
Cost to Industry	$	99,016,092.41	Cost to Industry	$	78,875,700.62	-$	20,140,391.80
Cost to Municipalities	$	99,016,092.41	Cost to Municipalities	$	78,875,700.62	-$	20,140,391.80
Common Costs*	$	4,989,415.00	Common Costs*	$	4,989,415.00		
			Common Costs to be Redistributed	$	1,583,957.00		
Gross Collection Costs	$	169,645,572.87	Gross Collection Costs	$	146,047,842.57	-$	23,597,730.29
Gross Processing Costs	$	98,112,820.72	Gross Processing Costs	$	84,465,309.37	-$	13,647,511.35
Gross Depot/Transfer Station Costs	$	22,369,970.78	Gross Depot/Transfer Station Costs	$	19,258,303.74	-$	3,111,667.04
Gross Promotion and Education Costs	$	6,439,553.55	Gross Promotion and Education Cos	$	5,543,810.47	-$	895,743.08
Gross Administration Costs	$	5,825,408.61	Gross Administration Costs	$	5,015,093.21	-$	810,315.41
Gross Interest on Municipal Capital Costs	$	11,159,240.03	Gross Interest on Municipal Capital C	$	9,606,987.70	-$	1,552,252.33

*Common Costs refer to the administrative/support costs common to all materials in the Blue Box program. These costs are then distributed on the basis of how much each material generates in the province.

Removing non-core materials has a significant impact on net system cost, but only a small impact on overall diversion rates. By no longer collecting non-core materials, net system costs decreased by $40.28 million, a 20.5% decrease in cost relative to the existing system. Given Ontario's shared responsibility model in financing the Blue Box program, municipalities and packaging producers each save $20.1 million dollars by removing non-core materials from the program. Conversely, under the modeled scenario, the overall recycling rate for the Blue Box program as a whole decreased by 2.22%. This is a reduction of 31,576 tonnes diverted. Stated alternatively, the net cost per tonne for managing non-core materials under the existing system is $1276/tonne (compared to a net cost per tonne of $183/tonne for core Blue Box materials).

This result was largely unexpected - while there was an expectation that removing non-core materials from the Blue Box program would result in a decrease in cost, the magnitude of the savings was a surprise. Looking at the model results, decreases in system cost could be attributed to the following:

- As noted in section 6.3.2.3, the net cost per tonne for non-core materials is significant. Removing these items from the program reduces the cost of material management, as MRFs would no longer require additional investments in infrastructure or technology.
- Non-core materials have very low revenues. Due to poor end markets for non-core materials, there is little demand for non-core materials from recycling re-processers. As such, whatever revenue is received from the sale of non-core materials (if any) does little to offset the cost of material management.
- Removing non-core materials from the Blue Box program reduces the cost for all other core materials. On average, the net cost per tonne for core materials (under the modeled scenario) decreased by 19.1%.

Of note, the greatest savings estimated in the modeled scenario was observed in collection and processing costs. By removing non-core materials from the Blue Box program, it is estimated that collection and processing costs would decrease by $23.6 million and $13.6 million respectively. This result is consistent with our expectation surrounding the cost drivers of material management for non-core materials. Non-core packaging (i.e. thermoforms and composites) tends to be light weight, but voluminous. This means that it physically occupies a significant portion of space in the Blue Bin (reducing the capacity for other materials), but results in fewer tonnes being collected. Collection costs increase as more recycling trucks are required to collect fewer tonnes of material per set out. Processing costs increase as MRFs often need to be specially configured to manage non-core packaging.

It should be noted that under our modeled scenario, there is a cost incurred by the municipality for collecting and disposing of non-core materials in a landfill (as they are no longer being managed in the Blue Box program). Each municipality faces different land filling costs, as it depends on their distances to landfill sites, tipping fees and respective contracts with service providers. In a study by the OWMA, the cost for land filling one tonne of waste in Ontario ranges from $20 to $190 (OWMA, 2013). Larger municipalities tend to have lower disposal costs, as they either a) own and operate their own landfills, or b) can negotiate preferable contracts with landfill operators (OWMA, 2013). If 31,576 tonnes of non-core materials are removed from the recycling system, estimated disposal costs would be $631,520 on the lower end and $5,999,440 on the upper end. Given that it is primarily larger municipalities who are recycling non-core materials, one would expect that disposal costs for removing fringe materials would tend towards to the lower end estimate.

6.3.3.3 Can Ontario achieve its 70% recycling target with non-core materials removed from the Blue Box?

It may seem unreasonable to expect Ontario to achieve its 70% recycling target while simultaneously reducing the range of materials included in the Blue Box program. However, using the cost model described in section 3.4, a scenario was modeled to test whether this result was not only possible, but economically preferable relative to the existing system. To do so, this study used Excel's solver feature, subject to the constraints that:

- The overall recycling rate for the Blue Box program must be 70%
- Achieve the goal recycling rate at the lowest possible cost

- Material specific recycling rates could not be significantly out of line with historical performance*

This last constraint requires elaboration, in that specific conditions were placed on each material such that the modeled recycling rates did not exceed historical averages by more than 25%. For example, the historical recycling rate for aluminum is approximately 45%. While aluminum is a low cost material and highly recyclable, it does not seem realistic that aluminum could achieve a 95% recycling rate in the near term. As such, upper limit caps were placed on each material such that the modeled scenario reflected a plausible system.

Table 64 summarizes how material recovery would need to change to achieve a 70% recycling target with non-core materials removed from the program.

Table 64: ***Changes in recovered tonnes to achieve 70% recycling rate***

Material	Baseline	Modeled Scenario	Difference
	Recovery (tonnes)	Recovery (tonnes)	(tonnes)
Newsprint -CNA/OCNA	203,689T	213,124T	9,434T
Newsprint - Non-CNA	139,062T	145,078T	6,016T
Magazines and Catalogues	61,776T	72,143T	10,367T
Telephone Books	7,968T	7,714T	-254T
Other Printed Paper	57,949T	95,842T	37,893T
Corrugated Cardboard	144,539T	162,113T	17,574T
Boxboard	67,998T	114,689T	46,691T
Gable Top Cartons	6,833T		-6,833T
Paper Laminates	1,264T		-1,264T
Aseptic Containers	955T		-955T
PET Bottles	32,701T	34,013T	1,312T
HDPE Bottles	16,409T	14,027T	-2,382T
Plastic Film	4,923T		-4,923T
Plastic Laminates	7T		-7T
Polystyrene	1,448T		-1,448T
Other Plastics	16,146T		-16,146T

Steel Food and Beverage Cans	29,187T	31,251T	2064
Steel Aerosols	942T	942T	
Steel Paint Cans	696T	696T	
Aluminum Food and Beverage Cans	10,860T	12,854T	1,994T
Other Aluminum Packaging	348T	348T	
Clear Glass	70,014T	70,014T	
Colored Glass	17,210T	20,179T	2,969T

As shown above, with non-core materials removed from the Blue Box program, the recovery of core materials would need to increase by 102,103 tonnes, the majority of which coming from boxboard and other printed paper. Despite the high recyclability of both of these materials, there are significant opportunities for improvement in their respective recycling performance. Boxboard and OPP are considered poor recycling performers relative to their peer group (similar packaging types), with recycling rates approximately 30% lower than other paper based packaging.

While the above table shows that it is potentially possible to achieve a 70% recycling rate despite removing non-core materials from the program, a more salient question is the effect of increased diversion on system costs.

Figure 67 below shows how system costs change under the modeled 70% recycling scenario.

Figure 67: ***Changes in system cost under 70% recycling scenario (non-core materials removed)***

Baseline		Modeled Scenario			Difference
Current Recycling Rate:	62.81%	Current Recycling Rate:		70.00%	7.18%
Gross System Cost	$ 313,552,566.56	Gross System Cost	$	305,453,276.56	-$ 8,099,290.00
Net System Cost	$ 198,032,184.82	Net System Cost	$	178,597,878.99	-$ 19,434,305.83
Revenue	$ 115,520,381.74	Revenue	$	126,855,397.57	$ 11,335,015.83
Industry Share of Cost	50%	Industry Share of Cost		50%	
Cost to Industry	$ 99,016,092.41	Cost to Industry	$	89,298,939.50	-$ 9,717,152.92
Cost to Municipalities	$ 99,016,092.41	Cost to Municipalities	$	89,298,939.50	-$ 9,717,152.92
Common Costs*	$ 4,989,415.00	Common Costs*	$	4,989,415.00	
		Common Costs to be Redistributed	$	1,583,957.00	
Gross Collection Costs	$ 169,645,572.87	Gross Collection Costs	$	165,263,504.79	-$ 4,382,068.08
Gross Processing Costs	$ 98,112,820.72	Gross Processing Costs	$	95,578,495.47	-$ 2,534,325.25
Gross Depot/Transfer Station Costs	$ 22,369,970.78	Gross Depot/Transfer Station Costs	$	21,792,138.22	-$ 577,832.56
Gross Promotion and Education Costs	$ 6,439,553.55	Gross Promotion and Education Cos	$	6,273,215.21	-$ 166,338.33
Gross Administration Costs	$ 5,825,408.61	Gross Administration Costs	$	5,674,934.09	-$ 150,474.53
Gross Interest on Municipal Capital Costs	$ 11,159,240.03	Gross Interest on Municipal Capital C	$	10,870,988.78	-$ 288,251.26

Under the 70% recycling scenario, net system costs decrease by $8 million dollars. This is despite a 7.18% increase in the recycling rate and an extra 102,140 tonnes diverted. This seemingly counter-intuitive result (increased diversion at a lower cost) can be attributed to the removal of high cost, difficult to manage non-core materials, and targeting core materials with low net costs and high revenues. Under the modeled 70% recycling rate scenario, system wide revenue increased by $11.3 million dollars.

While the 70% recycling rate scenario modeled in this study produces some very interesting findings, its results should be interpreted with caution. The assumptions surrounding changes and constraints on material-specific recovery may not be indicative of what is achievable in practice. Though every effort was made to model a "plausible" Blue Box system, targeting specific materials for increased recovery is a challenging, complex, and sometimes, impossible task.

6.3.4 Conclusion and Policy Implications

This study highlights the economic challenges of recycling in Ontario, specifically examining the effect of non-core package recycling on system and material specific costs. The findings from the cost model analysis found that the recovery of non-core Blue Box materials is a significant contributor to overall system costs, despite comprising a relatively small share of material diverted in the province. By removing these non-core items from the Blue Box system, both system and material specific recycling costs fell significantly, without negatively impacting the overall recycling rate in any meaningful way. This study also found that targeting specific materials for recovery (core Blue Box materials) could result in a scenario where the province can improve overall diversion while reducing material management costs.

This study also raises the question, at what point is it no longer economically feasible or desirable to recover a resource? Many of Ontario's municipalities and packaging producers have questioned whether a 1% increase in the recycling rate justifies a 9.4% increase in the cost of managing the recycling system. These concerns have been echoed in jurisdictions across North America and Europe, as municipal planners must weigh the benefits of recycling against rising material management costs (Boyce, 2012).

While this study is reluctant to offer recommendations regarding whether to remove non-core materials from the Blue Box program, policy planners need to be both adaptive and proactive in designing a system that is capable of responding to changes in the packaging mix. Whether this is achieved by prohibiting the use of these materials, incenting packaging producers to make alternative packaging choices, or investing in the necessary infrastructure to accommodate for the increased generation of non-core materials, will ultimately depend on the long term goals of the program. Do we choose to prioritize diversion, cost containment, or some combination thereof?

While movement towards more sustainable waste management options should certainly be promoted, we must recognize that the most sustainable system is not necessarily the one that recycles the most material. Though recycling is a central component of developing sustainable waste management systems, its adoption must be weighed against budgetary, social and environmental considerations. The careful balancing act between continuous improvement in diversion and cost containment is a topic that requires increased academic attention.

6.4 Conclusion

This chapter elaborates on the findings from Chapter 5, which evaluated four policies deemed as “Blue Box best practices” by the provincial government. Specifically, this section examined the disconnect between what stakeholders think is working and what is actually working. Given that none of the policies characterized as recycling best practices were able to satisfy the evaluative criteria chosen for this study (diversion, cost containment and stakeholder perceptions), this chapter explored possible barriers to best practice effectiveness. Findings suggest that while diversion and cost containment are not necessarily mutually exclusive pursuits, they are difficult to achieve simultaneously. The latter half of this chapter considered two hypothetical recycling systems that sought to minimize program costs while improving diversion. These scenarios are considered radical departures from the existing system, in that they propose contracting the Blue Box program and focusing efforts on “high performance” regions/materials. Using two independently developed cost models, this chapter found that it was possible to increase diversion while simultaneously reducing cost – even in a scenario where certain materials were eliminated from the Blue Box program and rural/northern regions were no longer being serviced. The take away message from this chapter is that while recycling should continue to be promoted as a preferred waste management option, the most efficient system is not necessarily the one that services the most people or recycles the broadest range of materials.

Chapter 7: Conclusions and Recommendations

7.1 Summary

This dissertation undertook a critical review of four recycling policies used in Ontario which are designed to promote household waste diversion and reduce material management costs. These policies include:

1) Municipal funding should be directly tied to program performance relative to their peer group. All other things being equal, municipalities who recycle more at a lower cost relative to other "like" municipalities will have a larger proportion of their funding reimbursed by industry. This is achieved by having "poorer" performing municipalities transfer a portion of their funding to municipalities with higher levels of relative recycling performance. The intuition behind this funding model is that municipalities will be incented to improve recycling performance over time, such that they are net recipients of funding transfers (or alternatively, to minimize the amount of funding that is being transferred away)

2) All municipalities should make investments in recycling promotion and education, and will be reimbursed $1 per household for all recycling promotion and education expenditures

3) Where possible, municipalities should implement pay as you throw schemes for household waste as a means to minimize the amount of material being disposed of in the waste stream. By increasing the marginal cost of waste disposal, households will be indirectly incented to source separate recyclables, as a means to avoid the costs incurred for putting recyclable material in the garbage.

4) Where possible, municipalities should opt for single stream collection and processing of household recyclables (all printed paper and packaging waste generated by households is collected in a single commingled container and processed at a material recycling facility that is specially equipped to sort through commingled loads). The intuition behind single stream recycling is that it is more convenient for both households and waste collectors to put all recyclables in one bin – households are more inclined to participate in recycling programs if recycling is made easier for them, while waste collectors spend less time collecting materials at the curb, reducing costs.

To date, these policies have yet to be examined to determine whether they successfully achieve their intended objectives of increased diversion and reduced material management costs. Given the success of such initiatives in other jurisdictions, the effectiveness of these initiatives is largely assumed – recycling stakeholders have little impetus to question these policies given their past successes.

However, in light of rising system costs for the Blue Box program and a stalled recycling rate (which is actually trending downwards in the past two years), I found it necessary to challenge the conventional wisdom and develop an evaluative model to gauge the success of these policies. Using a combination of recycling data spanning the past 12 years for each of Ontario's 223 obligated municipalities, the aforementioned recycling best practices were evaluated using three criteria: 1) the ability to increase waste diversion 2) the ability to contain costs and 3) perception and attitudes among recycling stakeholders (do they think the policy is working).

As shown in Chapter 5, none of the four recycling best practices tested were able to satisfy all three criteria. Of note, no policy was able to reduce recycling system costs – in fact, there is significant empirical support to suggest that policies such as pay as you throw and single stream recycling increases material management costs for municipalities. While this is not an entirely unexpected result for PAYT schemes (as there are administrative costs for municipalities who must enforce PAYT schemes), the increased costs associated with single stream recycling was a surprising result. Both intuitively and based on past evidence, single stream recycling collection should be cheaper for municipalities as collection vehicles spend less time picking up material from one recycling bin (compared to two or more). However, whatever savings are realized on the front end with respect to collection, are negated by the additional investments required at the MRF to sort commingled material. Furthermore, the loss in revenue resulting from the inferior quality of single stream bales (due to increased levels of contamination) further reduces any savings that might be realized from opting for single stream collection.

Only two of the policies (PAYT and single stream collection) were able to increase municipal recycling rates in any meaningful way (and even in these instances, increases in recycling rates were region specific as opposed to system wide). Investments in recycling promotion and education and municipal incentivization failed to promote recycling, with the latter actually having the opposite of its intended effects.

Stakeholder perceptions and attitudes towards the best practice policies were mixed. As discussed in Chapter 6, this is largely expected given the competing interests and objectives of stakeholder groups – making universal consensus virtually impossible to achieve (with a few notable exceptions). With respect to recycling promotion and education, all stakeholder groups agreed that it was an effective tool for promoting diversion and, as such, should remain a policy best practice (despite the lack of empirical support in an Ontario context). Given that the recycling best practices tested in this study failed to achieve their intended objectives, I then proposed alternative systems that could be characterized as a radical departure from the existing system.

This was done to call into question the appropriateness of having “increased diversion” as the focal point of policy objectives in the province, particularly in light of rapidly increasing material management costs.

In these alternative systems, I propose a “contraction” of the existing Blue Box program – I first begin by examining the economic challenges of recycling in Ontario’s rural and northern regions. Specifically, this section quantified the impact of operating recycling programs in these regions. Using a systems based cost model, focus was placed on analyzing: 1) What would happen to provincial recycling costs and diversion levels if recycling programs were eliminated in “high cost” northern and rural regions? 2) Is it possible to increase the provincial recycling rate by focusing investments in low cost, high performance regions (while simultaneously eliminating recycling programs in rural and northern areas)? And 3) How would the mix of material being recovered change (if at all) if recycling programs were eliminated in Ontario’s rural and northern areas? The results of this analysis demonstrated that eliminating recycling programs in high cost regions significantly decreased system costs without negatively impacting overall recycling rates. The findings of this section also suggest that Ontario reevaluate whether rural and northern municipalities be legislatively required to operate household recycling programs.

As an extension to the idea of “is more better?” the second alternative system considered in this study examines how changing the mix of materials accepted in Ontario's residential recycling program affects provincial material management costs and recycling rates. Specifically, this section quantified the impact of "non-core" material recycling on system costs and diversion levels (where non-core materials are defined as materials with high material management costs and low levels of recyclability). The results of the cost model analysis show that removing non-core materials from the Blue Box program significantly decreased system costs without negatively impacting overall recycling rates. Ultimately, it was found that it was possible to increase the provincial recycling rate while simultaneously reducing program costs by targeting specific materials for recovery. Once again, the purpose of this section was to challenge the notion that increased diversion should be a policy priority in Ontario. Given increases in system costs, the province needs to reevaluate the types of material included in the residential Blue Box program.

This dissertation concludes with a brief summary of research findings, policy recommendations, contributions to the broader literature and what steps should be taken moving forward.

7.2 Recommendations

Putting forward recommendations for Ontario's Blue Box Program is a complicated topic, as it tacitly implies that there are clear cut solutions to the problems facing the province. Based on the findings from this thesis, it would appear that there is little evidence to support the use of existing recycling policies, and as such, these policies need to be refined, and/or repealed. However, this isn't (entirely) the case. There is a need to critically examine why such policies may or may not be working - and the first step in doing so, is furthering our understanding with respect to how these policies work to begin with.

There is an unnecessary complexity with respect to many of the policies characterized as recycling best practices. While certain policies (namely, pay as you throw and P&E investments) are relatively straightforward, others (such as the municipal incentivization model) are predicated on a series of complicated calculations and rationalizations. Speaking as someone who actively worked on both of these files, as both a consultant and researcher, I still struggle with the many intricacies and nuances of the respective models. Partial disaggregations, in kind contributions, equalization payments etc. are all critical components in determining how fees and funding transfers are calculated. However, comparatively few truly understand how these things work. There is a need for increased transparency with respect to the inner workings of Blue Box best practice policies.

If we want to improve upon these policies such that they successfully promote recycling performance, it is of paramount importance that we do away with the black box nature of the Blue Box program. In order to foster constructive dialogue, stakeholders need to be on the same page, both with respect to their objectives and levels of understanding.

In addition to increased transparency, comes the need for clear cut objectives and realistic diversion goals for the province. Ontario's Blue Box program suffers from an identity crisis of sorts – it wants to be too many things to too many people. Having a system that is accessible to everyone, recycles the broadest range of materials, is cost effective and successful in promoting household recycling is not only an ambitious undertaking, but virtually impossible to achieve. Decision makers and policy planners need to make a conscious decision to prioritize what they want from the Blue Box system – if the focus (as it appears to be) is on the overall recycling rate, then municipalities cannot be expected to simultaneously reduce costs. The idea of doing more with less is an almost impossible proposition. However, if the province chooses to focus on overall goals (i.e. system wide recycling rates and program costs), then it may be possible to achieve recycling efficiency if policy planners are willing to specifically target regions and material types for recovery. As noted in Chapter 6, increased diversion at a lower cost is seemingly possible to achieve by optimizing the mix of materials included in the Blue Box program, and investing resources in low cost recycling regions. In both modeled scenarios, the province was able to increase the overall recycling rate at a lower net system cost – however, this involved a contraction of recycling services that may be met with opposition from certain stakeholder groups.

As noted in section 6.2, policy planners need to think about the "opportunity cost of incremental diversion". Instead of operating recycling programs in silos, with independent budgets and policy objectives, it might be more effective to take a comprehensive approach for the province as a whole. If the goal is truly a more sustainable Ontario, there needs to be mechanisms in place to transfer funds both within and across diversion programs (for Blue Box, Waste Electronics, Hazardous waste etc.). If investments aren't working in one program, it may be worthwhile allocating that money elsewhere. Continuing to pour money into policies or initiatives that yield no tangible results is not an efficient use of public resources. Conversely, if there are promising initiatives that are worth pursuing, it may prove more fruitful to reallocate funds and adjust budgets such that only the most effective policies/projects are undertaken. What is apparent is that we can no longer be recycling for feel good reasons alone. In many ways, we need to take a step back and ask how we design a system that not only promotes diversion, but is economically tenable and socially desirable.

If I were to recommend a potential alternative to the current system (that doesn't involve a radical departure as outlined in section 6), it would be to implement a hybrid IPR/EPR model to optimize the mix of materials included in the Blue Box system. While there is a significant movement within the waste management sector to move towards individual producer responsibility schemes for all materials (where in individual producers are responsible for the end of life management of packaging waste), I think that a hybrid approach would be more appropriate given how material already flows through the system. For our "core" Blue Box materials (newsprint, cardboard, PET bottles etc.), municipalities are already doing an effective job of collecting, sorting and selling them. It seems unlikely that individual producers would be able to assume responsibility of these materials and realize efficiencies that have not already been identified. However, IPR may be seen as a more appropriate mechanism for the management of "fringe" materials - the individual producers of these materials should assume responsibility for the EOL management of these materials, and incur all costs until such time that a) recycling rates for the materials are comparable to core materials, or b) there is sufficient evidence that these materials cannot be recycled, necessitating that alternative packaging types be explored.

7.3 Contributions

The contributions of this study to the broader literature on recycling, particularly within a Canadian context, are potentially quite significant. The qualifier of "potentially" is a critical distinction, as in many ways my findings can be seen as opening the door to additional scholarly investigation. What I have done is demonstrate that the policies presently employed in Ontario, in their current form, are not successful in promoting either diversion or cost containment. As an extension to that point, my interviews with recycling stakeholders (households, municipal waste managers and packaging producers) demonstrate that there is a marked disconnect between what people think is working, and what is actually working. While highlighting these policy shortcomings is critical in helping identify the issues that require attention, proposing solutions to said issues was outside the scope of this study. As a point of concession, I am not entirely certain solutions even exist to the problems facing Ontario's Blue Box program. With that being said, perhaps it is time that we redefine the problem – as noted in Chapter 6, the province's policy focus has been on increasing diversion. The decision to do so has come at an enormous cost to both municipalities and industry, necessitating that we rethink what is meant by a successful and sustainable recycling system. Perhaps the greatest contribution of this study is that it challenges the conventional wisdom with respect to what the goals of recycling policy should be, and highlights that policy planners need to think about ways that encourage savings while simultaneously driving environmental goals. If we continue to define success in terms of purely diversion goals, the recycling system is on a bee line trajectory to economic collapse (as evidenced by the significant year over year increases in material management costs).

On a more general level – there is a novelty to my research findings that has not been demonstrated in previous investigations. As noted in Chapter 1, this is one of the few studies of its kind to examine the effectiveness of recycling policies in a mature recycling system – most of the existing discourse has generally tended to focus on areas where recycling programs were newly implemented or voluntary. Furthermore, the consideration of locality when gauging which policies are effective (and where) is a factor that has traditionally been omitted from recycling research. With respect to each of the policies evaluated, as far as can be ascertained, my research was the first of its kind to examine the following:

- How municipalities respond to financial incentives
- How pay as you throw schemes are affected by recycling bin capacity and mandatory recycling legislation
- Differences in material management costs for single and multi-stream recycling systems in Ontario
- How municipal recycling rates respond to marginal investments in recycling promotion and education
- How changing the mix of materials found in a recycling system changes material management costs for the system as a whole

These findings have been used to write and publish seven independent studies on each of the aforementioned topics in industry leading peer reviews journals. While this isn't necessarily the best barometer of quality research, it does lend credence to my assertion that my work has contributed to the broader literature in some way.

If there is a take away message from my research findings, it is that significantly more work needs to be done – from both a policy and research stand point. While evidence from this thesis would suggest that the province's recycling best practices are not working, extreme caution should be used when attempting to generalize these findings to other jurisdictions (or apply them universally within Ontario). The effectiveness of policies are largely contingent on site and situation specific factors that require each project/initiative to be evaluated on its own merits. Broad brush policy is sloppy work at best, and both dangerous and costly (in both economic, environmental and social terms) at worst. The province cannot continue with the status quo, and expect different results.

7.4 Research Reflections

In closing, despite the overall tone of the thesis, I want to stress that Ontario's Blue Box program has achieved some amazing things. However, past successes do not necessarily guarantee positive results moving forward. The recycling system is rapidly changing - from the demography of Canadian households to changes in the packaging mix. We need to be able to glean what we can from our previous experiences and be adaptable, flexible and willing to embrace these changes. This is an exciting time for the Canadian waste management sector, in many ways we are entering uncharted territory as EPR spreads to other jurisdictions. However, there is a propensity in the waste management industry to operate in silos - which leads to antagonism and mistrust. We need to encourage interagency and inter-sector collaboration in order to achieve meaningful change.

Identifying what does and does not work in promoting residential recycling, as well as who is affected by policy initiative outcomes will be of critical importance in developing an effective and economically viable recycling system in both Ontario and abroad.

On a final note, given my findings and the way I have positioned some my arguments, it may seem that I am giving preference to economic objectives and losing sight of the broader tenets of environmental and social sustainability. Conspicuously absent from my discussion (beyond a few brief observations in section 2) is recycling's impacts on climate change, resource stewardship/conservation and environmental justice and equity. While these are certainly vitally important considerations that deserve weighting and consideration in policy discussion, I am of the opinion that there are more than enough researchers and advocates working in that space. In a strange about face, environmental and social objectives have now come to the forefront of discussions on recycling, and planners have lost sight of broader economic considerations. Though I am hesitant to carry the rallying banner for the "economics" of recycling, I would like to emphasize that in the absence of a balanced system (that gives consideration to economic, environmental and social objectives), it is by definition, not sustainable.

APPENDIX A: Survey Participation Statements

MUNICIPAL WASTE MANAGERS SURVEY

Site Name: ______________________________

Date: ______________________________

Introduction

My name is Calvin Lakhan and I am a student at Wilfrid Laurier University. I am currently working on a survey to study the attitudes of recycling stakeholders towards the existing Blue Box system and proposed changes in waste management legislation. In this survey we would like to know your experience as a stakeholder and your views with regards to the Blue Box system. Your input is important because it will help us learn more about what changes can be made to Blue Box recycling initiatives as a means to improve household recycling activities. This interview should take around 10-15 minutes to complete. Please note: This interview is being recorded for the archival purposes.

By continuing with this interview, you indicate your voluntary consent to participate in this study and have your answers included in the project data set. Your participation is voluntary. Your refusal to participate in or to withdraw from the study carries no penalty or loss of any benefits. You are free to not answer any of the questions that we will ask you. However, we hope that you will agree to answer the questions, as your answers are very important to this study. Answers are anonymous, and we will keep your individual views entirely confidential. Your privacy will be protected to the maximum extent allowable by law.

All data recorded, including audio recordings of your interview, will be retained by Calvin Lakhan. Upon completion of the study, this data will be destroyed.

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,*) you may contact the researcher, Calvin Lakhan , at calvin.lakhan@gmail.com , and 416-523-5164. This project has been reviewed and approved by the Wilfrid Laurier University Research Ethics Board. If you have any questions or comments concerning your rights as a survey participant, please contact Dr. Robert Basso, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-1970, extension 4994 or rbasso@wlu.ca; or my PhD Supervisor, Dr. Scott Slocombe

Consent

I have been read and understand the above information. I have received a copy of this form. I agree to participate in this study.

Participant's signature______________________________________ Date __________________

Investigator's signature___________________________________Date _________________

PACKAGING PRODUCER SURVEY

Site Name: _______________________________

Date: _______________________________

Introduction

My name is Calvin Lakhan and I am a student at Wilfrid Laurier University. I am currently working on a survey to study the attitudes of recycling stakeholders towards the existing Blue Box system and proposed changes in waste management legislation. In this survey we would like to know your experience as a stakeholder and your views with regards to the Blue Box system. Your input is important because it will help us learn more about what changes can be made to Blue Box recycling initiatives as a means to improve household recycling activities. This interview should take around 10-15 minutes to complete. Please note: This interview is being recorded for the archival purposes.

By continuing with this interview, you indicate your voluntary consent to participate in this study and have your answers included in the project data set. Your participation is voluntary. Your refusal to participate in or to withdraw from the study carries no penalty or loss of any benefits. You are free to not answer any of the questions that we will ask you. However, we hope that you will agree to answer the questions, as your answers are very important to this study. Answers are anonymous, and we will keep your individual views entirely confidential. Your privacy will be protected to the maximum extent allowable by law.

All data recorded, including audio recordings of your interview, will be retained by Calvin Lakhan. Upon completion of the study, this data will be destroyed.

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,*) you may contact the researcher, Calvin Lakhan , at calvin.lakhan@gmail.com , and 416-523-5164. This project has been reviewed and approved by the Wilfrid Laurier University Research Ethics Board. If you have any questions or comments concerning your rights as a survey participant, please contact Dr. Robert Basso, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-1970, extension 4994 or rbasso@wlu.ca; or my PhD Supervisor, Dr. Scott Slocombe

Consent

I have been read and understand the above information. I have received a copy of this form. I agree to participate in this study.

Participant's signature____________________________________ Date _________________

HOUSEHOLD SURVEY

Site Name: ______________________________

Date: ______________________________

Introduction

My name is Calvin Lakhan and I am a student at Wilfrid Laurier University. I am currently working on a survey to study the attitudes and behaviors of recyclers in Ontario. In this survey we would like to know your experience as a recycler and your views with regards to the Blue Box system. Your input is important because it will help us learn more about what changes can be made to Blue Box recycling initiatives as a means to improve household recycling activities. This interview should take around 10-15 minutes to complete. Please note: This interview is being recorded for the archival purposes.

By continuing with this interview, you indicate your voluntary consent to participate in this study and have your answers included in the project data set. Your participation is voluntary. Your refusal to participate in or to withdraw from the study carries no penalty or loss of any benefits. You are free to not answer any of the questions that we will ask you. However, we hope that you will agree to answer the questions, as your answers are very important to this study. Answers are anonymous, and we will keep your individual views entirely confidential. Your privacy will be protected to the maximum extent allowable by law.

All data recorded, including audio recordings of your interview, will be retained by Calvin Lakhan. Upon completion of the study, this data will be destroyed.

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,*) you may contact the researcher, Calvin Lakhan , at calvin.lakhan@gmail.com , and 416-523-5164. This project has been reviewed and approved by the Wilfrid Laurier University Research Ethics Board. If you have any questions or comments concerning your rights as a survey participant, please contact Dr. Robert Basso, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-1970, extension 4994 or rbasso@wlu.ca; or my PhD Supervisor, Dr. Scott Slocombe.

Consent

I have been read and understand the above information. I have received a copy of this form. I agree to participate in this study.

Participant's signature____________________________________ Date _________________

Appendix B: Sample Surveys and Interview Questions

Interview ID # _______________

Location of Interview: __________________

Informed Consent Form Signed? (Yes/No) *Cannot continue if consent form is not signed

Recorded? (Yes/No)

Demographic Information

Enumerator Instructions: Please circle the answer provided by study participants.

Variable	Mean/Percent
Gender	Male / Female
Age	
College	Primary/Secondary/Some College/College/Post Grad
Income	<$10K, $10K-$24999, $25K-$44999, $45K-$64999, $65K-$89,999, $90K+

Enumerator Instructions: Please read survey statement in full to participants, followed by each of the Likert categories. Place check in box corresponding to the answer provided by the participant.

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
I am aware that the city has recycling promotion and education campaigns					
I see signs, flyers, advertisements etc telling me to recycle regularly					
I recycle more because of the promotion and education					

initiatives under taken by the city I think recycling promotion and education campaigns are an effective way to get me to recycle more					
I am aware that the city imposes limits on how much garbage I can place on my curb I pay a fee for putting out more garbage bags than the city allows The city enforces their garbage bag limit policy I put out more garbage on days where the city has unlimited garbage pickup My recycling bin has enough space for the amount the recyclables my house generates I put my recyclables in the garbage bin because I don't have enough space in my recycling bin					

I know that I can purchase additional recycling bins and bags from the city					
I am willing to purchase additional recycling bins to store my recyclables					
I illegally dump garbage to avoid paying the bag limit fee					
I notice my neighbours illegally dumping garbage to avoid paying the bag limit fee					
I know that recycling is mandatory in Ontario					

Open ended questions

1) Do you think recycling promotion and education is an effective tool for getting you to recycle more?
2) Do you think garbage bag limits are a good thing?
3) Would you still recycle if your city eliminated limits on the amount of garbage bag you could put out?
4) Do you think recycling is good for the environment?

Municipal Waste Managers Survey

Name of Municipality __________________

Municipal Group ___________________

Survey completed: In person / Electronically / Over the Phone

Informed Consent Form Signed? (Yes/No) *Cannot continue if consent form is not signed

Recorded? (Yes/No)

If survey is being conducted in person*

Enumerator Instructions: Please read survey statement in full to participants, followed by each of the Likert categories. Place check in box corresponding to the answer provided by the participant.

If survey is being conducted electronically*

Participant Instructions: Please indicate whether you strongly agree, agree, neither agree/nor disagree, disagree, or strongly disagree with each of the survey statements provided. Please place a checkmark in the appropriate box indicating your level of agreement/disagreement with the statement.

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
I think that that the WDO municipal incentivization methodology helps improve household recycling					
The municipal incentivization methodology influences my decisions when planning and managing my recycling program					
The municipal incentivization methodology is a fair way to distribute municipal funding					

The municipal incentivization methodology should be promoted as a recycling best practice The municipal municipal incentivization methodology should be eliminated					
I think that recycling promotion and education is an effective way to increase recycling rates Recycling promotion and education is an easy policy to implement The $1 per household provision for recycling promotion and education is fair Recycling promotion and education campaigns should continue to be a recycling best practice					
I think that pay as you throw schemes are an effective way to increase household recycling Pay as you throw policies are an easy policy to enforce Pay as you throw policy requires significant administrative and staffing resources					

Pay as you throw policy results in households illegally dumping garbage Pay as you throw schemes should be promoted as a recycling best practice					
I think that single stream recycling is effective in promoting household recycling Single stream recycling is cheaper compared to multi stream recycling Single stream recycling is convenient for both municipalities and households Single stream recycling results in lower revenues from the sale of recyclable material Single stream recycling should be promoted as a recycling best practice					

Please provide comments on the effectiveness of each best practice policy in the space provided below:

Enumerator Instructions: Please ask respondents to comment freely on each of the best practice policies being examined. If conducting the interview in person, please ensure that the interview is electronically recorded

Packaging Producer Survey

Name of Steward ___________________

Obligated remitter under Stewardship Ontario? (Yes/No)

Survey completed: In person / Electronically / Over the Phone

Informed Consent Form Signed? (Yes/No) *Cannot continue if consent form is not signed

Recorded? (Yes/No)

If survey is being conducted in person*

Enumerator Instructions: Please read survey statement in full to participants, followed by each of the Likert categories. Place check in box corresponding to the answer provided by the participant.

If survey is being conducted electronically*

Participant Instructions: Please indicate whether you strongly agree, agree, neither agree/nor disagree, disagree, or strongly disagree with each of the survey statements provided. Please place a checkmark in the appropriate box indicating your level of agreement/disagreement with the statement.

Survey Statement	Strongly Agree (5)	Agree (4)	Neither Agree Nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
I think that that the WDO municipal incentivization methodology helps improve household recycling					
The municipal incentivization methodology is an effective mechanism for minimizing Blue Box program costs					
The municipal incentivization methodology is a fair way to distribute municipal funding					

The municipal incentivization methodology should be promoted as a recycling best practice The municipal municipal incentivization methodology should be eliminated					
I think that recycling promotion and education is an effective way to increase recycling rates Recycling promotion and education is an easy policy to implement The $1 per household provision for recycling promotion and education is fair Recycling promotion and education campaigns should continue to be a recycling best practice					
Single stream recycling is cheaper compared to multi stream recycling Single stream recycling is convenient for both municipalities and households					

Single stream recycling results in lower revenues from the sale of recyclable material Single stream recycling should be promoted as a recycling best practice					
I think that pay as you throw schemes are an effective way to increase household recycling Pay as you throw schemes should be promoted as a recycling best practice					

Please provide comments on the effectiveness of each best practice policy in the space provided below:

Enumerator Instructions: Please ask respondents to comment freely on each of the best practice policies being examined. If conducting the interview in person, please ensure that the interview is electronically recorded

APPENDIX C: DATA SHARE AGREEMENT

WDO Data Share Agreement

This document outlines the data share agreement between Waste Diversion Ontario and Calvin Lakhan with respect to information accessed from the WDO. To ensure the protection of such information and in consideration of the agreement to exchange said information, the parties agree as follows:

1. The publicly available information to be disclosed by Waste Diversion Ontario under this agreement ("Data Use") can be described as and includes:

- Blue Box Municipal Funding (2002-2012)
- Blue Box Financials (Program Costs 2002-2012)
- Blue Box Municipal Tonnage (2002-2012)

In addition to the above, confidential information shall also include, and Calvin Lakhan shall have a duty to protect, other confidential and/or sensitive information which is (a) disclosed by Waste Diversion Ontario in writing and marked as confidential (or with other similar designation) at the time of disclosure; and/or (b) disclosed by Waste Diversion Ontario in any other manner and identified as confidential at the time of disclosure.

2. Calvin Lakhan shall use the publicly available information for academic purposes only (namely journal publications, conferences and presentations). All data must be attributed to Waste Diversion Ontario and its affiliate organizations.

3. Calvin Lakhan and Dr. Scott Slocombe (supervisor) shall not disclose any confidential Information with any third party not affiliated with Waste Diversion Ontario. Calvin Lakhan shall have satisfied its obligations under this paragraph if he takes affirmative measures to ensure compliance with these confidentiality obligations.

4. Waste Diversion Ontario warrants that they have the right to make the disclosures under this data share agreement.

5. This agreement shall not be construed as creating, conveying, transferring, granting or conferring upon the Calvin Lakhan any rights, license or authority in or to the information exchanged, except the limited right to use confidential information specified in paragraph 2. Furthermore and specifically, no license or conveyance of any intellectual property rights is granted or implied by this agreement.

6. If there is a breach or threatened breach of any provision of this agreement, it is agreed and understood that Waste Diversion Ontario shall have adequate remedy in money or other damages and accordingly shall be entitled to injunctive relief.

7. This agreement states the entire agreement between the parties concerning the disclosure of confidential information and supersedes any prior agreements, understandings, or representations with respect thereto. Any addition or modification to this agreement must be made in writing and signed by authorized representatives of both parties. This agreement is made under and shall be construed according to the laws of the province on Ontario, Canada. In the event that this agreement is breached, any and all disputes must be settled in a court of competent jurisdiction in the province of Ontario, Canada.

8. If any of the provisions of this agreement are found to be unenforceable, the remainder shall be enforced as fully as possible and the unenforceable provision(s) shall be deemed modified to the limited extent required to permit enforcement of the agreement as a whole.

WHEREFORE, the parties acknowledge that they have read and understand this agreement and voluntarily accept the duties and obligations set forth herein.

Matt

Discloser
Michael Scott, CEO
Waste Diversion Ontario

Recipient
Calvin Lakhan

C. Lakhan

11/25/2013

APPENDIX D: List of Terms

Affiliates – A steward is affiliated with another entity if it controls or is controlled by the other entity or if both entities are controlled by a common entity, where "control" in the case of a corporation has the meaning ascribed thereto by subsection 1(5) of the Business Corporations Act (Ontario) as amended from time to time

Annual Obligation – Total monetary amount that a steward of Designated Blue Box Waste is required to contribute to the cost of Ontario Blue Box Programs

Best Practice - Waste system practices that affect Blue Box recycling programs and that result in the attainment of provincial and municipal Blue Box material diversion goals in the most cost effective way possible

Best Practices System Cost - Defined as the province's hypothetical costs incurred if all municipalities were subscribing to recycling best practices

Blue Box Program Plan (BBPP) – the document that sets out the blue box program as required in Ontario's Waste Diversion Act (2002)

Brand Owner - with respect to a specific trademarked Printed Material which is Designated Blue Box Waste, and with respect to a specific good, the packaging of which is Designated Blue Box Waste, where either the good or the packaging bears a trademark means during any time in the Data Year:

a) a person Resident in Ontario who is the holder of the registered trademark, or

b) a person Resident in Ontario who is the licensee, in respect of the registered trademark, or

c) a person Resident in Ontario, who owns the intellectual property rights to the unregistered trademark ; or

d) a person Resident in Ontario, who is the licensee, in respect of the intellectual property rights of the unregistered trademark;

Where “licensee” includes a person who packages goods, the Packaging of which is Designated Blue Box Waste and bears a trademark, other than a packer or filler of Private Label Goods, and includes any person whose corporate name or business name registration contains the trademark

Data Year – Calendar year (January 1 to December 31) for which stewards calculate steward's reports (i.e. first data year is 2002; stewards use data from 2002 as a basis for 2003 and 2004 obligation year; 2003 for the 2005 obligation year; 2004 for the 2006; 2006 for the 2007; 2007 for the 2008 and 2008 for the 2009 obligation year steward's reports)

Designated Blue Box Waste (DBBW) – Packaging, Service Packaging and Printed Materials that are comprised of metal, glass, paper, plastics, textiles or any combination thereof but does not include packaging or printed materials used exclusively for packaging products during their shipment from their place of manufacture to their place of distribution in Ontario, and packaging that is intended for continued use as packaging by the consumer over a period of five years or more

Diversion Rate - The percentage of waste materials diverted from traditional disposal such as landfilling or incineration to be recycled, composted, or re-used.

Excluded Waste - Designated Blue Box Waste that is retained by a steward or its commercial customer, franchisee or licensee, at a location which one of them owns or occupies and is not carried away by retail customers and is not collected by municipal waste management services

Steward Fee Rates- Eco fee charged to each steward to help fund the cost of operating the blue box program

First Importer - A person Resident in Ontario, who imports into Ontario:

a) a specific printed material which is Designated Blue Box Waste, for which a Brand Owner does not exist, or

b) a specific good, the packaging of which is Designated Blue Box Waste, for which a Brand Owner does not exist; and includes a person Resident in Ontario who is the first to take title to such material or good, upon or after arrival in Ontario from elsewhere during the Data Year

Industry Funding Organization - An IFO is the organization with designated responsibility for implementing the diversion plan for the designated material. The IFO has the ability to recover fees from Stewards to cover the cost of implementing and operating the diversion program.

Marketed Material - Refers to the quantity of material recycled for a given material category. In Ontario, measurements for quantity recycled are done at the point where a material recycling facility has baled and marketed a material for end market use.

Material Recycling Facility - A specialized plant that receives, separates and prepares recyclable materials for marketing to end-user manufacturers

Municipal Grouping - The WDO has chosen to categorize the province's municipalities into nine distinct groups based on factors such as population density, collection type (curbside vs. depot) and location (i.e. rural north vs. urban south). These groups include:

1) Large Urban

2) Urban Regional

3) Medium Urban

4) Rural Regional

5) Small Urban

6) Rural Collection - North

7) Rural Collection - South

8) Rural Depot - North

9) Rural Depot - South

Obligated Steward – A designated steward that is obligated to file a steward's report and may be obligated to pay fees

Obligation year – Calendar year during which fees may be due to Stewardship Ontario (i.e. first program obligation year is 2003)

Packaging – Materials that are used for the containment, protection, handling, delivery and presentation of goods sold or delivered to consumers in Ontario

Printed Material – Printed materials that are sold, issued, distributed or delivered to consumers in Ontario

Program Code- Numerical code assigned to each municipality for identification in the WDO data call

Recovery - Separating and processing waste products to reclaim usable material is the emphasis of this type of resource recovery method.

Recycling rate - Total recycled (by weight) divided by total discarded (by weight) + recycled (by weight)

Rules – Rules made by Stewardship Ontario under the Waste Diversion Act (2002) respecting Designated Blue Box Waste.

Service Packaging - Packaging which may or may not bear a trademark that is filled or applied at the point of sale by the retail, food service or other services industries to the consumers in Ontario to enable or facilitate the delivery of goods

Stewardship Ontario – Private, not-for-profit corporation that is the IFO for Blue Box Waste as approved by the WDO and the Minister of the Environment

Steward's Reports – A report prepared by a steward and Filed with Stewardship Ontario, describing the aggregate amount of Designated Blue Box Waste, expressed in kilograms by category as required under these Rules, that were sold or delivered in Ontario in the Data Year by the steward and his Franchisees and / or his Affiliates.

Steward – Name given to obligated person or company who is a brand owner or first importer of Designated Blue Box Waste

Supplied - Means sold, leased, donated, disposed of, used, transferred the possession or title of, or otherwise made available or distributed for use in the Province of Ontario. Supply ("supplies" has similar meanings.)

Waste diversion – Reduction, reuse and recycling printed paper and packaging materials

WDA – A Government of Ontario Act that empowers the Minister of the Environment to designate materials for which waste diversion programs are to be established and promote the reduction, reuse and recycling of such designated waste.

WDO – A non-crown corporation whose mandate is to develop, implement and operate waste diversion programs for a wide range of materials that the Minister of Environment designates.

APPENDIX E – Permission to Reproduce Work

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