

Organic Waste Diversion: Increasing the Participation of Multi-Family Residences in Vancouver

by

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Abstract

This study examines the issue of low participation in organic waste diversion by residents of multi-family housing in Vancouver. This research aims to understand the barriers to participation as well as develop policy options that overcome these barriers. I use the theory of planned behaviour as the framework for explaining the barriers. I undertake a comparative analysis of three jurisdictions with successful organic waste diversion programs – Hamilton, Halifax, and San Francisco. I develop four policy options: an incentive for adopting organic waste collection services, a mandate that building managers adopt organic waste collection services, an outreach campaign including the provision of kitchen bins for organic waste collection, and an outreach campaign with facilitating information on re-purposing existing garbage bins for organic waste collection. My evaluation supports the mandate for building managers as well as the outreach campaign to re-purpose existing garbage bins. Both options are highly effective, garner stakeholder support, and are cost effective.

Keywords: Organic waste; composting; diversion; multi-family sector; theory of planned behaviour; Vancouver

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Glossary

Term	Definition
Building Manager	A person who manages the operation of an apartment building in which all suites are rented.
Compost	A fertilizer and soil amendment.
Composting	The process of transforming organic waste into compost.
Industrial, Commercial, and Institutional (ICI) Sector	<p>Multi-family buildings belong to this sector because they are commercial properties. Owners of commercial properties are responsible for acquiring private waste collection services.</p> <p>In the waste management literature sometimes multi-family residences are defined as their own sector.</p>
Mini-bin	A kitchen bin designated for the disposal of organic waste.
Multi-Family (MF) Building	<p>A multi-unit residence, such as an apartment building or condominium. For convenience, I use the term to refer to the subset of multi-family buildings, generally with 6 or more units, that are not eligible for municipal curbside waste collection services.</p> <p>Multi-family buildings with less than 6 units are generally treated like single-family households and receive municipal curbside waste collection services.</p>
Multi-Family Household	An individual suite within a multi-family building.
Organic waste	Biodegradable waste used to create compost. This includes food scraps and yard trimmings.
Property Owner	<p>A person who owns a suite within a multi-family building and either occupies the residence (owner-occupant) or rents the residence.</p> <p>Property owners of apartment suites form a strata corporation to manage affairs relating to the whole building, such as waste management. While the strata council makes decisions regarding matters such as waste management, one person may be designated to manage the service.</p> <p>For convenience, I use the term “building manager” to refer to both building managers and property owners.</p>
Residential Sector	Single-family households belong to this sector. Owners of single-family households automatically receive municipal waste collection services.
Residual Waste	The waste that remains after all compostable and recyclable material has been diverted.

Single-Family (SF) Household	A single-unit residence, also known as a detached home. These homes receive municipal curbside waste collection services.
Source separation	Where organic waste and recyclable material are collected separately from residual waste.
Waste	Anything that is disposed of. This includes organic waste, recyclables, and residual waste.
Waste Diversion	The process of removing organic and recyclable material from the residual waste stream so that the material is composted or recycled instead of being disposed of in the landfill.
Waste Diversion Rate	Of the total amount of waste generated in a given period, the waste diversion rate is the proportion of waste that is recycled or composted instead of being disposed of in the landfill.

Executive Summary

This study examines the issue of low participation among residents of multi-family buildings in organic waste diversion in Vancouver, British Columbia. Organic waste comprises approximately 40% of the waste disposed of in local landfills. The residential sectors, comprised of the multi-family sector and single-family sector, have the highest proportion of organic waste in their waste stream. Diverting organic waste not only reduces the environmental impacts of landfill disposal, but creates a sustainable resource.

The City of Vancouver has already taken actions to improve organic waste diversion from SF households and improving organic waste diversion in multi-family buildings is a current priority. The management of waste in multi-family buildings is significantly different from that of SF households. These differences present unique challenges to establishing successful organic waste diversion programs in multi-family buildings.

The goal of this research is to understand the barriers to participation as well as develop policy options that overcome these barriers. I use the theory of planned behaviour as the framework from which to understand the determinants of organic waste diversion behaviour and industry literature to understand the barriers. My findings reveal that the barriers to participation operate on two levels. Challenges are encountered by the building managers and property owners as well as by the residents. In the theory of planned behaviour, these barriers are categorized as pertaining to attitudes, social norms, and perceived behavioural control.

My policy options aim to remove the barriers as a means to increase the likelihood of participation. I develop my policy options based on an examination of the waste diversion programs for multi-family buildings in Hamilton, Halifax, and San Francisco. I supplement these findings with a review of the literature on strategies to improve the participation of single-family households in curbside recycling. I interpret my findings through the framework of the theory of planned behaviour and in terms of how the components of the examined strategies address the identified barriers to participation.

Based on my evaluation of the strategies, I develop four policy options. The first two options address challenges at the building manager level:

- **Explicit Incentive:** This option establishes a pricing mechanism that provides an incentive to building managers to adopt organic waste collection services and encourage residents to participate.
- **Mandatory Access:** This option makes building managers and property owners responsible for providing adequate access to an organic waste diversion program.

The other two options address challenges at the resident level:

- **Starter Kit:** This option uses door-to-door outreach to provide residents with starter kits consisting of educational information and a kitchen bin for organic waste collection.
- **Commitment Strategy:** This option uses door-to-door outreach to provide residents with educational information and instructions on how to re-purpose their existing garbage bin for organic waste collection. In addition, residents are asked to make a commitment to participate in the program.

I evaluate these policy options based on the following four criteria: effectiveness, implementation cost, implementation feasibility, and stakeholder acceptance.

Based on my evaluation of the options, I recommend the mandate on building managers to provide access as well as the outreach campaign on re-purposing the existing garbage bin. I recommend one strategy from each set to provide a comprehensive strategy for increasing organic waste participation in MF buildings. Both recommended options are highly effective, garner considerable stakeholder support, and are cost effective.

1. Introduction

The disposal of organic waste in landfills has negative consequences for the environment. When organic waste decomposes in landfills it creates pollutants and releases powerful greenhouse gas emissions into the atmosphere. These negative impacts can be avoided through diverting organic waste from the landfill and towards composting. Organic waste diversion not only reduces the environmental impacts of landfill disposal, but creates a sustainable resource that can displace the use of inorganic fertilizers whose supply chains present their own environmental problems.

In Vancouver, organic waste comprises approximately 40% of the waste disposed of in local landfills. The residential sectors, comprised of the multi-family (MF) sector and single-family (SF) sector, have the highest proportion of organic waste in their waste stream (TRI Environmental Consulting Inc., 2012). 45% of waste from single-family (SF) households is organic material and 37% of waste from multi-family (MF) households is organic material. While the proportion of organic waste is higher from SF households, the total tonnage of organic waste disposed in landfills is roughly equivalent; SF households dispose of 28,000 tonnes of organic waste per year and MF households dispose of 27,000 tonnes per year (City of Vancouver, 2012b). Therefore, low participation in organic waste diversion occurs in both sectors.

My research examines the policy problem that the current participation of Vancouver's MF households in diverting organic waste is inadequate to reduce the environmental impacts of disposing of organic waste in landfills. I focus on MF households for two reasons. First, actions are already underway to address low participation in SF households. Second, the management of waste in MF buildings is significantly different from that of SF households. These differences present unique challenges to establishing successful organic waste diversion programs in MF buildings.

One challenge is that MF buildings are generally not built with waste diversion in mind. This has resulted in limited space for waste diversion as well as inconvenient access to the facilities. In addition, MF units are generally smaller than SF households, which implies less storage space within the residence and potentially more trips to the communal facilities. These factors add to the perception that waste diversion is inconvenient because it takes up too much time and space.

The communal nature of waste diversion in MF buildings is also problematic. The use of communal diversion bins means the waste management behaviour of MF households remains anonymous. MF households that do not divert their waste or do so incorrectly cannot generally be distinguished from compliant households. This anonymity means that individual MF units cannot be held accountable for improperly disposing of organic waste or recyclables as with SF households. The communal arrangement makes it difficult to monitor and enforce diversion guidelines and program requirements. The lack of accountability can also provide a disincentive to participate if the household perceives minimal negative consequences to not participating.

This study aims to understand the barriers to participation and to develop policy options that overcome these barriers. I use the theory of planned behaviour as the framework for explaining the determinants of organic waste diversion behaviour. Then I review industry literature to explore the barriers, and I relate these factors to the behavioural framework. Based on these materials plus a review of relevant policies implemented in three other jurisdictions, I formulate and evaluate policy options for the Vancouver context.

The first section of my study provides a background on the regulatory context of organic waste management and other aspects pertaining to organic waste management. A review of the literature on the factors that influence whether a MF residence participates in organic waste diversion follows. I then describe my research methodology, which consists of a comparative analysis of selected jurisdictions that have successfully increased the participation of MF residents in diverting organic waste. After I present my research findings, I discuss the policy options I have created based on my research. The following section provides an assessment of these options against evaluative criteria and measures. In the final section I provide policy recommendations based on the evaluation of the policy options.

2. Background

2.1. Environmental Context

2.1.1. *What is Organic Waste?*

This study is concerned with organic waste, which forms part of the municipal solid waste stream. Organic waste can be divided into two categories: compostable and non-compostable. Compostable organic waste includes: yard trimming, such as leaves, branches, and grass; both cooked and uncooked food scraps, such as fruit, veggies, dairy, meats, and oil; as well as unpainted and untreated wood, such as pallets, and unfinished wood furniture (TRI Environmental Consulting Inc, 2012).

A further distinction within compostable organic waste is between that which is compostable in the backyard (e.g. yard trimming, fruit, veggies, coffee grounds) and that which requires enhanced technologies found at composting facilities (e.g. meat, bones, oil, grease). Some types of organic waste, such as dairy products, fall in between these categories. A skilled home composter can incorporate these types of organic waste but it is not recommended for beginners.

Non-compostable organic waste includes: treated or painted wood, such as panelling and shingles; textiles; rubber; and leather (TRI Environmental Consulting Inc, 2012). Most organic material is compostable. For convenience, therefore, I refer to “compostable organic waste” as simply “organic waste” throughout the study.

2.1.2. *What is Composting?*

Composting is a natural process that converts organic material into a stable humus-like product called compost. The composting process involves the decomposition of organic material

by microorganisms, including bacteria and fungi. Composting is an aerobic process, which means oxygen is required for the microorganisms to properly break down the organic material. When oxygen is not present, such as when organic material is buried in landfills, the organic material cannot transform into compost. Typically, composting occurs in a controlled setting which enables the right mixture of organic material and oxygen to produce higher quality compost (Compost Council of Canada, 2010).

2.1.3. *Environmental Impacts of Organic Waste Disposal*

When organic material is disposed of in landfills, it produces leachate and methane. Both of these substances have a negative impact on the environment. Leachate is created when water moves through the landfill picking up contaminants from the waste, including organic material. This contaminated water, or leachate, can pollute ground and surface water. Most landfills try to prevent leachate from contaminating the surrounding area by implementing controls such as liners to collect the leachate as well as leachate treatment systems (Statistics Canada, 2012).

The larger negative environmental impact of landfills is methane emissions. Methane is produced under anaerobic conditions in the landfill, where organic material is trapped without oxygen. As with composting, microorganisms break down the organic material. Without oxygen, however, the microorganisms start producing methane as they decompose the organic material (United Nations Environment Programme, 2010).

Methane is a greenhouse gas with a global warming potential 25 times the strength of carbon dioxide (CO₂) when considered over a time horizon of 100 years. This means that 1 tonne of methane has the equivalent impact of 25 tonnes of CO₂ over 100 years. This relationship, however, is not constant across time horizons. When a 20 year time horizon is considered, methane has 72 times the global warming potential of CO₂ (UNEP, 2010).

2.1.4. *Environmental Impacts of Organic Waste Diversion*

Organic waste diversion has a positive impact on the environment. The most significant benefit is that diverting organic waste from the landfill reduces leachate and methane

emissions. The diversion of organic waste also helps conserve landfill capacity (Compost Council of Canada, 2010). In addition, the use of compost for gardening and other agricultural activities not only restores nutrients to the soil but reduces GHG emissions in two fundamental ways. First, the use of compost reduces the need for artificial fertilizers, which are produced from fossil fuels. In addition, the use of compost improves the ability of topsoil to absorb carbon dioxide from the environment (The Center for a Competitive Waste Industry, Gary Liss & Associates & Sherman, 2010).

2.2. Regulatory Context

2.2.1. *Metro Vancouver*

Municipal solid waste management for Vancouver is regulated by both the City of Vancouver and the regional district, Metro Vancouver. As mandated by the provincial government, through the BC Environmental Management Act, Metro Vancouver is responsible for providing the region with a solid waste management plan. The current plan is called the Integrated Solid Waste and Resource Management Plan (ISWRMP) and was approved in 2010. One of the goals outlined in the plan is to increase the regional diversion rate, which includes the diversion of both recyclables and compostables, from an average of 55% to at least 70% by 2015. A key strategy in achieving this target is increasing the amount of organic waste diverted from landfill disposal. To achieve this strategy, Metro Vancouver and the City of Vancouver are working together to develop and implement organic waste diversion programs for the single-family (SF), multi-family (MF), and institutional, commercial, and industrial (ICI) sectors. In addition, the plan establishes that a landfill ban on the disposal of compostable organic material from all sectors be implemented in 2015 (MV, 2010).

2.2.2. *City of Vancouver*

The City of Vancouver, through its Greenest City 2020 Action Plan (GCAP), also sets goals and strategies regarding the management of waste. The GCAP, adopted in principle by City Council in 2011, sets out a strategy for making Vancouver the greenest city in the world. One of the goals in the plan is to reduce the disposal of solid waste by 50% from 2008 levels by 2020. A

key action for achieving the city's goal is to improve the diversion of organic waste from all sectors (COV, 2012a; COV, 2012b). To achieve this goal, the city has begun an organic waste diversion program. The program has focused on SF households to date and improving organic waste diversion from MF households is considered a priority for 2013. At this time, the city does not have any policies or programs in place regarding the provision of organic waste collection services for MF residences (COV, 2012b). Appendix A provides details on the progress of the City of Vancouver's organic waste diversion program.

2.2.3. Service Provision

Municipal solid waste management services include the collection and transportation of waste, the operation of transfer stations, waste disposal facilities, waste-to-energy facilities, and recycling and composting facilities. In Vancouver, these services are provided jointly by Metro Vancouver, the City of Vancouver, and private companies (MV, 2010).

The City of Vancouver provides collection services for residual waste, recycling, and organic waste for all SF residences. The city also provides residual waste collection to some smaller MF buildings that are located on SF collection routes. In addition, the city offers a recycling program for MF buildings (COV, 2012b; MV, 2010).

Private haulers provide residual waste collection services for most MF buildings. Private haulers also offer recycling collection services for MF buildings. In addition, some private haulers have begun to offer organic waste collection services. Voluntary uptake of the service by MF buildings, however, has been minimal (COV, 2012b; MV, 2011b). MF residents' main option for diverting organic waste is currently through designated "drop spots" located across the city (Food Scraps Drop Spot, 2013). Some community gardens also have composting (eg. Langara Community Garden, 2010; Mount Pleasant Garden, 2012; Strathcona Community Gardens, n.d.).

Metro Vancouver owns and operates six transfer stations, a waste-to-energy facility, and the Cache Creek Landfill (MV, 2010; MV, 2011a). The City of Vancouver owns and operates the Vancouver South Transfer Station and the Vancouver Landfill (MV, 2010). Private companies operate the recycling facilities in the region as well as broker the movement of recyclables to market (MV, 2010). Organic waste collected by the city and private haulers is composted by

Harvest Power Canada Ltd. (Harvest BC, 2013b). The main composting facility is located in Richmond (Harvest BC, 2013a).

2.2.4. *Organic Waste Diversion Options Available to Multi-Family Residents*

MF residents have three main types of composting options: off-site composting, on-site composting, and in-suite composting.

Off-site composting happens when participants dispose of organic waste in a communal bin located either on the building's property or another location and the organic waste is transported from this location to an off-site composting facility. Collection of organic waste from communal bins located within the apartment building as well as collection of organic waste from designated drop spots both belong to this category.

On-site composting happens when participants dispose of organic waste in a communal bin located on the building's property or another location and the organic waste is transformed into compost on-site. The use of small-scale industrial composters and large backyard composters on a building's property belong to this category. Composting at a community garden is also included in this category.

In-suite composting happens when participants dispose of organic waste in a personal bin located within the apartment suite and the organic waste is transformed into compost within the suite. Homemade indoor composting bins, vermicomposting, and electric assist composters belong to this category. Homemade indoor composting bins are similar to backyard composters but on a smaller scale. As long as the right wet/dry mix is achieved these bins should not produce any odours (Starkey, 2011). Vermicomposting uses worms to transform the organic waste into compost. The worms feed off the organic waste and create compost as a result. Electric Assist Composters use electricity to heat and automatically turn the organic waste to increase the speed of the composting process. These composters look like a bar fridge but with the door on the top. While these machines are a very effective and convenient way of composting indoors, they are expensive (Gillespie, 2011).

My research will focus on increasing participation in organic waste diversion under the assumption that organic waste is collected by a private hauler from communal bins located on the building's property and composted off-site. I consider the on-site and in-suite composting options as complementary to an off-site composting program, just as backyard composting is complementary to the organic waste collection program for SF households. As my research focuses on improving participation, my policy options could be adapted to on-site or in-suite programs.

3. Literature Review

I begin my review of the literature by examining the theory of planned behaviour (TPB). I use the TPB as a conceptual framework from which to understand the determinants of organic waste diversion behaviour.¹ I then examine the academic literature on the determinants of composting and recycling participation by SF households. Since scholarly research on organic waste diversion in MF buildings is non-existent, I use this literature as a proxy to my specific focus. As both behaviours involve source separation, the existing literature is relevant to my topic.

In addition, some industry groups have recently published reports on organic waste diversion in MF buildings. I use this literature to identify barriers to improving participation specific to the MF setting.

3.1. Conceptual Framework

3.1.1. *The Theory of Planned Behaviour*²

The theory of planned behaviour is a model for understanding human behaviour that was first introduced by Icek Ajzen in 1985 (Ajzen, 2005). The theory came to be applied as a basis for examining the determinants of composting and recycling behaviour starting with two studies by Boldero (1995) and Taylor and Todd (1995). The theory became an accepted framework for examining the determinants of composting and recycling behaviour because it provided a way to integrate previous research findings (Chu & Chiu, 2003).

¹ The TPB is a useful framework for understanding the barriers to improving participation; however, it is not the only means by which to understand the barriers to improving participation.

² This section is based on Ajzen's book Attitudes, Personality and Behaviour (2005).

The theory of planned behaviour has two underlying assumptions. The first is that humans are generally rational beings; humans weigh the benefits and drawbacks involved in making a decision and make decisions consistent with their preferences. The second assumption is that a person's intention to perform a behaviour is a strong predictor of actual performance of the behaviour. Therefore, the TPB identifies the determinants of behavioural intentions as a means to understanding behaviour.

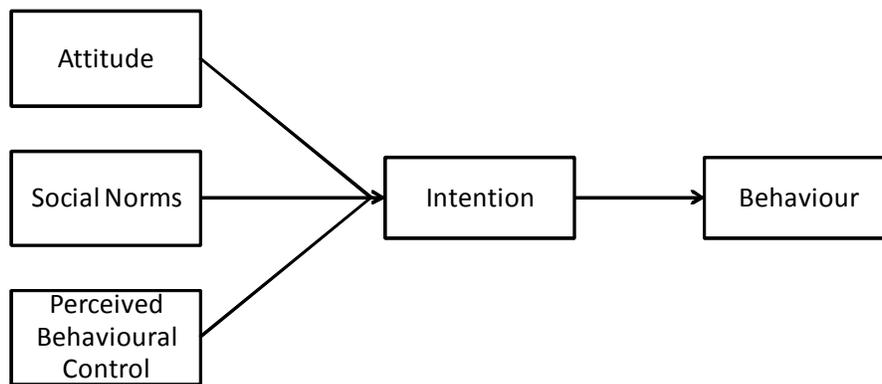
The theory states that behavioural intention is a function of three determinants: attitudes, social norms, and perceived behavioural control. Attitudes about an activity, such as composting, result from the individual's evaluation of the outcome of the activity. If the individual thinks the outcome will have a negative impact on them, they are likely to form a negative attitude. If the attitude is negative, the individual is less likely to perform the activity. For example, an individual who believes composting attracts flies and restricts the amount of time available for leisure activities is likely to form a negative attitude toward composting and decide not to participate.

Social norms about performing an activity, such as composting, are a result of the individual's perception of whether his peers would approve or disapprove of participating in the activity. If the individual thinks his peers would approve, a positive normative influence is exerted. A positive normative influence increases the likelihood the individual performs the activity. For example, an individual who believes his peers approve of composting is more likely to engage in the activity.

Perceived behavioural control over performing the activity, also termed self-efficacy, results from how internal and external factors either facilitate or hinder the individual's ability to perform the behaviour. Internal factors include whether the individual has the necessary information, skills, and abilities to perform the behaviour. If the individual doesn't believe they have enough information to perform the activity, they are likely to perceive a lower level of control over performing the activity and they are less likely to participate. For example, an individual who feels they lack information regarding the proper technique for creating compost is less likely to participate.

External factors are related to situational and environmental circumstances that either hinder or facilitate participation. They include whether an opportunity exists to perform the behaviour and whether the individual is dependent on another to perform the behaviour. A lack of opportunity, such as not having a compost bin, could prevent an individual from composting. In addition, if an individual's composting depends on getting access to the compost area from the building manager, this also reduces the individual's degree of control over performing the behaviour and reduces the likelihood of participation. Figure 1 provides an illustration of the TPB.

Figure 1. *Theory of Planned Behaviour*



While each determinant influences the individual's intention to perform the behaviour, the relative role of each determinant depends on the behaviour and the individual. For example, one individual's behavioural intention to compost might be more heavily influenced by attitudes than social norms whereas another individual might place more weight on social norms and perceived behavioural control. In addition, the weighting of determinants may be completely different for composting than they are for recycling or brushing one's teeth.

The theory also states that each determinant has antecedents. These antecedents are beliefs held by the individual that support their attitude towards the behaviour, the perceived

social pressure to perform the behaviour, and their perceived control over the behaviour.³ All the antecedents are influenced by background factors. These background factors can be divided into the categories of personal, social, and information factors and include variables such as age, gender, education, ethnicity, personality, and exposure to information. The theory of planned behaviour does not directly address the background conditions but does state that they influence the creation of attitudinal, normative, and control beliefs.

3.1.2. *Implications for Behavioural Change*

The theory of planned behaviour suggests that behavioural change should result following a change in one or more determinants to favour the activity. Behavioural interventions can be designed to address the beliefs behind the evaluation of the determinants as a means of encouraging a change in behaviour. For example, if the barrier to participation in organic waste diversion is a negative attitude based on the belief that composting is smelly, the intervention could try to remove this negative attitude by highlighting that it's the same waste with the same smells as before, it's just being handled differently.

Ajzen suggests that behavioural interventions should be designed with two stages in mind. The first stage is outlined above, where interventions are used to address the negative beliefs underlying the determinants to encourage a favourable intention towards the behaviour. As a second stage, any foreseeable external obstacles that could hinder the performance of the behaviour should be removed. Ajzen suggests that stage two also include the development of implementation plans to enhance the effectiveness of the intervention.

³ While not discussed by Ajzen, an underlying belief may impact more than one determinant. For example, the belief that collecting organic waste separately from residual waste takes up too much space within the household may lead to a negative attitude towards composting as well as a diminished sense of behavioural control. The lack of storage space means the household either has to use a small in-suite collection bin and make more trips to the composting bin or substitute other space within their suite for organic waste collection purposes. Either way, these costs, in terms of time and space, outweigh the perceived benefit of composting and lead to a negative attitude. In addition, the lack of storage space is an external factor that may hinder participation by reducing the individual's physical ability to participate.

Implementation plans are a mechanism used to confirm the behavioural intention. Implementation plans are created when the individual with the intention is asked to confirm their intention and how the behaviour will be performed. For example, simply asking the individual when, where, and how they will go about diverting their organic waste constitutes an implementation plan (Ajzen, 2005). Research suggests that having people confirm their intention and how they will proceed to follow through with their intention greatly increases the chance of their performing the behaviour (Orbell et al., 1997, in Ajzen, 2005). As a variation on creating an implementation plan, research also suggests that merely asking people to make a commitment to performing the behaviour increases the likelihood of the behaviour (Kiesler, 1971, Braver, 1996, Cialdini, 2001, in Ajzen, 2005).

3.1.3. *Habitual and Default Behaviour*

Composting, like brushing one's teeth, is a habitual behaviour. Habitual behaviours are those routine behaviours that are performed automatically and “without thinking” in given situations. In contrast, non-habitual behaviours are those that require some form of deliberation prior to their performance.

Habitual behaviour is a form of default behaviour. Default behaviour occurs when an individual performs a behaviour according to a pre-selected option instead of an active reasoning process (Dolan, Hallsworth, Halpern, King, & Vlaev, 2010). Disposing of organic and residual waste in the same bin, for example, is a pre-selected behaviour. Accordingly, individuals don't decide where to place kitchen waste each time they need to throw something away; they act according to the default.

Behavioural economists suggest individuals select default behaviours for convenience (Dolan et al., 2010). For example, it's easier to designate a bin for disposal of kitchen waste than to actively decide where to put the waste each time. The default reduces the time required to make a decision as well as the time required to perform the behaviour.

Policy options, such as asking residents to place residual and organic waste in separate bins, disrupt the pre-selected default. Until the desired behaviour becomes the new default, active decision-making is required; this decision-making reduces the perception of convenience.

3.2. Empirical Findings

Consistent with the determinants identified in the TPB, the most frequently studied determinants of recycling and composting behaviour relate to attitudes, social norms, and perceived behavioural control. However, conclusions regarding the significance and impact of these factors vary.

3.2.1. Attitudes

Most studies examine specific attitudes towards the behaviour, while some examined the relationship between general environmental attitudes and composting or recycling behaviour. The measurement of attitudes varies tremendously across the studies. In general, variables relating to an individual's attitude toward composting or recycling measured whether the individual's evaluation of performing the behaviour was positive or negative. For example, if an individual thought composting took too much time, too much effort, or too much space, this indicated a negative attitude toward composting. Variables relating to general environmental attitudes measured the individual's concern over environmental issues such as pollution.

In terms of composting behaviour, most researchers found a positive significant relationship between attitudes towards composting and composting behaviour (Edgerton et al., 2009; Mosler et al., 2007; Park et al., 2002; Sterner & Bartlings, 1999; Taylor & Todd, 1995). The studies by Mosler et al. (2007) and Taylor and Todd (1995) found attitudes toward composting to be the strongest determinant of composting intentions, compared to social norms and perceived behaviour control. While the strength of the determinant is not consistent across studies, no study reviewed found a negative relationship. In addition, the relationship between general pro-environmental attitudes and composting behaviour was explored in Edgerton et al. (2009) and Sterner and Bartlings (1999), but the relationship was not significant.

The relationship between attitudes and composting behaviour is consistent with much of the research regarding the determinants of recycling behaviour. Researchers who found a positive relationship between attitude and recycling behaviour include Chu and Chiu (2003), Mosler et al. (1997), Taylor and Todd (1995), and Tonglet et al. (2004). As with composting, studies by Mosler et al. (2007) and Taylor and Todd (1995) found attitudes to be the strongest

determinants of recycling intention compared to social norms and perceived behavioural control. Chu and Chiu (2003), however, found perceived behavioural control to be a stronger determinant than attitudes. A possible explanation offered by Chu and Chiu is that Taylor and Todd conducted their study in an area with a well-established recycling program, whereas Chu and Chiu conducted their study in an area where the program was not well established. Therefore, it's possible the duration of the program could alter the relative strength of the determinants (Chu & Chiu, 2003). While there is much support for the positive relationship, Oom Do Valle et al. (2005) found a negative relationship between attitudes and recycling intentions.

3.2.2. Social Norms

Most studies include variables related to normative influences on composting and recycling behaviour. These variables were often measured in terms of whether people who exert an influence on the individual (e.g. family, friends, neighbours) perform the behaviour or whether the individual feels pressure from his peers to perform the behaviour.

In terms of composting behaviour, many studies found a positive relationship between social norms and composting behaviour. This includes studies by Mosler et al. (2007), Park et al. (2005), and Taylor and Todd (1995). However, Edgerton et al. (2009) did not find social norms to be a significant determinant of composting behaviour.

In terms of recycling behaviour, the findings are less consistent. While some studies found a positive relationship (eg. Chu and Chiu, 2003; Mosler et al., 2007; Oom Do Valle et al., 2005), others found no significant relationship (Tonglet et al., 2004). In addition, Taylor and Todd (1995) found a negative relationship. Taylor and Todd (1995) conducted their study in an area with a well-established recycling program but less established composting program. They suggest that while social pressure to engage in either behaviour might be a positive determinant in the early stages of a program, such as their composting results indicate, social pressure might have adverse effects once the program is well established (Taylor and Todd, 1995).

3.2.3. Perceived Behavioural Control

Most studies include variables related to perceived behavioural control. This concept is often divided into two or three components that represent aspects of the TPB's internal control factors and external control factors. Internal control factors are often divided into two variables, one that measures the level of knowledge or skill the individual has in relation to recycling or composting and another that measures the individual's perceived competence at performing the behaviour. External control variables generally measured whether environmental conditions hindered or facilitated participation, such as whether the individual has access to a composting program or compost bin.

In terms of composting behaviour, the studies by Mosler et al. (2007) and Taylor and Todd (1995) support the conclusion that perceived behavioural control is a significant positive determinant of recycling behaviour. In addition, Edgerton et al. (2008) found a positive relationship specifically between composting knowledge and composting behaviour.

In terms of recycling behaviour, many studies support the conclusion that perceived behavioural control is a significant positive determinant of recycling behaviour (eg. Chu and Chiu, 2003; Mosler et al. 2007; Oom Do Valle et al., 2005; Taylor and Todd; 1995). The studies by Chu and Chiu (2003) and Oom Do Valle et al. (2005) suggest that perceived behavioural control is the strongest determinant of recycling behaviour. The study by Tonglet et al. (2004), however, suggests no significant relationship.

3.2.4. Conclusion

While composting and recycling are distinct behaviours, they share many similarities. Furthermore, the literature on both recycling and composting supports that in most cases attitudes, social norms, and perceived behavioural control—specifically knowledge and access to facilitating resources—are the main determinants of recycling and composting behaviour. While some differences in findings emerge across studies, this is expected based on their differing samples, model specifications, and measurement of variables.

3.3. Industry Literature Review

In this section I discuss the barriers to organic waste diversion in MF buildings identified in reports by industry groups, such as the Recycling Council of British Columbia.⁴ I categorize the barriers according to the attitude, social norms, and perceived behavioural control determinants of behaviour.

3.3.1. *Attitudes*

As discussed in Section 3.1.1, attitudes are formed by evaluating the outcome of a behaviour, such as waste diversion. If the outcome is favourable to the individual, where the benefits of performing the behaviour outweigh the costs, then the individual is more likely to participate. The industry literature reveals that it's not just the attitudes of residents but also the attitudes of building managers that impact participation.⁵

In terms of residents, three key attitude-related barriers identified in the industry literature are: the perceived inconvenience of participating (eg. Association of Municipal Recycling Coordinators, 2006; Best, 2011; Gartner Lee, 2008; Parker, 2012), the “yuck” factor (Best, 2011; Cote, 2009; The Center for a Competitive Waste Industry, Gary Liss and Associates, and Sherman, 2010), and a lack of personal responsibility towards waste diversion (eg. AMRC, 2006; Best, 2011; Gartner Lee, 2008; Parker, 2012).

Inconvenience, in this context, relates to outcomes where the time or space needed for waste diversion outweighs the perceived benefits of performing the activity. The most commonly identified source of inconvenience is the location of the communal diversion bins (AMRC, 2006; Gartner Lee, 2008). This is especially true for buildings with a garbage chute on every floor and one set of communal waste diversion bins down in the basement (AMRC, 2006; Gartner Lee, 2008).

⁴ I also incorporate the industry literature on the barriers to recycling in MF buildings to supplement the limited literature on the barriers to organic waste diversion.

⁵ For convenience, I use the term “building manager” to refer to both building managers and property owners of suites with MF buildings.

Another source of inconvenience is the limited space available within the household to store recycling and organic waste (Gartner Lee, 2008). The lack of storage space means the household either has to make more trips to the bins or substitute other space for the purpose of waste diversion. Either way, these costs, in terms of time and space, outweigh the perceived benefit of waste diversion.

The “yuck” factor is the perception that participating in organic waste diversion leads to odour and pest problems beyond any existing problems (Best, 2011; Cote, 2009; The Center for a Competitive Waste Industry, Gary Liss and Associates, and Sherman, 2010). Given this perception, individuals evaluate the benefits of not participating as outweighing the costs.

The communal nature of waste diversion in most MF buildings means individual households cannot be held accountable for their waste diversion behaviour (AMRC, 2006; Best, 2011; Gartner Lee, 2008). Without a means of holding individuals to account for their behaviour it becomes easier for residents to overlook a personal responsibility towards waste diversion (Gartner Lee, 2008). In other words, without a penalty, either financial or mediated through social influences, individuals evaluate the benefits of not participating as outweighing the costs.

In terms of building managers, two key attitude-related barriers identified in the literature are: the perceived increase in waste collection costs associated with adopting organic waste collection (Best, 2011; Gartner Lee, 2008; Yepsen, 2009) and the perception that adopting the service is not worth the cost because residents won't participate anyway and the service will cause odor and pest problems in the building (Best, 2011). This second perception is a reflection of the resident-related attitude barriers. In both cases, the building manager perceives the costs of adopting the service as outweighing the benefits. The result is a lack of support for providing access to organic waste collection. A general lack of support from building managers for waste diversion programs is also identified in the literature (Best, 2011; Gartner Lee, 2008; Parker, 2012). In-building access is an essential component of encouraging widespread participation; therefore, addressing the determinants that underlie the lack of support is crucial.

3.3.2. Social Norms

As discussed in Section 3.1.1, social norms are also determinants of waste diversion behaviour. An individual is more likely to participate in an activity, such as waste diversion, if his peers think it is a good thing to do or if they participate themselves. The social norm-related barrier identified in the industry literature is anonymity (eg. AMRC, 2006; Best, 2011; Gartner Lee, 2008; Parker, 2012). Anonymity, as with the lack of accountability, is created by the communal nature of waste diversion in most MF buildings. The quality of being anonymous means a given individual's waste diversion behaviour, or lack thereof, is unknown to the other residents. As a result, the potential for a positive social influence to be exerted by seeing neighbors participate in waste diversion is limited. In contrast, when SF households use the blue box to set out recyclables, this allows neighbors to see that they participate.

3.3.3. Perceived Behavioural Control

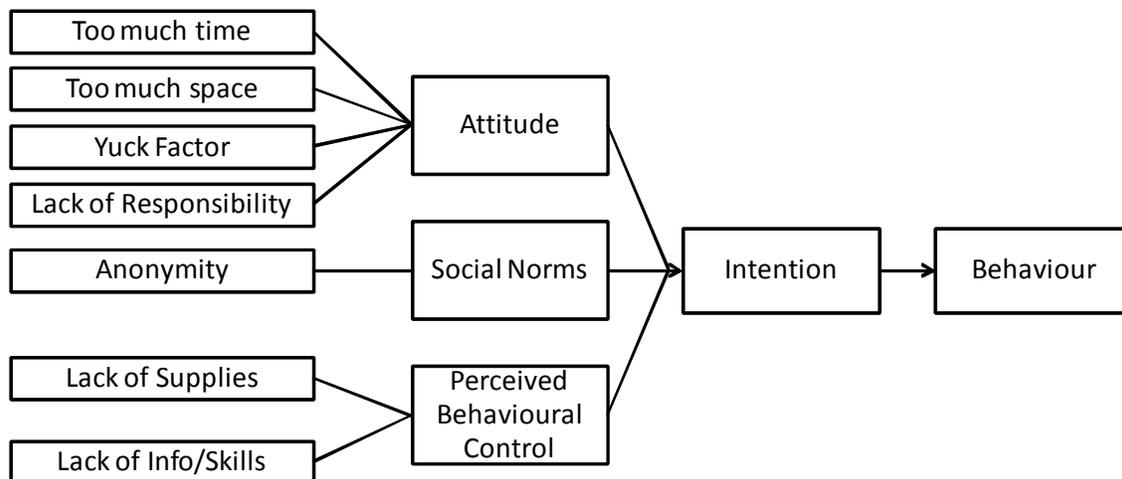
As discussed in Section 3.1.1, the determinant of perceived behavioural control is divided into internal and external components. The internal component relates to having the information and skills required to participate, while the external component relates to having the proper physical conditions such as access to communal waste diversion bins. The industry literature identifies barriers relating to each component of perceived behavioural control.

There are two main barriers to providing the necessary information and skills for participation. The first is the transient nature of tenants in MF buildings (eg. AMRC, 2006; Best, 2011; Gartner Lee, 2008; Parker, 2012). The high turnover common to many MF buildings means ongoing support is required to educate new tenants about the program (Gartner Lee, 2008). The second information-related barrier is proper communication with MF buildings (eg. Best, 2011; Parker, 2012). MF buildings have three channels of communication, with building managers, property owners, and tenants (Parker, 2012). Each channel may require slightly different information and a slightly different approach in the delivery of the information (Parker, 2012). In addition, accessing these audiences in person can be difficult. Building managers are often busy with other priorities (Best, 2011), and residents are inaccessible without authorization to enter the building (AMRC, 2006; Parker, 2012). This situation is in stark contrast to SF households, where there is no building manager and distributing informational leaflets or providing door-to-

door visits does not require permission. The prevalence of multiple languages among residents has also been identified as a challenge to providing information (AMRC, 2006; Gartner Lee, 2008; Parker, 2012).

Two physical barriers to participation also exist. The first barrier is that most MF buildings were not built with source separation in mind (Best, 2011; Parker, 2012). As a result, the space for such activities is limited and inconvenient to access, which reduces the ease of performing the activity. This is especially true for residents in buildings with garbage chutes because of the added convenience of garbage disposal (AMRC, 2006; Best, 2011; Gartner Lee, 2008). The second physical barrier is that each MF building is unique. Therefore, no one-size-fits-all approach is appropriate when developing a MF organic waste diversion program (Best, 2011; Gartner Lee, 2008). This means consultation with building managers, property owners, and residents may be necessary to find building-specific solutions (Parker, 2012). Figure 2 provides a summary of the barriers to participation arranged according to the TPB.

Figure 2. Theory of Planned Behaviour with Barriers to Resident Participation



3.3.4. Conclusion

My review of the industry literature provides insight into the barriers specific to improving organic waste diversion in MF buildings. Inconvenience, the yuck factor, and a lack of responsibility are barriers to residents forming a positive attitude about organic waste diversion participation; additional costs and the perception that the service is not worth the cost results in a lack of support from building managers for adopting the service; anonymity hinders the ability of peer pressure to exert an influence over organic waste diversion participation; the high turnover of residents and multiple channels of communication are barriers to providing information and enabling the skills to properly participate; the physical constraints of unique building designs hinder the convenience of participation and make a standardized approach to MF organic waste diversion difficult. These findings are fundamental to the development my policy options.

4. Supplemental Methodology

Case study analysis is the main methodology I use to develop my policy options. Prior to discussing the findings of my case study analysis, I examine academic literature on the strategies used for improving the participation of SF households in curbside recycling. The review of this literature helps frame the type of interventions found in the case studies and highlights the potential for some SF interventions to be adapted to the MF setting. As with the academic literature review, this literature is used as a proxy to my specific focus.

5. Interventions Literature Review

Many types of interventions for increasing the participation of SF households in waste diversion are examined in the literature. Broadly classified, these strategies include educational and persuasive campaigns, service design strategies, incentives, social influence strategies, and commitment-making procedures. The interventions common to these categories are not mutually exclusive.

5.1. Information Strategies

The use of educational and persuasive campaigns as an intervention strategy is based on the assumption that not only do households need to be aware that the program exists in order to participate, but they are more likely to participate if they understand why they should participate as well as how to participate. These strategies relate to the information component of the TPB's perceived behavioural control determinant.

Studies found education and persuasive communication initiatives are necessary but not a sufficient component of effective recycling programs (e.g. Geller, 1989, Katzev and Johnson 1987, Stern and Oskamp, 1987, in Bryce et al., 1997). In other words, education and persuasive messaging should be used in combination with other strategies (Bryce et al., 1997). Empirical studies found a number of combinations can be effective. One study suggests that an effective information-based intervention will provide sound reasoning for individuals to participate, be delivered personally or by a small group, and include an interactive demonstration of how to participate (Geller, 1989, in Bryce et al., 1997). Other researchers found persuasive communication using normative influences and action-specific suggestions to be an effective approach (Burn and Oskamp, 1986, in Bryce et al., 1997).

One common approach to implementing an educational campaign is having volunteers go door-to-door to deliver the information and respond to any questions or concerns (Timlett and Williams, 2008). A variation on this approach is to have a “block leader” for every block or designated area. This person is responsible for going door-to-door in their area and is generally available to respond to any questions or concerns that come up throughout the household's participation in the program. Sometimes the household is also supplied with a waste diversion bin on these visits along with a paper copy of the educational information and stickers or fridge magnets that can serve as reminders to participate (Bryce et al., 1997). Implementation of the door-to-door strategy, however, may be costly to implement on a large-scale without the assistance of volunteer groups (Bryce et al., 1997).

Regardless of the type of educational strategy used, clear communication of the information is important (Timlett and Williams, 2008). The provided information should promote both a better understanding of the reasons why they should perform the behaviour as well as promote a better understanding of how to effectively perform the behaviour. Without the latter, sometimes programs have high participation rates yet low diversion rates or a highly contaminated diversion stream. This lack of compliance is not necessarily intentional. Often participants who are not effectively participating do so inadvertently because they do not have a full understanding of how to effectively perform the behaviour (Thomas, 2001).

Another information-based option is providing feedback to households on their waste diversion performance over a given period. This strategy often requires evaluation of the contents of the household's recycling bin and is usually performed on a spot check basis. The feedback is often in the form of a letter grade or some other ranking along with comments regarding their performance, such as “pop bottles are not permitted in the recycling bin, please return to a designated depot for return of your deposit.” The success of this intervention is based on the assumption that households are motivated to perform the behaviour properly. Therefore, they heed the feedback and correct their behaviour. Timlett and Williams (2008) found personalized feedback was an effective means of reducing contamination; the strategy was more effective than providing general information on how to properly participate and as effective as providing an incentive.

If a household is not participating, the feedback mechanism does not work. In a trial study of this intervention, non-participating households received a leaflet with general information about the program each time the spot check was performed. The feedback intervention can also be combined with a reward-based incentive, such as offering a reward to the household with the best performance as based on the feedback evaluation (Timlett and Williams, 2008).

5.2. Service Design

The aim of service design strategies is to reduce the physical barriers to participation. These strategies relate to the facilitating conditions component of the TPB's perceived behavioural control determinant. Such strategies often involve providing households with an adequately sized container for storing their diverted materials. In addition, some jurisdictions offer containers in multiple sizes for further convenience. Container types can also range from durable plastic pouches and boxes to wheeled bins (Abbott, Nandeibam, and O'Shea, 2011; The Center for a Competitive Waste Industry, Gary Liss & Associates, and Sherman, 2010).

Other service design strategies relate to the frequency of collection of waste and diverted materials. One common strategy, once the program is adequately established, is to collect diverted waste more often than regular waste. This strategy, in addition to being part of the service design, also provides an incentive to the household to participate in waste diversion (Timlett and Williams, 2008).

5.3. Incentives

Incentive-based strategies alter the perception of the costs and benefits of performing the behaviour as a means of encouraging participation. These strategies relate to the TPB's attitude determinant. As attitudes are based on the evaluation of performing the behaviour, incentive-based strategies manipulate this evaluation to stimulate a more positive attitude and thereby encourage participation.

For example, an individual might not recycle because they think it takes too much time; the cost of participating is the time “lost” by doing so. If this time has a value of \$5, all else constant, performing the behaviour puts the individual at negative \$5. However, if the individual is offered \$6 for participating, he stands to gain \$1. Upon re-evaluation, the individual is better off by participating. This new positive evaluation of the outcome should improve the individual's attitude toward recycling and increase the likelihood of participation.

Incentive-based strategies can use either positive or negative reinforcement to increase recycling participation. Positive incentives include distributing financial rewards such as coupons or raffle tickets to households that achieve a high level of participation (Bryce et al., 1997; Timlett and Williams, 2008). These strategies rely on monitoring household recycling bin contents similarly to feedback intervention. Reward-type incentives can also be awarded at the community level and go towards community-related projects (Timlett and Williams, 2008).

Negative reinforcement incentives include financial penalties for non-participation such as pay-as-you-throw charges. Pay-as-you-throw, also termed unit-pricing, means households are charged user-based fees for garbage collection, either by bag or weight, while the collection of recycling is free (Timlett and Williams, 2008). One method of implementing unit pricing is by requiring households to purchase tags that they affix to their garbage bags and only garbage bags with stickers are collected. Another method is for waste haulers to weigh the garbage upon collection and invoice each household for the applicable charge.

While studies found both positive and negative incentives increase participation in recycling (eg. Geller, 1989, Luyben and Cummings, 1981-1982, Grogan and Bell, 1989, in Bryce et al., 1997), Sterner and Oskamp (1987) found incentives to result in a relatively small effect on total participation (Sterner and Oskamp, 1987, in Bryce et al., 1997). In addition, studies found that once the incentive is withdrawn individuals often resume pre-intervention behaviour patterns (Katzev and Pardini, 1987-1988, Luyben and Bailey, 1979, in Bryce et al., 1997).

One explanation for the return to pre-intervention behaviour, termed the “over-justification effect,” is that the incentive reduces any internal justification for performing the behaviour. Therefore, once the reward is removed so is the reason for performing the behaviour (Deci, 1975, in Bryce et al., 1997). This explanation also aligns with economic theory on

behaviour, where an individual performs an action when the benefits of doing so outweigh the costs. If the reward alone induces the behaviour, then removing the reward causes the cost of performing the behaviour to outweigh the benefit and the action is not performed.

In addition, the implementation of an incentive-based approach can also be costly. Incentive-based approaches require continuous monitoring in order to apply the reward or punishment (Oskamp et al., 1991, in Bryce et al., 1997).

5.4. Social Norms

Other strategies use social influence to motivate household participation in recycling. These strategies relate to the TPB's social norm determinant of behaviour and are based on the assumption that an individual's behaviour can be influenced by what other people are doing. Therefore, if an individual thinks their neighbours and friends are recycling, then they are more likely to recycle. These strategies try to establish waste diversion as a social norm. Social norm-based interventions are most effective when individuals believe they can be held accountable for their behaviour (Bryce et al., 1997).

Several field experiments found the “block leader” approach to be an effective way of increasing recycling through establishing a recycling norm (eg. Hopper and Nielsen, 1991, Nielsen and Ellington, 1983, in Bryce et al., 1997). The block leader is a member of the community who already participates in recycling. This person is asked to deliver persuasive information and sometimes facilitating materials, such as blue boxes, to non-recycling neighbours. The role of the block leader is to make non-recyclers aware that people in the neighbourhood recycle as well as to lead by example. In a field experiment, the block leader approach was found to result in a higher participation rate than an information-only approach (Bryce et al., 1997).

The use of standardized bins, such as the blue box, for setting out recyclables also leverages social influence. This strategy is similar to having the block leader relay information on the participation level of the area. When the bins are set out for collection, this gives

neighboring households a visual signal of the level of participation on their block which is intended to encourage households to conform to the social norm of the area.

5.5. Commitment Strategies

Commitment strategies have household members make a verbal or written commitment to participate in waste diversion in the presence of at least one other person (Bryce et al., 1997). The effectiveness of this intervention is based on the principle of consistency, where people are motivated to be consistent in what they say and do because being inconsistent is socially undesirable or internally stressful. Therefore, if an individual makes a commitment to recycle, they tend to act in a manner consistent with that statement (Bem, 1972, Cialdini, 1988, in Bryce et al., 1997). This type of intervention is similar to Ajzen's implementation plan.

Studies found commitment approaches to be more effective than incentives at increasing recycling behaviour (eg. Katzev and Pardini, 1987-1988, Pardini and Katzev, 1984, in Bryce et al., 1997). One study examined the impact of making a four-week commitment to recycle relative to receiving an incentive to recycle. The study found that after the four-week period had elapsed individuals who made the commitment continued to recycle significantly more than individuals who received the incentive (Fang and Katzev, 1990, in Bryce et al., 1997). In addition, Burn and Oskamp (1986) found commitment approaches as effective as persuasive communication (eg. Burn and Oskamp, 1986, in Bryce et al., 1997).

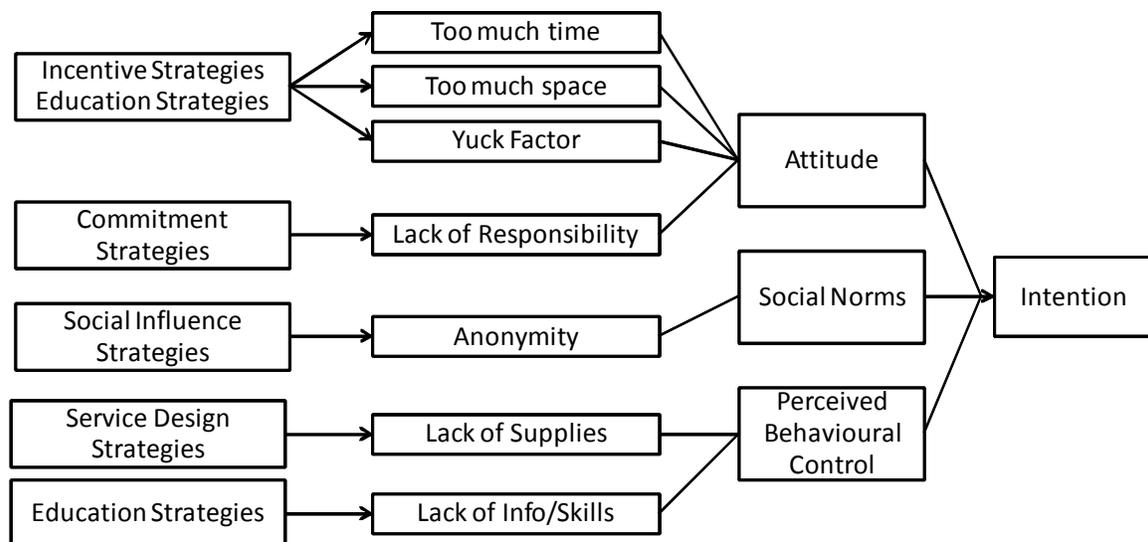
Commitment strategies can be implemented using the door-to-door approach and are complementary to the block leader approach. Alternatively, commitment strategies could be performed over the phone, or at a community event. While commitment strategies in themselves are less costly than incentives or social-influence-based approaches, implementing a commitment strategy using the door-to-door technique will be costly without the help of volunteers (Bryce et al., 1997). In addition, recruiting members of the targeted community to volunteer can enhance the legitimacy of the approach (Geller, 1989, in Bryce et al., 1997).

5.6. Conclusion

As MF buildings have unique characteristics not present in SF households, not all these interventions are sufficiently adaptable to varying circumstances. Due to the communal nature of waste management in MF residences, interventions requiring household-specific waste diversion information, such as the feedback intervention and some incentive interventions, can be difficult to implement. Variations of these strategies, however, are worth consideration. For example, feedback information could be provided for the building as a whole. In addition, information regarding the comparative participation rates in nearby buildings could be used to leverage social influence. Likewise, rewards could be offered to the building as a whole and put towards building-related projects or go toward reducing waste collection fees.

Other strategies are directly applicable, such as educational campaigns and commitment interventions. The review of SF interventions gives a well-rounded range of alternatives to consider, but these options are still proxies for my specific focus on waste diversion in MF units. Figure 3 provides a summary of the interventions as they relate to the barriers to participation outlined in Section 3.3.

Figure 3. *Interventions to Barriers, Based on the Theory of Planned Behaviour*



5.6.1. *Limitation of the Theory of Planned Behaviour*

Figure 3 is a simplified illustration of the relationship between the interventions and the barriers to participation as arranged according to the TPB. The figure suggests a linear relationship, where specific interventions address specific components of each determinant, thereby independently increasing the likelihood of participation. Interventions designed to overcome one barrier, however, might also help overcome other barriers. In other words, some of the determinants are partially endogenous because improving one determinant may also influence another determinant.

A key source of endogeneity arises between the internal component of perceived behavioural control, noted in the figure as a lack of information and skills on how to participate, and attitudes. Providing residents with the necessary information and skills improves their ability to participate. Improving this aspect of perceived behavioural control, however, may also help overcome residents' negative perceptions that participation takes too much time, too much space or causes odor and pest problems. The how-to information may address these attitude-related barriers by implicitly demonstrating that participation will not take as much time, space, or cause any additional yuck factor problems. How-to information may also help overcome the perception of a lack of supplies by providing instructions on how to establish an organic waste collection system.

The external component of perceived behavioural control, noted in the figure as a lack of supplies with which to participate, is also endogenous to attitudes. Providing residents with a separate bin for collection of their organic waste, for example, improves their ability to participate. Improving this aspect of perceived behavioural control, however, may also help overcome residents' perceptions that participation takes too much time or causes odor and pest problems. Providing the bin not only reduces the upfront time costs associated with procuring their own bin but may reduce the ongoing time cost of source separating organic waste – to the extent that the bin is easy to use. Providing the bin may also help overcome the yuck factor if the bin is effective at reducing potential odors from the organic waste.

When persuasive information and incentives are used to improve residents' attitudes, this may also improve residents' perceived behavioural control, albeit in a less direct manner.

Persuasive information campaigns may include messaging about how diverting organic waste isn't going to add to the time it takes to dispose of waste because it's a substitution of time. Along the same lines, diverting organic waste doesn't have to take up more space than already allocated to waste disposal, it's just a re-allocation of the existing space. And again, collecting organic waste separately from residual waste isn't going to create additional odours; it's going to create the same odours because it's the same waste as before but just handled differently. Persuasive messaging can also be used to encourage residents to take responsibility for their waste diversion behaviour – such as through messaging about how big changes start with individual actions.

While persuasive messaging doesn't directly enhance the ability to participate (no information on how to participate; no supplies provided), residents who are persuaded by these arguments may seek out how to participate as well as where to acquire supplies. As I discuss in my case study findings, San Francisco stresses persuasive messaging over instructional information. San Francisco's rationale is that residents who are persuaded to participate will seek out information on how-to participate (MCLU & ESA, 2011). The use of incentives to overcome attitude-related barriers may have a similar effect. If the incentive is strong enough to change the resident's attitude, the resident will find out how to comply.

While endogeneity is a drawback of using the TPB, the framework is still useful for understanding the barriers to participation and related interventions. Moving forward, I attribute interventions to the barriers they seek to most directly address.

6. Methodology

My primary methodology for developing policy options is a comparative analysis of jurisdictions with successful MF organic waste diversion programs. The examination of these cases gives me further insight into the range of options available for increasing organic waste diversion participation of MF households in the Vancouver context. In addition, a review of these cases allows me to see whether the SF interventions have been adapted to the MF setting as well as whether new strategies, unique to MF households, have been employed. In the following section I describe my method for selecting cases.

6.1. Case Study Selection Methodology

I consider only jurisdictions in North America for greatest comparability to Vancouver in socio-demographic, cultural, and political characteristics. I use two strategies to identify my cases. I review a number of industry reports on best practices regarding organic waste diversion in MF buildings; and I employ a systematic search of major cities across Canada and the United States to identify those having a program for organic waste diversion in MF buildings.

To select a sample of cases from my population, I developed four selection criteria. I evaluated my cases against the criteria using an incremental method. For example, cases which did not pass the first criterion were eliminated from consideration in the next criterion.

The first criterion is that the jurisdiction's population should be comparable in size to Vancouver's population of 603,502. This criterion controls for differences in programs and policies that would arise in areas that are less densely populated. My decision rule in evaluating this criterion was to eliminate all cities with less than 300,000 people.

The second criterion is whether the jurisdiction's programs and policies have been established long enough that their outcomes have been measured. My decision rule in

evaluating this criterion was to restrict my sample to cases that implemented programs before 2009.

The third criterion is whether a jurisdiction was successful in improving the participation of MF residents in organic waste diversion. I evaluated this criterion by means of four decision criteria, depending on available information. In the first decision rule, the case was considered successful if the diversion rate for MF residences was above Vancouver's rate of 16%. In the second decision rule, the case was considered successful if the overall residential diversion rate was above Vancouver's 39% diversion rate. In the third decision rule, the case was considered successful if the diversion rate for all sectors was above Vancouver's diversion rate of 54% for all sectors. In the fourth decision rule, the case was considered successful if the literature indicated it was successful.

The final criterion was based on the prevalence of the case within five best practices reports (Best, 2011; Federation of Canadian Municipalities, 2009; HDR Corp., & Kelleher Environmental, 2012; Mecklenburg County Land Use & Environmental Services Agency, 2011; Stantec Consulting Ltd., 2012). This criterion was another way to measure the success of the program. In evaluating this criterion, I assume the prevalence of the case is an indication of its success. Cases mentioned in at least four of the five best practices reports were retained in the eligible sample.

Based on this methodology, I selected as case studies the following cities: Hamilton, Ontario; Halifax, Nova Scotia; and San Francisco, California. The evaluation of these cases against the selection criteria is provided in Table 1.

Table 1. Case Selection Criteria

Cases	Selection Criteria					
	Population Size	Program Start	Waste Diversion Rate* ⁶			Prevalence in Literature
			2004	2008	2011	
Hamilton	519,949	2008	30%**	44%	49%	4 of 5
Halifax	390,096	1999	52%	57%	63%	4 of 5
San Francisco	812,826	2001	63%	77%	78%	4 of 5
Vancouver	603,502	-	-	-	39%***	-
*Note: Waste diversion rates for Halifax and San Francisco include all municipal solid waste sectors (SF, MF, ICI, DO); waste diversion rates for Hamilton and Vancouver include only the residential sectors.						
**Note: Hamilton's waste diversion rate for 2005.						
***Note: Metro Vancouver's residential waste diversion rate for 2010. I use Metro Vancouver's rate as a proxy for the City of Vancouver. Including all sectors, Metro Vancouver's waste diversion is 54%.						

6.2. Case Study Evaluation Methodology

I evaluate my cases according to the framework outlined in Table 2. The framework is based on the determinants of behaviour outlined in the TPB as well as the barriers to participation identified in the industry literature.

⁶ Waste Diversion Rate Source Material:

Hamilton: City of Hamilton. (n.d.) *2011 Annual Report: Solid Waste Management Master Plan City of Hamilton*.

Halifax: English, D., & Anguish, B. (2007 February 13). *Solid Waste/Resource Management System-Diversion Opportunities*; Why Halifax is a king of trash. (2008, May 7). *Ottawa Citizen*; Labrecque, M. (2012, July 10). *Solid Waste Resource Management Strategy System Review - Project Budget Allocation*.

San Francisco: San Francisco Department of Environment. (2005, June 2). *San Francisco Achieves 67 Percent Recycling, Lowest Disposal in Over Twenty Years*; San Francisco Department of the Environment. (2010b, August 27). *SF Attains 77 Percent Recycling*; San Francisco celebrates composting achievements. (2012, May). *American Recycler*.

Vancouver: Metro Vancouver. (2011). *Zero Waste Challenge Strategy*.

Table 2. Case Study Evaluation Framework

Category	Criteria	Measure
Policy Context	General Regulations	Is there a landfill ban on organic waste?
		Is there a waste diversion target?
		Is participation in waste diversion mandatory?
Service Design	General Design Conditions	Is waste source-separated into three streams (organics, co-mingled recyclables, residual waste)?
		Is waste source-separated into four streams (organics, two streams of recyclables, residual waste)?
		Is waste source-separated into five streams (organics, three streams of recyclables, residual waste)?
		Are MF waste streams collected by one or more private haulers?
		Are MF waste streams collected by a combination public and private haulers?
		Are all food scraps accepted?
		Are compostable kitchen-bin liners accepted?
	Facilitating Access	Are building managers required to provide access and adequate service to communal bins?
		Are building managers required to locate communal bins in close proximity to each other?
		Are building managers required to put adequate signage on the communal bins?
		Upon implementation, is a starter kit delivered by volunteers going door-to-door?

Category	Criteria	Measure
	Implementation Considerations	Upon implementation, is a starter kit delivered to residents by a block leader going door-to-door?
		Upon implementation, is a starter kit delivered to residents by the building manager going door-to-door?
Education	MF Specific “How to Participate” Information and Skills	Is there how-to information, in print/online/other media, specifically for MF residents?
		Is there information, in print/online/other media, specifically for MF managers (including how-to guides, educational posters, signs for the communal bins, template letter to residents regarding the program)?
		Is there ongoing free training for MF residents and managers?
		Are building managers required to educate new tenants?
		Are building managers required to periodically re-educate existing tenants?
	MF Specific Feedback Information	Are MF residents provided feedback information (in the form of notifications) regarding waste diversion performance or compliance issues?
		Are building managers provided with notifications regarding issues of non-compliance?
	MF Specific “Why Participate” Information	Is information available, in print/online/other media, regarding why residents should participate?
		Is information available, in print/online/other resources, regarding why building managers should provide access to the program?
	General Public	Is there periodic distribution of a waste diversion related newsletter?
Social Norms	Within MF Buildings	Are residents required to place residual waste in clear bags?
		Is there a block leader?

Category	Criteria	Measure
	General Public	<p>Has one or more public events been held to thank or recognize residents for their waste diversion efforts?</p> <p>Are diversion rates publicized in annual press releases?</p>
Attitudes	Negative Incentives	Is there a waste collection pricing incentive for MF buildings to divert waste?
		Is there a waste collection pricing incentive for haulers to divert waste?
		Are MF buildings charged a financial penalty for failing to properly divert waste?
		Are any non-financial penalties (eg. revoking service) applied to MF buildings for failing to properly divert waste?
	Positive Incentives	Are MF buildings or residents eligible to receive a financial reward for participating in waste diversion activities?
		Are MF buildings or residents eligible to receive a non-financial reward (eg. free compost) for participating in waste diversion activities?
	Responsibility Strategies	Does a local bylaw require residents to participate in source separation?
		Are residents asked to provide a written commitment to divert waste?
		Are residents asked to provide a verbal commitment to divert waste?
		Does a local bylaw require building managers to provide access to waste diversion services?
		Is there an anonymous reporting mechanism available for residents to report building managers who fail to provide adequate waste diversion service access?

7. Case Study Findings

7.1. Comparative Analysis

In this section, I compare my findings across cases. I use my evaluation framework as a guide in discussing these findings. Appendix B provides a detailed description of my findings for each case and Appendix C provides a summary table of my findings. While Hamilton, Halifax, and San Francisco's waste diversion strategies have a number of common features, there are also significant differences in each city's approach.

7.1.1. *Mandatory Participation*

Common to all three programs is the provision that participation in source separating organic waste and recyclables is mandatory. In each case, the regulation is enforced through written notifications and financial penalties for non-compliance.⁷ For SF households, these enforcement measures are directly applied to individual households for not properly participating in source separation. For MF households, the communal nature of waste collection means these enforcement measures cannot be applied to individual suites without incurring

⁷ In Halifax, MF buildings are considered non-compliant if they do not have organic waste collection services or if there is a considerable amount of organic waste and recyclables in the residual waste stream.

In San Francisco, MF buildings are considered non-compliant only if they do not have organic waste collection services. San Francisco's private waste hauler, however, monitors contamination of the bins and can suspend buildings from their diversion incentive program for unacceptable contamination levels.

significant monitoring costs.⁸ Instead, written notifications and fines are applied to the building as a whole and issued to the building manager. Such enforcement measures have yet to be tested in Hamilton; however, Halifax and San Francisco use notifications almost to the exclusion of financial penalties. Only one MF building in Halifax has been charged the maximum penalty of \$5,000 and the available information suggests no MF buildings have been charged in San Francisco.

The fact that individual suites are not held to account limits the repercussions of not participating for residents and in turn the effectiveness of the mandate. Nonetheless, the regulation sends a normative signal to MF residents regarding how they should behave. The signal alone may have a positive impact on participation.

San Francisco and Halifax add a further provision to the mandate that requires building managers to provide MF residents with access and adequate service levels for communal waste diversion bins. The mayor of San Francisco called the mandate the “strongest tool to date to increase source separation” (Sullivan, 2011, p. 28). Upon implementation of the mandate, the number of MF buildings participating in organic waste diversion in San Francisco more than tripled (Sullivan, 2011).

7.1.2. Education

All three jurisdictions provide educational information regarding how to participate in the program to MF residents as well as provide building managers with separate information regarding how to implement and manage the program. Hamilton and San Francisco found public

⁸ None of the jurisdictions issue fines to individual units within a MF building. This is likely due to a lack of an effective means of monitoring the waste diversion behaviour of individual suites. For example, even if video surveillance was installed in communal waste diversion areas, this would not help to determine whether residents are putting organic waste in with residual waste. Video surveillance along with the use of clear bags for residual waste could overcome the shortfall; however, proper identification of residents and their respective suite could still be problematic. In addition, the video surveillance may not have a high enough resolution to actually see the composition of waste in the clear bag. As an alternative, residents could be asked to tag their bags with their suite number and periodic waste audits performed to issue notifications and fines to individual suites. All else constant, the option does not provide an incentive to residents to tag their bags properly. To avoid the fine, residents could mis-tag their bags or not tag them at all and face no negative consequences.

outreach initiatives critical to the success of the program (MCLU & ESA, 2011; Winning, 2009). The outreach initiatives in Hamilton and San Francisco primarily used the door-to-door strategy, where volunteers delivered a starter kit to each household; the starter kit included a mini-bin for organic waste and how-to information. The volunteers also discussed the program with residents and responded to questions. Both Hamilton and San Francisco found the door-to-door strategy an effective method of reaching residents and improving participation (Parker, 2012; SFDOE, n.d.b).

While Halifax did not use the door-to-door method or provide starter kits upon implementation, building managers are strongly encouraged to provide new tenants with a “What Goes Where” Apartment Guide as well as discuss how to participate in the program. Building managers also have the option of supplying tenants with a mini-bin, which can be included in the damage deposit. San Francisco employs a similar strategy, where building owners are required to educate new tenants about the program and re-educate existing tenants at least once a year. Such methods take the spirit of the door-to-door strategy – face-to-face communication with tenants regarding participation – and place the responsibility on building managers to implement.

7.1.3. Incentives

All three programs use various negative incentives to encourage participation. Halifax and San Francisco use pricing incentives to make residual waste collection more expensive than organic waste collection. In Halifax, private haulers face lower tipping fees for organic waste than for residual waste. The lower tipping fee is intended to be passed on to MF buildings through a lower price for organic waste collection than regular waste. In San Francisco, MF buildings participate in a diversion incentive program where the building’s waste collection fees are discounted based on the building’s diversion rate.

These pricing incentives are primarily directed at the building manager to encourage their adoption of organic waste collection as a means of cost-savings. Building managers facing a strong enough pricing incentive may be encouraged to actively promote resident participation to gain further cost savings. San Francisco found gaining building manager “buy-in,” through

appealing to the cost-savings of the program, critical to the success of the program (MCLU and ESA, 2011; Yepsen, 2009). In addition, Hamilton uses the negative incentive of threatening to revoke residual waste collection services from buildings that are not participating in organic waste diversion.

7.1.4. Social Norms

While all three cases combined education, service design, and various incentives in their approach, social norm strategies were relatively under-used. San Francisco and Halifax leveraged social norms through hosting public events rewarding residents for their waste diversion efforts; however, neither city used social norms strategies aimed directly at MF residents, such as block leaders or clear bag policies.⁹ Therefore, the barrier of anonymity in improving waste diversion behaviour in MF buildings is not directly addressed in these cases.

As Taylor and Todd (1995) suggest in their analysis of recycling behaviour,¹⁰ social norms may not play as important a role in areas with well-established diversion programs because the norm of recycling is already well-entrenched in the behaviour of the community (Taylor and Todd, 1995). San Francisco and Halifax have well-established programs and a well-established culture of waste diversion. In accordance with Taylor and Todd's argument, it's likely that social norms strategies aimed specifically at MF buildings are unnecessary. How these jurisdictions achieved a culture of waste diversion in the first place is a question worth exploring, but this falls outside the scope of my research.

While Vancouver has a growing culture of waste diversion, as evidenced by a relatively high recycling rate in SF households and the use of organic waste drop spots, a comprehensive organic waste diversion program for MF buildings has yet to be established and the SF program

⁹ The clear bag strategy means residents place their residual waste in clear bags. In MF buildings, use of the clear bags creates the possibility that in transporting their waste to the communal area residents passing by will notice whether the resident is participating in source separation. The intervention assumes residents think it's socially desirable to source separate their waste. Therefore, they will improve their diversion efforts to avoid the socially undesirable consequence of being caught not participating. For SF households, the policy also makes it easier for haulers to monitor compliance.

¹⁰ Please see Section 3.2.2 for this discussion.

was implemented city-wide only in September 2012 (COV, 2012b; Food Scraps Drop Spot, 2013; MV, 2011b). Therefore, a social norms approach, either to a general audience or specific to MF residents, should not be discounted based on the evidence from the examined cases.

7.1.5. Commitment

Commitment strategies were also under-used in respect to the importance given to the technique by Ajzen and in empirical findings. Halifax was the only jurisdiction to employ a commitment strategy. In Halifax, residents make a commitment to participate in organic waste diversion as part of their lease agreement. The provision in the lease agreement to source separate waste is a creative way of gaining a commitment from tenants and a useful tool by which building managers can hold individual tenants accountable. While no evidence in my examination of Halifax mentioned the relative effectiveness of this intervention, theoretical and empirical literature suggests commitment strategies are highly effective (Ajzen, 2005; Burn and Oskamp, 1986, Fang and Katzev, 1990, Katzev and Pardini, 1987-1988, Pardini and Katzev, 1984, in Bryce et al., 1997). It's possible the commitment request is not explicit enough (Katzev and Pardini, 1987-1988, in Bryce et al., 1997).¹¹

7.1.6. Persuasive Information

Another discrepancy between the cases and theory was the under-use of persuasive information strategies in favour of “how-to-participate” information strategies. San Francisco was the only jurisdiction to balance persuasive messaging with how-to messaging. Such persuasive messaging focused on both general reasons to participate, such as helping to conserve resources and reduce GHG emissions, as well as more specific reasons, such as returning nutrients to local farmers and vineyards and thereby creating a sustainable closed-loop composting system that benefits the local economy. Halifax provided a persuasive component in their information strategies by putting “it's the law” on how-to brochures and online content. While no evidence in my examination of Halifax and San Francisco mentioned

¹¹ Katzev and Pardini (1987-1988) suggest the intervention is more effective if the individual makes an explicit commitment to engage in a specific activity.

the relative effectiveness of this type of intervention, the empirical literature suggests persuasive communications are a necessary component of an effective intervention (Geller, 1989, Katzev and Johnson, 1987, Stern and Oskamp, 1987, in Bryce et al., 1997).

7.1.7. Conclusion

Based on my case study findings, the most effective strategies for improving the participation of MF residents in organic waste diversion include requiring building managers to supply access to the program and using the door-to-door technique to distribute mini-bins and how-to information. Both of these strategies address the determinant of perceived behavioural control and encourage participation through providing facilitating resources. Commitment strategies, social norm strategies, and persuasive messaging were not pervasive across the cases, but theoretical and empirical findings suggest that these strategies are also effective.

8. Policy Options

In this section, I describe the policy options I have developed based on my comparative analysis as well as my review of the literature. Appendix D describes the methodology I used to develop my options. The first two options are targeted at increasing the adoption of organic waste collection services by building managers, as a key component of improving participation is access to these services within the building. The next two options are targeted directly at improving the participation rate of MF residents, assuming they have access to in-building organic waste collection services. The options are not mutually exclusive, and I recommend one option from each set so as to provide a comprehensive strategy for increasing the participation of MF residents in organic waste diversion. I start with a discussion of the status quo as the baseline from which my policy options are developed and evaluated.

8.1. Status Quo

In Vancouver, organic waste collection from MF buildings is an optional service offered by multiple private firms. Most of these firms also collect recyclables and residual waste. Based on the available information, the extent to which these firms provide educational outreach regarding waste diversion is minimal (COV, 2013).

Current tipping fees at Metro Vancouver transfer stations provide an incentive to haulers to divert waste. The tipping fee for residual waste is \$107 per tonne, while for organic waste the fee is \$71 per tonne and there is no charge for recyclables. There is an additional charge of \$50 if contamination in the organic waste is greater than 0.05% (Greater Vancouver Sewerage and Drainage District Bylaw No. 267, 2012). Organic waste collected by the city as well as private haulers is composted by Harvest Power Canada Ltd. (Harvest BC, 2013b). The

composting facility does not accept biodegradable or compostable bags because it degrades the quality of the compost (COV, 2012d).¹²

While the larger tipping fee for residual waste creates an incentive for waste haulers to divert waste, the extent to which the incentive is passed on to MF building managers is not clear based on available information. The minimal uptake of the service by MF buildings suggests the incentive is not encouraging MF building to adopt organic waste collection (COV, 2012b; MV, 2011b).

On October 17, 2012, Vancouver's City Council adopted, in principle, the introduction of mandatory participation in recycling and organic waste diversion for all sectors by the end of 2013 (COV, 2012c). In the analysis of my policy options, therefore, I will assume that mandatory participation has been introduced but is strictly defined as the requirement that residents source separate their waste, similar to Hamilton's bylaw. The introduction of mandatory participation is not presumed to include additional mandates such as requiring building managers to provide access or education materials to new tenants. I assume that the mandate is not being enforced through written notifications and fines to individual MF households – consistent with my case study findings. The mandate is assumed to provide just a normative signal that residents should participate in waste diversion.

¹² In addition to degrading the quality of the compost, compostable bags are designed to decompose within a set time frame and at a certain temperature and moisture content. If the facility's composting system does not process materials according to these dimensions, the compostable bags will not decompose properly (Carniol, 2013). It's likely Harvest BC's composting system does not operate according to these dimensions and therefore cannot process compostable bags. Just because the composting facility doesn't accept compostable bags doesn't necessarily prohibit wide-scale use of compostable bags by residents. In Toronto, for example, compostable bags are separated from organic waste at the processing facility and sent to the landfill (Carniol, 2013). As the City of Vancouver states on its website that compostable bags are prohibited, I take the rule as given. Biodegradable bags are also prohibited. These bags are designed to change their chemical structure, but necessarily change into compostable material (Carniol, 2013).

8.2. Explicit Incentive

This option establishes a pricing mechanism that provides an incentive to building managers to adopt and encourage organic waste diversion.

The pricing mechanism is modelled on San Francisco's Uniform Commercial Rate Structure and Recycling Incentive Program. San Francisco's rate structure consists of a base rate that covers the fixed costs of collection as well as a variable rate that depends on the volume of waste collected. A discount is applied to the variable rate based on the proportion of waste diverted up to a 75% diversion rate. Upon collection, the volume of waste is estimated based on the capacity of the bins; it is not directly measured (Recology, n.d.a). In addition, the variable rate is the same for all bin types – holding the size of the bins constant (Recology, 2012). Therefore, if a MF building has three bins of equal size – one for organic waste, one for recyclables, and one for residual waste – then the proportion of waste diverted is 67% and a discount of 67% applies to the variable rate portion of the service charge. The rate structure provides building managers with an incentive to adopt and encourage the diversion of organic waste and recyclables so as to benefit from reduced waste collection charges.

In addition, the rate structure is compatible with current tipping fees and does not require a subsidy to compensate for the discount when the variable rate for the bins is set so as to offset the discount amount. The adoption of the pricing mechanism doesn't change the incentive created by the tipping fees; it makes the incentive explicit to building managers. Appendix E provides an illustration of the offsetting procedure.

In San Francisco, rates are set by a Rate Board and apply only to Recology as the sole waste collection provider. This makes the rate relatively easy to set because it is based on only one firm's variable costs. Vancouver, in contrast, has multiple private firms competing to provide the service. Setting a single rate across multiple firms suppresses the competitive nature of the marketplace. In adapting this approach to Vancouver, therefore, I assume the City of Vancouver requires waste haulers to apply the given discount methodology, as detailed in Appendix E, but does not set a uniform rate as in San Francisco.

In addition, I assume this policy option would be implemented at the regional level because bylaws applying to the private haulers are Metro Vancouver's jurisdiction. Metro Vancouver is currently considering a licensing program for private haulers and the pricing mechanism could be included as a component of the licensing agreement (MV, n.d.).

8.3. Mandatory Access

This option makes building managers responsible for providing adequate access to an organic waste diversion program.

This option is modelled on the requirements placed on building managers in San Francisco's Mandatory Ordinance and includes the following requirements:

- Building managers must provide collection services for organic waste, recyclables, and residual waste.
- The collection service level must be adequate in relation to the estimated volume of waste generated in each stream.
- Building managers must provide communal bins for organic waste, recyclables, and residual waste.
- The communal bins must be appropriate in size and number to accommodate the estimated volume of waste generated in each stream.
- The communal bins must be appropriately labelled to identify the type of waste acceptable in each.
- The communal bins must be reasonably accessible and placed within a reasonable proximity of each other in order to provide convenient access.

Failure to comply with any component of the regulation would result in a written notification stating how the building is non-compliant, steps to remedy the non-compliance, and a request to remedy the non-compliance within a reasonable period. Persistent non-compliance would result in the issuance of a fine up to \$1,000 to the person or persons responsible as stipulated in the bylaw. This option includes implementation of an anonymous reporting line for MF residents to report any non-compliance to the city for follow-up.

8.4. Starter Kit

This option uses door-to-door outreach to provide MF residents with starter kits consisting of educational information and a mini-bin for organic waste collection.

This option is modelled on the educational outreach strategies implemented in Hamilton and San Francisco where MF residents are provided with a starter kit when the organic waste diversion program is initiated in their building. The starter kit consists of a brochure with information on why participation is important and how to properly participate as well as a free mini-bin to facilitate participation in the program.

The persuasive messaging component will place emphasis on how diverting food scraps creates a valuable resource that benefits local farmers and the local economy, as well as how recycling food scraps creates a sustainable local closed loop network because diverted food scraps become the nutrients used to cultivate the food we consume. As a means of counteracting the perceived “yuck” factor, the persuasive messaging will highlight that it's the same waste with the same smell as before, it's just being handled in a more environmentally responsible way (Cote, 2009).

The how-to information focuses on the items acceptable in each waste stream. This messaging is image-based, colour-coded (green background for organics messaging, blue for recyclables, black for residuals), and available in multiple languages. Compostable bags are not accepted at the local processing facility; therefore, the volunteer will also discuss how the bin can be used without a liner or with newspaper or paper bags as liners (COV, 2012d).

The starter kits will be personally delivered to each suite by volunteers, with these groups arranged by City staff. An attempt should be made to get residents from the building to volunteer so as to enhance the legitimacy of the intervention.¹³ Along with distributing the starter kits, the volunteers will discuss the benefits of participation, how to most effectively participate as well as respond to any questions.

¹³ As mentioned in Section 5.5, using members of the targeted community can enhance the legitimacy of the approach (Geller, 1989, in Bryce et al., 1997).

Implementation of the outreach strategy is performed in coordination with adoption of an organic waste collection service. When building managers adopt the service they will be prompted to contact the city to arrange the provision of the starter kits.

8.5. Commitment Strategy

This option uses door-to-door outreach to provide MF residents with educational information as well as encourage residents to re-purpose their existing garbage bin for organic waste collection. In addition, each resident is asked to make a commitment to participate in the program.

This option is modelled on the theoretical and empirical literature that suggests making an explicit commitment to participate in organic waste diversion is an effective means of increasing participation as well as the theoretical literature on default behaviour. As in the previous option, this option incorporates components of the educational outreach strategies implemented in Hamilton and San Francisco where volunteers distribute information on why participation is important and how to participate properly. In addition to the persuasive and how-to information outlined in the previous option, messaging regarding how most of the waste stream is organic waste or recyclable material is emphasized.

While mini-bins are not provided, the volunteers will supply residents with paper bags and encourage residents to re-purpose their existing garbage bins for organic waste collection only. The volunteer will suggest they switch out their regular garbage bags for paper bags and dispose of only organic waste in the bin and subsequently in the communal organic waste bins. To keep the bin clean, the volunteer will suggest lining the bin first with a plastic bag, then with a paper bag. The volunteer will also suggest lining the paper bag with strips of newspaper to maintain the integrity of the bag.

Volunteers will also suggest placing a small container beside the regular bin for residual waste. As residual waste does not take up a large portion of the waste stream and is mostly dry material, any container, or even a plastic bag, will be sufficient. A sticker and fridge magnet are

provided to the resident as visual reminders to participate, much like seeing the mini-bin is a reminder to participate in the previous option.

After explaining how to participate, the volunteer will ask if the resident would be willing to try the new method of source separation explained above. Empirical evidence suggests the commitment should be made to engage in a specific action (Katzev and Pardini, 1987-1988, in Bryce, 1997). Therefore, placing the commitment on the action of separating organic waste within the resident's suite is more specific than asking them to commit to organic waste diversion in general.

As with the starter kit strategy, implementation of the outreach strategy is performed in coordination with adoption of an organic waste collection service. When building managers adopt the service they will be prompted to contact the city to arrange for the outreach.

9. Criteria, Measures, and Evaluation

I use four criteria to analyze my policy options: effectiveness, implementation cost, implementation feasibility, and stakeholder acceptance. In the following section I define each criterion and related measure, and I then provide an analysis of each of my options for each measure. A summary table of my criteria and measures is presented in Appendix F. Appendix G contains a summary table of my analysis according to the criteria and measures.

9.1. Effectiveness

The criterion of effectiveness examines the extent to which each policy option contributes to the main objective of increasing participation of MF residents in organic waste diversion. To evaluate effectiveness, I apply two measures to each policy option.

The first measure involves examining the number of barriers to participation each option seeks to remove. I assume the removal of each barrier has an equal positive impact on the likelihood of participation. Therefore, the policy option that removes the most barriers has the greatest impact on participation. Section 3.3 provided a full discussion of the barriers. Based on this discussion, I have identified 10 key barriers to participation. I evaluate effectiveness by awarding one point for each barrier the policy option addresses. Table 3 lists the key barriers to participation, arranged according to the determinants of behaviour outlined in the theory of planned behaviour, as well as provides a summary of the analysis on effectiveness.

Table 3. Summary of Barriers to Participation Analysis

Barriers to Participation		Policy Options			
		Explicit Incentive	Mandatory Access	Starter Kit	Commitment Strategy
Attitudes of Residents	Takes too much time		✓	✓	✓
	Takes too much space			✓	✓
	Yuck Factor			✓	✓
	Lack of Responsibility				✓
Attitudes of Building Managers	Costs too much	✓			
	Perception that Residents won't participate	✓			
Social Norms	Anonymity				
Perceived Behavioural Control	Lack of how-to information/skills	✓	✓	✓	✓
	Lack of why information			✓	✓
	Lack of supplies within suite			✓	✓
Total:		3	2	6	7

9.1.1. *Explicit Incentive (3)*

This option removes a moderate amount of barriers. These barriers include the building manager-related attitude barriers as well as the lack of how-to information barrier.

The cost-savings implication of this option removes the attitude barrier that organic waste collection services are too expensive and should prompt the building manager to adopt the service. The cost savings are also expected to motivate the building manager to overcome his perception that the service is more trouble than it's worth. In addition, because participation in organic waste diversion now results in cost savings to the building manager, he may take responsibility for promoting awareness and proper use of the service. I assume the extent to which the building manager promotes the program is through signs posted around the building regarding acceptable materials to dispose of in the green bins.

9.1.2. *Mandatory Access (2)*

This option removes the least amount of barriers. These barriers include the attitude that organic waste diversion takes too much time as well as a lack of how-to information.

The mandate removes the barrier that organic waste diversion takes too much time by requiring the communal bins be equally convenient to access relative to residual waste bins. In addition, the mandate requires that appropriate signage be placed on each bin to indicate the acceptable materials, which is a form of providing how-to information.

9.1.3. *Starter Kit (6)*

This option removes the second largest number of barriers. These barriers include three of the resident-related attitude barriers as well as all the behavioural control barriers.

The persuasive messaging component of this option is used to overcome the attitude-related barriers that participation is going to take too much time, too much space, and cause yuck factor problems. To confront these perceptions, the persuasive messaging discusses how diverting organic waste isn't going to add to the time it takes to dispose of waste because it's a substitution of time, how diverting organic waste doesn't have to take up more space than

already allocated to waste disposal because it's just a re-allocation of the existing space, and how collecting organic waste separately from residual waste isn't going to create additional odours but create the same odours because it's the same waste as before, just handled differently. The provision of the mini-bin is also intended to overcome the perception that participation takes too much time. In addition, the provision of the mini-bin removes the barrier of a perceived lack of supplies needed to participate. The provision of the how-to brochure, along with the explanation offered by the volunteer, removes the barrier of a lack of knowledge regarding how to participate.

9.1.4. Commitment Strategy (7)

This option removes the most barriers to participation. The barriers addressed by the commitment strategy are the same as those addressed in the starter-kit option, with the addition of the barrier of a lack of responsibility.

As with the starter kit strategy, persuasive messaging is used to overcome the attitude-related barriers that participation takes too much time, too much space, and causes yuck factor problems. While this option does not provide residents with a mini-bin to facilitate participation, they are provided with information on how to participate by re-purposing their existing garbage bin. I assume that both methods sufficiently overcome the barrier of a perceived lack of supplies. In addition, this option addresses the barrier of a lack of responsibility by asking residents to make a commitment to participate.

9.2. Discrete Effectiveness

The explicit incentive and mandatory access interventions aim to change building managers' behaviour as a means of indirectly changing residents' behaviour. The starter kit and commitment strategy interventions, in contrast, aim to change residents' behaviour directly. I subsequently refer to the former set of options as “building manager interventions” and the latter set of options as “resident interventions.” With the different characteristics of each set of options in mind, I have created a secondary measure of effectiveness unique to each set.

9.2.1. Building Manager Interventions

Evaluation of the building manager interventions involves estimating the change in the participation rate of MF residents in Vancouver under each policy. To estimate this, I determine the proportion of MF buildings likely to adopt organic waste collection services upon implementation of the interventions. Of the MF buildings that adopt the service, I estimate the proportion of residents likely to participate given my previous assumptions regarding resident awareness.¹⁴ Then, I multiply the estimated number of MF households with service access by the estimated participation rate of those residents to get the estimated change in the participation rate of MF households.¹⁵

Evaluation

To determine the proportion of MF building likely to adopt organic waste collection under these policies, I consider both theoretical and empirical evidence.

Economic theory suggests both options would result in the adoption of organic waste collection in 100% of MF buildings because, theoretically, both options establish conditions where the benefits of adopting the service outweigh the costs. The explicit incentive policy rewards the building manager with cost savings on waste collection; this benefit is assumed to outweigh the cost of implementing the service. Therefore, the building manager is predicted to adopt organic waste collection. The mandatory access policy punishes the building manager with a financial penalty if he doesn't adopt the service. The benefit of avoiding the penalty is assumed to outweigh the cost of implementing the service; therefore, the building manager is predicted to adopt organic waste collection.

¹⁴ For the mandatory access intervention, I assume residents are made aware of the service through signage regarding acceptable materials in the green bins. For the explicit incentive intervention, I assume building managers also put up the signage but may engage in other activities to promote participation, such as distributing leaflets or discussing the program at building meetings. It is more likely that building managers engage in this added activity under the explicit incentive intervention because higher participation leads to larger cost savings.

¹⁵ I make the simplifying assumption that MF households are distributed equally across MF buildings. Therefore, the proportion of MF buildings with access is the same as the proportion of MF households with access.

Case study evidence, however, suggests that neither intervention will achieve 100% adoption. Under San Francisco's pricing incentive and prior to implementation of the city's Mandatory Ordinance,¹⁶ only 25% of MF buildings adopted organic waste collection services (Wildermuth, 2010). The pricing incentive was the main policy lever for three years, from 2006 to 2009 (Mandatory Recycling and Composting Ordinance, 2009; Recology, n.d.a). Within two years of implementing the mandate the adoption rate tripled, increasing the proportion of buildings with access to 76% (Sullivan, 2011; Yepsen, 2009).

I will use the change in adoption rates observed in San Francisco to estimate the proportion of MF buildings likely to adopt organic waste collection under each of my building manager interventions. Therefore, the explicit incentive policy is estimated to change the adoption rate by 25 percentage points and the mandatory access policy is estimated to change the adoption rate by 51 percentage points (76% minus 25%).¹⁷

To determine the proportion of MF residents likely to participate given my assumptions regarding awareness, I consider theoretical evidence. Theory suggests awareness of such a service, alone, does not have a strong impact on increasing participation. It is a necessary component, but not sufficient (Geller, 1989, Katzev and Johnson, 1987, Stern and Oskamp, 1987, in Bryce et al., 1997; Dolan et al., 2010). For the purposes of this evaluation, I will assume that awareness in its most minimal form – as occurs under the mandatory access policy – encourages 20% of residents, on average, to participate. Under the explicit incentive, it is likely building managers will engage in additional activities to encourage participation. To accommodate the possibility of this effect, I use a range to describe the estimated impact of the explicit incentive policy on participation. I will assume this range is between 20% and 50%.

¹⁶ San Francisco's Mandatory Ordinance included the provision that all residents must participate in organic waste diversion as well as required building managers to provide access to organic waste collection services.

¹⁷ Underlying the use of these numbers are four simplifying assumptions. In using the 25% rate, I assume that no MF buildings adopted organic waste collection prior to implementation of the pricing incentive. I also assume that the 25% increase is fully attributed to the incentive intervention. In using the 51% rate, I assume that the voluntary adoption of organic waste collection under the pricing incentive was saturated. In other words, all building managers willing to adopt the service based on the incentive did so prior to the mandate. I also assume the change in the adoption rate can be fully attributed to the mandatory access component of San Francisco's Mandatory Ordinance.

Based on estimates of the respective adoption rates and participation rates, mandatory access leads to an increase of 10%, while the explicit incentive leads to an increase of between 5% and 13%.¹⁸ While the incentive has a greater potential to influence the overall participation rate, mandatory access accounts for a larger number of buildings with access to the service and a larger number of residents to reach through other complementary strategies. Table 4 provides a summary of the analysis of discrete effectiveness.

Table 4. Summary of Participation Rate Analysis

Criteria	Policy Options	
	Explicit Incentive	Mandatory Access
Adoption Rate	25%	51%
In-building Participation Rate	20% to 50%	20%
Percent change in MF household participation	5% to 13%	10%

9.2.2. Resident Interventions

Evaluation of the resident interventions involves comparing the convenience of receiving and using a mini-bin for organic waste collection to the convenience of re-purposing and using the existing garbage bin for organic waste collection. When the perceived convenience of organic waste diversion improves, this improves the attitude determinant of behaviour and the likelihood of participation. Therefore, examining convenience is a means of examining the effectiveness of the policy options.

¹⁸ Calculation: 154,000 MF households multiplied by the applicable adoption rate (Footnote 22 explains why the figure 154,000 is used). The product of this equation multiplied by the in-building participation rate, which equals the change in the number of participating MF households. This product is divided by the total number of eligible MF households and multiplied by 100. For example, the mandatory access participation rate is estimated based on the following equation:

$$((154,000 * .51 * .2) / 154,000) * 100 = 10.2$$

I define convenience in terms of time saved using the facilitating supplies of one intervention relative to the other. Both options already increase time saved relative to the status quo of not receiving either type of facilitating supplies; therefore, I do not discuss the status quo in my analysis. To evaluate convenience, I first identify the main actions required to participate as:

- Acquiring/re-purposing an in-suite bin for collecting organic waste
- Source separating organic waste into the bin
- Transporting the organic waste to the communal area and disposing in the designated green bin
- General upkeep of the facilitating supplies

Second, I evaluate each option in terms of whether the intervention creates a time cost or a time savings in performing each action. A time cost is scored as -1 and a time savings is scored as 1.

For the starter kit strategy, I make the simplifying assumption that the mini-bin is not used in combination with paper bag liners. For the commitment strategy, I assume the recommended approach is used where re-purposing the bin consists of lining the garbage bin with a plastic bag, inserting a paper bag in that, and lining the paper bag with newspaper. Table 5 provides a summary of the analysis of convenience including a hybrid option where the mini-bin is used in combination with a paper bag liner.

Table 5. Convenience Analysis

Criteria	Policy Options		
	Starter Kit (Mini-Bin; No Liner)	Hybrid (Mini-Bin; Liner)	Commitment (Re-purposed Bin; Paper Bags)
Acquisition of Supplies	1	1	-1
Source Separation Behaviour	-1	-1	1
Transportation to Communal Area	-1	1	1
General Upkeep	-1	0	1
Total:	-2	1	2

Evaluation

Based on my evaluation, using the re-purposed bin is more convenient than using the mini-bin. While provision of the mini-bin does present an upfront time savings as compared to re-purposing the existing garbage bin, this is the only time saving benefit of starter kit strategy. Without a liner, the mini-bin needs to be transported to the communal green bin and returned upon each trip. Often residents dispose of waste upon leaving for the day and returning the bin to their suite requires an extra trip. With the re-purposed bin, the paper bags are disposed along with the organic waste and the resident does not have to make the return trip. In addition, the mini-bin requires relatively frequent cleaning. The re-purposed bin, however, does not involve cleaning to the same extent due to the use of paper bags and the plastic bag liner. Not only does the paper bag help maintain the cleanliness of the bin, the additional plastic bag liner further reduces the cleaning time; periodic replacement of the plastic bag should suffice.

The action of source-separating the waste is also more convenient by using the re-purposed bin based on the difference in the default change.¹⁹ Both options disrupt the default action of disposing of residual and organic waste in the same bin. However, the starter kit option asks residents to change how they treat organic waste and the re-purposed bin option asks residents to change how they treat residual waste.

When a default is changed, the new behaviour is perceived as inconvenient because it requires active thinking to remember and perform the new activity. When using the mini-bin, organic waste disposal is the new activity. When using the re-purposed bin, residual waste is the new activity. Therefore, using the mini-bin makes organic waste diversion seem inconvenient relative to residual waste diversion, while using the re-purposed bin makes residual waste diversion seem inconvenient relative to organic waste diversion.

This inconvenience is further exacerbated by the fact that most residential waste is organic waste, assuming recyclables are already being source separated. Therefore, residents using the mini-bin have to remember to put organic waste in the mini-bin more times than residents who re-purpose their existing garbage bin. When using the re-purposed bin, the disruption of the default change only impacts their behaviour in regards to residual waste, which makes up a much smaller portion of the waste stream and results in having to remember where to put residual waste fewer times.

Adjustments could be made to the starter kit option to enhance the convenience, as represented by the hybrid option in Table 5. Using a paper bag to line the mini-bin would increase time savings because it maintains the disposable nature of the re-purposed bin option and requires less cleaning.²⁰ However, the inconvenience inherent in changing the default organic waste disposal activity remains. These adjustments make the hybrid option almost as

¹⁹ Section 3.1.3 provides a discussion of defaults and convenience.

²⁰ The hybrid option would still require more cleaning than the re-purposed bin. I assume the hybrid option uses only a paper bag liner, not both a paper bag and plastic liner. The additional plastic liner makes for the easiest upkeep. With just a paper bag, the bin will still have to be cleaned more frequently as the moisture inherent in organic waste can saturate the bag and leak into the bin. I assume the mini-bin is too small to be used with both a plastic and paper liner. Therefore, the hybrid option scores a 0 in terms of general upkeep.

convenient as the re-purposed bin; however, the re-purposed bin is still more convenient overall.

Despite this conclusion, it's possible the upfront time savings make the mini-bin seem more convenient to residents and they might be more likely to accept the mini-bin than to accept advice on how to re-purpose their existing bin. The commitment request, however, helps overcome the upfront time cost based on the principle of consistency, where people are motivated to be consistent in what they say and do because being inconsistent is socially undesirable or internally stressful. Therefore, if an individual makes a commitment to participate, they tend to act in a manner consistent with that statement, irrespective of the upfront time cost (Bem, 1972, Cialdini, 1988, in Bryce et al., 1997).

9.3. Implementation Cost²¹

This criterion examines the additional capital and labour costs required by the City of Vancouver to implement each policy. In considering these costs, I assume that each policy is implemented over a three-year period. This assumption is based on Hamilton's implementation period of three years.

To evaluate capital costs, I first identify the physical equipment required to implement the policy, such as a mini-bin for each MF household. I then estimate the cost of each type of physical equipment per household and sum the cost of equipment supplied per household. Lastly, I multiply the cost per household by the number of households estimated to receive the

²¹ I assume that each policy option, through achieving increased composting of organic waste, provides a net social benefit relative to the status quo of disposing of most organic waste from MF buildings in landfills. Therefore, my analysis does not examine the social costs and benefits of each option.

supplies.²² In addition, I assume that supplies are distributed to eligible MF households evenly across the three-year period. A summary of my analysis of capital costs is provided in Table 6.

Table 6. Capital Costs Per Household and Per Year

Capital Costs		Policy Options			
		Explicit Incentive	Mandatory Access	Starter Kit	Commitment Strategy
Mini-bin	\$3.00			✓	
How-to Brochure	\$0.50			✓	✓
Paper Bags	\$0.25				✓
Fridge Magnet	\$0.50				✓
Sticker	\$0.50				✓
Total per household:		\$0	\$0	\$3.50	\$1.75
Total per year:		\$0	\$0	\$179,666	\$89,833
Total over implementation:		\$0	\$0	\$538,997	\$269,498

To evaluate labour costs, I first estimate the additional employees required over the three-year period to implement the policy. I assume each additional full time employee receives an annual salary of \$50,000. I assume each additional auxiliary employee receives a wage rate equivalent to an annual salary of \$30,000. While I evaluate labour costs in terms of the number of employees required per year, one auxiliary employee's annual hours may not be worked by

²² There are an estimated 160,000 MF households in 5,000 building in Vancouver. 1,000 of the smaller buildings (such as duplexes and townhouses), however, have organic waste collection provided by the city. I assume the number of units in these buildings ranges from 2 to 10, with an average of 6 units per building. 6,000 MF households, therefore, are removed from consideration in estimating the capital costs per household. While some of the existing MF buildings may already have organic waste collection services, uptake of the services is considered minimal (COV, 2012b). In addition, these buildings could still benefit from the outreach initiatives. Therefore, I will assume that 154,000 MF households are eligible to receive outreach packages.

one employee. Auxiliary hours would be distributed according to demand. For example, the auxiliary annual salary of “one employee” may be distributed across multiple employees working part time. Lastly, I sum the salaries required each year. In addition, I assume the amount of additional labour is constant across the three-year implementation period. A summary of my analysis of operating costs is provided in Table 7.

Table 7. Operating Costs Per Year

Operating Costs	Policy Options			
	Explicit Incentive	Mandatory Access	Starter Kit	Commitment Strategy
Outreach Team Member			✓	✓
Enforcement Team Member	✓	✓		
Full time staff per year:	Enforcement by MV*	2 (\$50,000/yr)	2 (\$50,000/yr)	2 (\$50,000/yr)
Auxiliary staff per year:		2-4** (\$30,000/yr)	2-4** (\$30,000/yr)	2-4** (\$30,000/yr)
Total Salary per year:	\$190,000	\$190,000	\$190,000	\$190,000
Total over implementation:	\$570,000	\$570,000	\$570,000	\$570,000
<p>*Note: I assume the enforcement cost of the explicit incentive is equivalent to the cost of enforcing mandatory access. However, the number of employees or number of employee hours required may not be same.</p> <p>**Note: In the calculation of total salary per year, I use the average total wage of 3 auxiliary employees.</p>				

I add the capital and labour costs of each policy to get the total implementation cost. The total implementation cost of each policy is represented in constant dollars. I do not discount the costs over time because the costs occur within a short period of time that is within the near future. Given this time frame, the difference between the total costs in constant dollars and the total costs in present value are negligible. In addition, inflation during this period would partially

offset the discount rate and further decrease the difference. A summary of the total implementation costs is provided in Table 8.

Table 8. Annual and Total Implementation Costs

Total Costs	Policy Options			
	Explicit Incentive	Mandatory Access	Starter Kit	Commitment Strategy
Capital Costs per Year:	\$0	\$0	\$179,666	\$89,833
Operating Costs per Year:	\$190,000	\$190,000	\$190,000	\$190,000
Total Costs per year:	\$190,000	\$190,000	\$369,666	\$279,833
Total over implementation:	\$570,000	\$570,000	\$1,108,997	\$839,498

9.3.1. Explicit Incentive and Mandatory Access (\$570,000)

These options have the lowest estimated total cost. While the implementation of both policies does not require any capital expenditure, both options require human resources to enforce the policies.

The mandatory access option involves the cost of enforcing the policy on building managers. Based on San Francisco's enforcement strategy, city staff “ride-along” with waste haulers to issue notifications to non-compliant MF buildings. A reasonable compliance presence can be achieved without monitoring each of the 4,000 MF buildings in Vancouver. Under the assumption that 10% of buildings are monitored over the three year period, 133 buildings require a visit each year – or approximately 3 buildings a week. This estimate, however, assumes one visit to 10% of buildings is sufficient to ensure compliance. In practice, follow-up contact, likely through additional visits, is needed. If each building in the 10% sample requires an additional visit, the visits increase to six per week. This may still represent a lower bound estimate as monitoring more than 10% may be desirable and some buildings may require more than two notifications before compliance is achieved. In addition, staff would provide

educational outreach to building managers to facilitate the adoption of organic waste collection services as well as respond to anonymous reports regarding non-compliance.

I estimate a team of five city staff would be sufficient to provide adequate enforcement over a three-year period. Two full time staff would perform the ride-alongs, issue and track notifications, while 2-4 auxiliary employees would support this primary function by coordinating ride-alongs with private haulers, providing educational information to building managers, as well as responding to the anonymous report line. Therefore, two staff with an annual salary of \$50,000 and an average of 3 staff with an annual salary of \$30,000 totals \$190,000 per year. The total cost over the implementation period is \$570,000.

The explicit incentive option involves the cost of enforcing the policy on private waste haulers. Third-party audits of the private waste haulers' billing methodology and practices would be conducted at the discretion of Metro Vancouver. While the enforcement cost is technically passed on to Metro Vancouver, I assume that the City of Vancouver is partially responsible for funding the audits. As a proxy measure of the city's contribution to the audits, I assume the cost is equivalent to the cost of enforcing mandatory access. The total cost over the implementation period is projected as \$570,000.

9.3.2. Starter Kit (\$1,108,997)

The starter kit option has the highest estimated total cost. The physical equipment required for this option includes mini-bins and how-to brochures for each eligible MF household. I estimate the cost of the mini-bin at \$3 and the brochure at \$.50. Under the assumption that 51,333 MF households are visited each year for three years, the capital cost of this option is \$179,666 per year and \$538,997 over the implementation period.

With 4000 buildings eligible for the outreach, an average of 1,333 buildings would be visited per year – or 25 visits per week. As the outreach is elective but strongly encouraged, I assume that 50% of buildings elect the outreach. Therefore, I assume outreach is provided to approximately 12 buildings per week. While volunteers help distribute the starter kits, a team of city staff is required to supply the starter kits, recruit and train the volunteers, coordinate the

outreach with building managers, participate in the outreach, as well as respond to the feedback reports.

I estimate a team of five staff would be sufficient to implement this option. Two full time city staff would manage the outreach programs by arranging the visits with building managers, overseeing and participating in the outreach, procuring the starter kits, as well as recruiting the volunteers. 2-4 auxiliary employees would support the outreach by training the volunteers and participating in the door-to-door outreach. As with the previous policy options, the additional human resources are estimated to cost \$190,000 per year and \$570,000 over the implementation period. The total implementation cost is \$1,108,997.

9.3.3. Commitment Strategy (\$839,498)

The commitment strategy has the second highest estimated total cost. The cost of this option differs from the starter kit option only in terms of a reduction in capital costs. The physical equipment required for this option includes paper bags, how-to brochures, stickers, and fridge magnets. I estimate the cost of the paper bags at \$.25 and the how-to brochure, sticker, and fridge magnet each at \$.50. With 51,333 MF households visited each year, the total capital cost is estimated at \$89,833 per year and \$269,498 over the implementation period. The human resources required to implement this policy are the same as with the starter kit option; therefore, the estimated operating cost is also \$190,000 per year and \$570,000 over the implementation period. The total implementation cost is \$839,498.

9.4. Implementation Feasibility

To evaluate the feasibility of implementing each option I considered the following questions:

- Does an entity other than the City of Vancouver have a role in executing the policy?
- Does an entity other than the City of Vancouver have a role in enforcing the policy?

I identify six external entities that may be involved in implementing and enforcing the policy options. They include: building managers, MF residents, private haulers, volunteers, third

party auditors, and Metro Vancouver. Table 9 provides a summary of the analysis of implementation feasibility.

Table 9. Implementation Analysis

External Entities	Policy Options			
	Explicit Incentive	Mandatory Access	Starter Kit	Commitment Strategy
Building Managers		✓	✓	✓
Metro Vancouver	✓			
Private Haulers	✓	✓	✓	✓
Residents		✓		
Third Party Auditor	✓			
Volunteers			✓	✓
Total:	3	3	3	3

9.4.1. Explicit Incentive (3)

Implementation of the explicit incentive policy involves Metro Vancouver, private haulers, and a third-party auditor. Bylaws on private waste haulers are Metro Vancouver's jurisdiction; therefore, implementation of this policy option would be done in cooperation with Metro Vancouver and other member municipalities. Private haulers are involved as they would be required to implement the explicit pricing incentive in their billing methodology. Private haulers would also be required to keep a record of their billing methodology and practices which could be reviewed in third party audits at the discretion of Metro Vancouver (MV, n.d.).

9.4.2. Mandatory Access (3)

Implementation of the mandatory access policy involves building managers, residents, and private haulers.²³ Building managers have a role in carrying out the policy by adopting organic waste collection services at their building. Residents and private haulers are involved in enforcing the policy. Residents can help enforce the policy through anonymously reporting non-compliance to city staff to investigate. City staff would also enforce the policy by performing periodic audits of MF buildings. These audits would be done in coordination with private waste haulers where city staff would ride-along with the hauler and issue notifications to non-compliant buildings.

9.4.3. Starter Kit and Commitment Strategy (3)

Implementation of the starter kit and commitment strategy initiatives involves volunteers, building managers, and private waste haulers. Volunteers go door-to-door to distribute the starter kits and discuss the program. Coordination between city staff and building managers is required to arrange a time to implement the initiative as well as provide the building manager with information about the program. In addition, city staff and private waste haulers are presumed to cooperate such that when a building manager adopts the service, the private hauler suggests they contact the city to receive the free educational assistance.

9.5. Stakeholder Acceptance

To evaluate stakeholder acceptance, I first define who qualifies as a stakeholder. I then identify each group's general position on MF organic waste diversion as the basis for assessing whether they would support or oppose each policy.

I define "stakeholder" as any person or group of people that meet at least one of the following conditions:

²³ This policy could be adopted at the regional level, but such a variation is not considered in my analysis.

- Any person or group that is affected by the policy
- Any person or group that can affect the policy
- Any person or group with an interest in improving waste diversion

Based on this definition I identified four stakeholder groups: private waste haulers, the Recycling Council of British Columbia (RCBC) and other pro-recycling organizations, building managers, and MF residents. Private waste haulers, building managers, and residents meet the first two conditions, while RCBC and other pro-recycling organizations meet the last.

Based on the following general positions of the stakeholder groups, I create a decision rule by which to determine whether the groups are likely to support, oppose, or remain neutral towards each policy option. Table 10 provides a summary of the analysis of stakeholder acceptance.

RCBC

- Position: RCBC and other pro-recycling organizations are interested in improving organic waste diversion.
- Decision Rule: If the policy improves waste diversion then they are likely to support it.

As each policy option is intended to improve waste diversion, RCBC supports each option. Because their position is constant across options, a consideration of their stance does not impact the overall analysis. Therefore, I will not discuss RCBC's stance in the evaluation of each option.

Private Haulers

- Position: Private haulers are interested in how the policy impacts their business.
- Decision Rule: If the policy imposes additional costs that outweigh any additional benefits, they will oppose it.

Building Managers

- Position: Building managers are also interested in how the policy impacts their business.
- Decision Rule: If the policy imposes additional costs that outweigh any additional benefits, they will oppose it.

MF Residents

- Position: In defining MF residents' general position in the policy area, I make two assumptions. First, I assume residents in strong support of improving waste diversion outcomes make up the minority of MF residents, and their interests are represented by RCBC and other pro-recycling organizations. Second, I assume that most MF residents are generally interested in waste diversion but balance this interest with the level of perceived convenience in performing the activity.²⁴
- Decision Rule: If the policy enhances the perceived convenience of organic waste diversion or has other benefits that outweigh any additional costs, then they will support it.

Table 10. Stakeholder Analysis

Stakeholders	Policy Options				
	Status Quo ²⁵	Explicit Incentive	Mandatory Access	Starter Kit	Commitment Strategy
Building Managers	0	1	-1	1	1
Private Haulers	0	-1	1	1	1
Pro-Recycling Organizations	-1	1	1	1	1
Residents	0	0.5	0.5	1	0.5
Total:	-1	1.5	1.5	4	3.5

²⁴ The baseline position for MF residents is based on summary notes from a Multi-Family Stakeholder Focus Group held in Calgary, September 8, 2012.

²⁵ RCBC and other pro-recycling groups oppose the status quo because it has not improved organic waste diversion. The remaining stakeholders remain neutral as a baseline position from which they react to the policy options.

9.5.1. *Explicit Incentive (1.5)*

This option has a low level of support from stakeholders. Building managers support the option because they benefit from reduced waste collection costs. Private haulers, however, likely oppose the policy. While they might receive additional clients based on the incentive, the offsetting methodology creates additional administrative costs. In addition, estimation of the variable rate requires information and projections of service levels that may not be available or may be insufficient. The risk of a revenue shortfall in conjunction with additional administrative costs suggest private haulers would oppose the policy. Residents have modest support for the policy. The option potentially reduces the costs of waste collection passed on to the resident; however, creating an incentive to adopt the service does not mean the service will be convenient to use. Given a general interest in waste diversion, some support exists for this policy.

9.5.2. *Mandatory Access (1.5)*

This option has a low level of support from stakeholders. Private haulers support the policy because it would drive up demand for their organic waste collection services. For firms that provide all three types of collection, demand for organic waste collection will be partially offset by a reduction in demand for residual waste collection. Nonetheless, initial demand may not reflect the long-term substitution effect, resulting in higher overall demand for waste collection services in the short run.

Residents are anticipated to have modest support for this policy. While the mandate requires access to organic waste bins to be equally convenient to access as residual waste bins, the additional service is also likely to add to waste collection fees in the short term. However, the extent to which these fees are passed on to residents, especially renters, is minimal. Given a general interest in waste diversion, some support exists for this policy. Building managers oppose this policy. The need to adopt the service places a transaction cost on the building manager and may increase waste collection bills.

9.5.3. Starter Kit (4)

This option received the highest level of support among stakeholders. Private haulers, building managers, and residents all support the initiative. Private haulers support the outreach program because it encourages proper usage of the service they provide. Building managers support the outreach program for the same reason. As most residents are generally interested in waste diversion, residents support the initiative because they benefit from receiving a free mini-bin, which increases convenience, as well as facilitating information on how to participate properly.

9.5.4. Commitment Strategy (3.5)

This option also received a high level of support. As mentioned above, private haulers and building managers support the initiative because it encourages proper use of the organic waste collection service. Residents also support the initiative. However, residents support the initiative slightly less than the starter kit option because they perceive the inclusion of the mini-bin as having a higher value than instructions on re-purposing your own bin.

10. Recommendations

Based on my evaluation of the policy options, I recommend the mandatory access policy and the commitment strategy. I recommend one building manager-related intervention and one resident-related intervention because of the complementary nature of the policy options. Together, these options offer a more comprehensive approach to increasing the participation of MF residents in organic waste diversion.

10.1. Mandatory Access

The key strength of the mandatory access strategy over the explicit incentive is the increased effectiveness. While the mandate does not address as many barriers as the incentive, the mandate results in a higher adoption rate of organic waste collection services among MF buildings. The mandate also results in a higher overall participation rate, holding awareness of the program constant. The incentive, in contrast, is likely to encourage building managers to promote more than a minimal awareness level, which would increase participation. Nonetheless, the mandate's larger adoption rate represents a greater potential for participation than the explicit incentive. The commitment strategy complements this measure by providing more than a general awareness of the program to encourage more residents to participate.

The mandate also has a higher level of stakeholder support when combined with educational outreach. Whereas private haulers oppose the explicit incentive due to the additional administrative costs, private haulers support mandatory access because of the extra demand it creates for their services. Residents also support the option, although they may be concerned about additional service fees. While building managers oppose the option because of the potential increase in collection costs and the additional time cost required to implement and oversee the program, the complementary educational outreach somewhat reduces their opposition.

The implementation of both options requires two main external entities. The mandate involves private haulers and building managers, while the incentive involves private haulers and Metro Vancouver. Although each requires coordination with two entities, the coordination with private haulers is likely more complex under the explicit incentive, where private haulers would be expected to change their billing practices. Under the mandate, city staff would coordinate with private haulers only to do ride-along inspections, at no cost to the hauler.

10.2. Commitment Strategy

The key strengths of the commitment strategy over the starter kit strategy include increased effectiveness and a lower implementation cost. While the two strategies address many of the same barriers, the commitment strategy also removes the barrier of a lack of responsibility. In addition, the re-purposing of the garbage bin, as opposed to providing a separate mini-bin, enhances the overall convenience of participation. Although the upfront time cost of re-purposing the bin may seem like a deterrent, the commitment request helps overcome this weakness.

While the two strategies share many of the same implementation costs, the commitment strategy does not include the capital cost of the mini-bins. As a result, the commitment strategy costs roughly 25% less to implement.

The commitment strategy has slightly less stakeholder support. The difference is based on resident support. While residents perceive the provision of the mini-bin more favourably than no such provision, residents still support the commitment strategy. In addition, both building managers and private haulers support the strategy.

11. Additional Considerations

11.1. Mandatory Access

While I recommend the mandate, the building manager options are not mutually exclusive and could be implemented simultaneously. Building managers would certainly support the addition of the pricing incentive as implementation of the mandate alone would likely have a larger impact on their waste collection fees.

Another option is for the City of Vancouver to provide organic waste collection services to MF buildings. As organic waste collection services to MF buildings are currently provided only by private waste haulers, I make the assumption in my analysis that this arrangement is fixed. This assumption, however, does not need to hold. Organic waste collection services provided by the city would complement all of the policy options. Such an undertaking would likely increase the city's waste collection operating and capital costs because of the extra trucks and staff required to service the additional demand created by including MF buildings in the collection schedule. Nonetheless, such an undertaking is not without precedent. Recycling programs for MF buildings used to be solely provided by private waste haulers; however, the city started its own recycling program for MF buildings in 1995 (Bula, 1998; The Vancouver Sun, 1996).

11.2. Commitment Strategy

While I recommend the commitment strategy, both outreach strategies have distinct advantages and the strategies could be combined. For example, the commitment request could easily be added to the starter kit strategy. If that were the case, the key difference between the options would be the cost of implementation and the relative convenience of using the mini-bin or re-purposed bin. While providing the mini-bins doubles the capital costs of implementation, the standardized mini-bin embodies the norm of organic waste diversion much like the blue box

embodies the norm of recycling and may help encourage residents to participate if they think their peers are using the bins. Therefore, the mini-bin might leverage social influence to encourage participation even though MF residents don't set out the mini-bin like SF residents set out their blue bins. This potential advantage of the mini-bin is not captured in my analysis.

Regardless of whether a mini-bin is provided, residents will differ in how they manage the collection of their waste streams and in their decision to comply. As residents don't directly face a penalty for non-compliance, educational outreach and the provision of supplies will likely change the behaviour of only those who are willing to participate, as opposed to those who are resistant to the idea.

Improving the convenience of participation is one way of reducing the resistance to behaviour change. Although I take the prohibition of compostable bags as given in my analysis, accepting compostable bags in the organic waste stream would greatly reduce the yuck factor and help improve the convenience factor. San Francisco and Hamilton, cities that implemented the starter kit strategy, both accept compostable bags. Distributing mini-bins was a successful part of their outreach strategy; however, without being able to use compostable bags the success of the strategy is untested in my cases. As compostable bags come in multiple sizes, they would be compatible with either outreach strategy.

As a variation on the commitment strategy, the city could provide MF residents with mini-bins for residual waste and larger compostable bags for re-purposing their existing bin. Mini-bins for residual waste could likely be provided at a lower cost as they would not have special features such as a lid or air vents, which are common to organic waste mini-bins.

In addition, the convenience of participating could be further improved through building design changes. Metro Vancouver is working with local municipalities to establish specifications for ensuring new and renovated building are designed with adequate communal space for waste diversion activities (Bérubé, 2012). Buildings can also be designed to include new technologies that improve convenience. For example, new and renovated buildings can now install “tri-sorter” chutes instead of traditional garbage chutes. To use the tri-sorter chute, residents select the type of waste they are disposing of from a menu of options and the chute diverts the waste to the appropriate communal bin (Genivar Consultants, 2010).

11.3. Building Managers and Property Owners

Throughout my research I use the simplifying assumption that building managers and property owners are synonymous and that the underlying characteristics of their buildings are equivalent as well. In practice, however, building managers and property owners may respond in different ways to the policy options; the characteristics of their buildings are also likely to differ. For example, MF buildings operated by building managers often have a higher resident turnover because the units are all rental suites, whereas MF buildings managed by property owners generally have a lower turnover rate as some owners occupy their suites.

As a result, buildings with more transience will require more ongoing education to maintain awareness and participation rates; these buildings are often run by building managers. Both Halifax and San Francisco's programs promote ongoing education efforts in addition to their initial outreach initiatives. In both jurisdictions, building managers and property owners are required to educate new tenants about their waste diversion program upon signing the lease. San Francisco takes an extra step by requiring building managers and property owners to re-educate all tenants at least once a year.

Building managers and property owners may respond in different ways to the same intervention. By owning the MF suite, property owners may be more invested in maintaining and improving the quality of the building. This investment may provide a stronger incentive for property owners to encourage their tenants to participate in waste diversion. In addition, property owners only have to engage with the tenants in their suite, whereas building managers would have to canvas the whole building for lack of a more strategic approach. The relatively few tenants that property owners would have to educate reduces the time commitment required by them to improve waste diversion in the building. As owner-occupants are directly responsible for their share of the waste collection fees, a price-based incentive would also have a stronger impact on property owners than building managers.

12. Conclusion

The low participation rate of MF residents in organic waste diversion is a common weakness in any city-wide program (Yepsen, 2009). Growing pressure from residents as well as the upcoming landfill ban on organic waste has increased the need to find options to address low participation rates in Vancouver. One aspect of the problem is that MF buildings often don't have access to on-site organic waste collection services. When these services are provided, voluntary participation may be minimal, as is commonly the case with recycling participation.

The goal of this research is to understand the barriers to participating in organic waste diversion in MF buildings as well as develop policy options that overcome these barriers. I use the theory of planned behaviour as the framework from which to understand the determinants of organic waste diversion behaviour and industry literature to understand the barriers, as they relate to the framework. My findings reveal that the barriers to participation operate on two levels. Challenges are encountered by the building managers and property owners as well as by the residents. My policy options, therefore, aim to remove the barriers faced at both levels so as to formulate a comprehensive strategy for increasing participation.

Development of my policy options includes a comparative analysis of three jurisdictions with successful organic waste diversion programs. Based on these findings as well as other research, I develop four options: an incentive for adopting organic waste collection services, a mandate that building managers adopt organic waste collection services, an outreach campaign that includes the provision of a mini-bin, and an outreach campaign that includes facilitating information on re-purposing the existing garbage bin. The first two options address challenges at the building manager level, and the second two options address challenges at the resident level. Based on my evaluation of the options, I recommend the mandate on building managers to provide access as well as the outreach campaign on re-purposing the existing garbage bin. Both options would be highly effective, garner considerable stakeholder support, and are cost effective.

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Appendices

Appendix A

City of Vancouver's Food Scraps Diversion Program

The City of Vancouver's food scraps diversion program consists of three phases. The first two phases, which focus on increasing the diversion of organic waste from SF residences, are nearing completion. The next phase is set as a priority for 2013 and involves increasing the diversion of organic waste from MF residences and the ICI sector (COV, 2012b).

The first phase was implemented April 2010 and allowed all SF residences in Vancouver to add raw fruit and vegetable scraps to their yard trimmings in the city-provided outdoor green bins for collection and subsequent composting. During this phase, garbage continued to be collected on a weekly basis and green bin waste was collected on a bi-weekly basis. Participation in the program is voluntary (COV, 2012b).

The second phase was implemented September 2012 and expanded the types of food scraps allowed in the green bin to include fruit, vegetables, meat, fish, dairy, bread, cereal products, and food soiled paper. Implementation of phase two followed a comprehensive pilot project launched in 2011 to test the logistics of the food scraps program expansion. As part of this phase, garbage collection will be changed to bi-weekly collection and green bin collection will be changed to weekly collection. This final piece of phase two is set to be implemented in the spring of 2013 (COV, 2012b).

The third phase involves developing and implementing options for diverting food scraps from MF residences as well as the ICI sector. This work will be done in collaboration with Metro Vancouver, private waste collectors, and organic material processors. Implementation of this phase is expected to occur in 2013 and 2014. As with the SF program, a pilot project was launched for MF food scraps collection; the results will be used to inform the development of policy options (COV, 2012b).

Appendix B

Case Study Findings

Hamilton

The Residential Green Cart Program is the organic waste diversion program for residents and some businesses in Hamilton. Under the program, MF buildings receive multiple green carts for their communal waste area as well as a mini-bin for each suite (Parker, 2012). Hamilton's Green Cart Program started in 2006 and focused on improving waste diversion from SF households. The program expanded to include MF buildings in 2008. The expansion came just in advance of Hamilton's new Solid Waste Management Bylaw no. 09-067, 2009. The bylaw requires SF and MF residences, as well as some businesses, to participate in source separating organic waste and recyclable materials (Bylaw no. 09-067, 2009). Under the bylaw, MF buildings are expected to have four types of communal bins: one for organic waste, two for recyclables – separated into containers and fibres (paper and corrugated cardboard) – and one for residual waste.

Waste collection for SF and MF residences is provided by both the City of Hamilton and Green For Life Environmental Corporation. The City of Hamilton collects residual waste and Green For Life collects recyclables. Collection of organic waste is divided between the two service providers. Green For Life collects organic waste in “B-Zones” while the city collects organic waste in “A-Zones” (City of Hamilton, 2012a). All residential organic waste is delivered to Hamilton's Central Composting Facility (COH, 2006). The City of Hamilton also provides educational information and outreach to support the program (COH, 2013; Parker, 2012).

Implementation of the Green Cart Program followed Hamilton's adoption of a residential waste diversion target of 65% by 2021 (COH, 2012a; COH, 2012c). This target was established in 2001 and renewed in 2012. As of 2010, Hamilton's residential waste diversion rate was 49%, comprised of a 55% diversion rate from SF households and a 21% diversion rate from MF households (COH, 2012a). The MF diversion rate marks an increase from a diversion rate of 15% before commencement of the Green Cart Program (Parker, 2012). While this diversion rate includes the diversion of both recyclable and organic waste, the organic-only diversion rate for MF buildings from 2009 to 2011 is also available. In 2009 and 2010, MF buildings achieved a 21% organic waste diversion rate. In 2011, however, the MF organic waste diversion rate dropped to 18% (Watson, 2012).

Interventions

Hamilton's strategy for improving the participation of MF residents in organic waste diversion focuses predominantly on service design strategies and educational outreach. In reaction to the decline in participation in 2011, Hamilton created a new action plan for improving waste diversion in MF buildings that includes the use of incentive-based strategies (Watson & Morello, 2012).

Service Design

Upon implementation of the program, the city provided MF residents with a starter kit which included a how-to manual, mini-bin for organic waste disposal, sample liners for the mini-bin, a fridge magnet, and a blue recycling bag for transporting recyclables to the communal disposal area. Volunteers delivered these kits to MF residents using the door-to-door strategy. The city also provided each building with green carts

for the communal disposal areas. These carts were personally delivered to building managers by city staff along with signs to put up around the building to serve as reminders (Parker, 2012).

Education

Hamilton's education strategy acknowledged that MF buildings have multiple channels of communication and created educational materials directed at each audience. Property owners were mailed letters advising of the new program along with program information. Building managers also received these letters and were given a "Superintendents' Handbook." Residents were given the starter kits including a how-to manual during the door-to-door visit. Upon delivering the starter kits, volunteers also discussed how to participate in the program. In addition to these educational tools, city staff offer in-building assistance with the program for both building managers and residents (Parker, 2012). The city also engages in ongoing consultation with low, medium, and high performing buildings to assess barriers to performance and successful components of the program (Watson and Morello, 2012).

Incentives

While Hamilton's Solid Waste Management Bylaw stipulates that fines could be issued for non-compliance with any provision of the bylaw, compliance efforts have focused on education-based initiatives (Bylaw no. 09-067, 2009; Davis 2009). In 2012, however, Hamilton amended its Solid Waste Management Bylaw to include two negative incentive strategies – the provision that MF buildings would have their waste collection services revoked for not participating in waste diversion and a reduction in the allowable garbage limit from three containers to one container per MF household (COH, 2012b; Winning et al., 2012). Strategies for enforcing these policies will be considered in 2013 (Watson and Morello, 2012; Winning et al., 2012). Reward-based strategies and block leader programs will also be considered in 2013 (Watson and Morello, 2012).

Findings

While implementation of the service design and education-based strategies had encouraging initial results, the decline in program performance suggests that a focus on these strategies was not enough to sustain or improve overall participation and diversion rates. Ongoing support of these services, however, is a critical component, especially for buildings with high turnover (Parker, 2012; Watson, 2011).

The City of Hamilton found that despite the overall decline in participation and diversion rates, there were large variations in the performance of buildings. While some buildings achieved overall diversion rates of 40-60%, other buildings barely achieved a 10% diversion rate and many buildings fell somewhere in between. In addition, despite the fact that participation in the program is mandatory, some buildings chose not to participate (Watson, 2012). This is likely due to lack of enforcement. The amendment to strengthen enforcement powers further supports this claim and suggests that enforcement is an important component of improving participation. Overall, approximately 15-20% of buildings are participating in the program as intended and achieving exceptional diversion rates (Watson, 2012).

Halifax

In Halifax, participation in the source separation of organic waste and recyclable materials is mandated under the Solid Waste Resource Collection and Disposal Bylaw no. S-600, 1999. The bylaw applies to SF and MF residences as well as some businesses (Bylaw no. S-600, 1999). MF buildings are expected to have five communal bins: one for organic waste, three for recyclables – separated into blue bag recyclables (containers), fibre recyclables (paper), and corrugated cardboard – and one for residual waste (Halifax Regional Municipality, 2011d).

The Halifax Regional Municipality (HRM) provides waste collection for SF households and some smaller MF units, such as apartment buildings with fewer than 7 units and some condominiums. Most MF buildings receive waste collection from private waste haulers (Bylaw no. S-600, 1999). Multiple private waste haulers offer collection services for all three waste streams. Organic waste is delivered to two composting facilities, Miller Composting and New Era Technologies (HRM, 2010; HRM, 2013). HRM also provides educational information and outreach to support waste diversion activities (e.g. HRM, 2011d; HRM 2012b).

Since implementation of the bylaw, Halifax's overall waste diversion rate has steadily increased. In 2000, Halifax reached a waste diversion rate over 50% and in 2012 achieved 63%, surpassing their 60% waste diversion target (English and Anguish, 2007; Labrecque, 2012). Reaching this target is especially impressive considering that prior to implementation of the bylaw Halifax's diversion rate was less than 5% (HRM, 2011b). As this diversion rate is for all sectors, it does not reveal anything specific about waste diversion in MF buildings. Unfortunately, performance measures specific to MF buildings are not available.

Interventions

Halifax's waste diversion strategy combines service design elements, educational outreach, and negative incentive-based interventions as well as a commitment strategy.

Service Design

Upon implementation of the bylaw, MF buildings eligible for municipal collection were provided with a mini-bin for organic waste disposal, an outdoor green cart, a collection calendar, fridge magnets and how-to information. Volunteers went door-to-door to deliver the materials as well as explain how to use the program and where to keep the bins. Residents of MF buildings using private collectors were not provided with these resources (Tools of Change, n.d.).

For MF buildings, the building manager is required to ensure adequate space is provided to accommodate communal bins for each waste stream and well as supply the communal bins (Bylaw no. S-600, 1999; HRM, 2012a). The building manager is also required to place signs on each bin indicating acceptable materials. If the building has a garbage chute, the building manager must also post signs near the chute indicating where the recycling and organic waste bins are located (HRM, 2012a). In addition, building managers are encouraged, but not required, to supply tenants with mini-bins (HRM, 2011d).

Education

Halifax uses a variety of educational tools to support source separation. As mentioned above, the door-to-door strategy was used to educate eligible MF buildings and SF households about the program. Building managers using private collection received program materials on how to implement source-separation in their building and were expected to educate tenants on their responsibilities (Tools of Change, n.d.). HRM also provides free educational workshops for building managers and residents on how to separate materials properly (HRM, 2011d). Educational information is also available on the HRM website (HRM, 2012a).

Other techniques to promote awareness and understanding of the program included display booths at malls, community events, and public fairs, televised interviews with HRM staff, TV commercials, a quarterly newsletter focusing on the community-based nature of Halifax's waste strategy, and school promotions that used games and contests to promote an understanding of source-separation (Tools of Change, n.d.).

In September 2004, an initiative called the "10% Challenge" was launched as a means to further boost participation in source separation with a goal of reaching the 60% diversion target (Bauld, 2004). The 10% Challenge was a challenge to all sectors to reduce the amount of garbage set out each week (Bauld, 2004; HRM, 2004b). Residents receiving municipal waste collection were asked to register to accept the challenge (Bauld, 2004). By registering, the city would measure and monitor waste reduction outcomes for the resident's street and provide feedback (HRM, 2004b). Although all sectors were encouraged to participate, no information was available on how other sectors could accept the challenge and receive similar feedback. The initiative ended with a highly publicized event that recognized residents for their participation in source separation (HRM, 2004a). The challenge was promoted through a feature in the quarterly newsletter *Naturally Green*, as well as a news release regarding the launch of the initiative (Bauld, 2004; HRM, 2004b). The challenge was successful in boosting the diversion rate from 52% in 2004 to 55% by 2007 (English & Anguish, 2007).

Incentives

Halifax uses landfill tipping fees to create an incentive for waste diversion in MF buildings. Private haulers are subject to a higher tipping fee for garbage than for diverted waste; the tipping fee for garbage is \$125 per tonne and \$75 per tonne for organic waste (Reashor, 2010). The lower tipping fee for organic waste is supposed to be passed on to building managers and residents through a lower price for organic waste collection and encourage waste diversion. Unfortunately, information on whether private waste haulers offer lower collection fees for organic waste is not publicly available.

Enforcement of the bylaw, through written notifications and fines for non-compliance, also provides an incentive to building managers to adopt organic waste collection services and encourage residents to properly participate. A building is considered non-compliant when no communal bins for organic waste collection are provided or when the bins are provided but a considerable amount of organic waste and recyclables are in the residual waste stream (English & Anguish, 2007).

The bylaw is enforced through the following approach: loads of residual waste are checked for contamination at HRM's waste management facilities; non-compliance reports are created for loads with an unacceptable levels of contamination through which the hauler and properties that generated the waste are identified; HRM staff follow up by visiting these buildings and completing an inspection; if non-compliance is confirmed, the building manager is provided with written notification of the issue and 14 days to comply; after 14 days HRM staff perform a follow-up inspection; if non-compliance persists, the building is issued a fine of \$215; repeat offenders could be subject to prosecution and a maximum fine of \$5,000 (English & Anguish, 2007). Between 2004 and 2007, 1,658 properties were inspected, 526 notices were issued to non-compliant properties, and 31 financial penalties issued with one successful prosecution for \$5,000 (English & Anguish, 2007).

Commitment

The standard lease agreement in Nova Scotia contains the provision that tenants are required to source separate their waste. In other words, by signing the lease the tenant makes a written commitment to participate in organic waste diversion. Upon having the lease signed, building managers are strongly encouraged to discuss the building's waste diversion program and provide the tenant with a copy of the "What Goes Where" Apartment Guide outlining the acceptable materials for each waste stream (HRM, 2011d).

The commitment made through the lease agreement provides building managers with a tool to hold tenants accountable for their waste diversion behaviour. If a tenant is not separating organics and recyclables, the building manager can give a written warning, fine, or ask the tenant to re-sort their waste. Given the communal nature of waste management in MF buildings, finding violators is difficult. However, building managers can regularly check communal areas to detect issues or conduct in-house waste audits. HRM staff are available to help building managers with conducting these waste audits (HRM, 2011a).

Proposed Amendment to Bylaw No. S-600

To further increase diversion outcomes, an amendment to Bylaw no. S-600 was proposed in December 2010 (HRM, 2011c). This amendment included three changes to the bylaw: a reduction in the garbage bag limit from 6 to 4 bags for residential collection, the use of clear bags for garbage collection in the residential and ICI sectors, and a requirement that building managers provide residents with mini-bins (HRM, 2011c; HRM, 2011d).

After a public hearing on the proposed changes as well as concern from council regarding current communication and education efforts, the amendment was abandoned in favour of undertaking additional communication and educational efforts (HRM, 2011c). A communications program called "What Goes Where?" was launched and included a number of educational brochures (HRM, 2011c; HRM, 2012a). The communications program also included advertising across a number of different media such as TV, radio, buses, local newspaper, and online. In addition, HRM staff have partnered with the Investment Property Owners Association of Nova Scotia to launch a MF waste diversion pilot program. The program will pilot the use of clear bags, the provision of mini-bins, as well as closing garbage chutes (HRM, 2011c).

Findings

The most important finding from this case is the stress placed on ongoing communication and education efforts. Not only did educational support accompany the implementation of the program, but was renewed by the 10% Challenge in 2004, and again with the "What Goes Where?" Campaign in 2011. In addition to large-scale campaigns, resources and workshops are continuously made available for building managers, property owners, and tenants alike.

In addition, the 10% challenge is an interesting example of how many different interventions can be combined. This initiative combines enhanced awareness through promotion of the challenge, a written commitment to participate through registration, feedback regarding performance, a reward-based incentive to participate through public recognition of the achievement, and a social norm component through the public recognition of participation. In addition, a grassroots block leader type intervention may have also occurred if the individual who registered the block takes it upon themselves to encourage participation on their street. The initiative also targets both current participants, by rewarding their efforts, and non-participants, through awareness and social norms mediated by seeing others rewarded for participation.

Another interesting finding is how responsibility is diffused across the parties. While Bylaw no. S-600 places responsibility on building managers to provide access to the waste diversion program, the lease agreement provision to source separate places responsibility on residents. In addition, the Integrated Solid Waste Resource Management Strategy places the responsibility on the entire community to participate.

San Francisco

Fantastic 3 is the waste diversion program for residents and businesses in San Francisco. Participating MF buildings receive three types of colour-coded communal bins – blue for recyclables, green for organics, and black for residual waste. Residents also receive a free mini-bin (San Francisco Department of the Environment, 2004). The Fantastic 3 program began in 2000, following three years of pilot programs that focused on improving waste diversion from SF households and small businesses (California Department of Resources Recycling and Recovery, 2002; SFDOE, 2004). Expansion of the program to include MF building with 6 or more units started in 2001 (Yepsen, 2009). The program replaced a previous recycling initiative that did not include organic waste diversion (SFDOE, 2004).

San Francisco's Department of the Environment (SFDOE) and Recology, a private waste hauler, jointly provide the program (Mecklenburg County Land Use & Environmental Services Agency, 2011). Recology provides collection services for all residents and businesses in San Francisco, while a subsidiary of Recology, Jepson Prairie Organics, processes the organic waste into compost (MCLU and ESA, 2011; Recology, n.d.b). Both SFDOE and Recology provide educational information and outreach (eg. Recology, n.d.c; Recology, n.d.d; San Francisco Department of Environment, 2010a, SFDOE, n.d.a; SFDOE, n.d.c).

Initially, participation in the program was voluntary. In 2009, however, San Francisco's Board of Supervisors passed the Mandatory Recycling and Composting Ordinance No. 100-09, making source separation mandatory for all sectors (Ordinance No. 100-09, 2009). While most SF households and some businesses had already been participating for some time, the ordinance put increased pressure on MF buildings and businesses to participate in source separation (Wildermuth, 2010). In response to the ordinance, the proportion of apartment buildings participating in the program increased sharply, from approximately 25% in 2009 to 76% in 2010 (Wildermuth, 2010; Sullivan, 2011; Yepsen, 2009). This increase means approximately 6,000 MF buildings in San Francisco have access to organic waste diversion (MCLU and ESA, 2011; Sullivan, 2011).

Implementation of the Fantastic 3 program followed enactment of California's Integrated Waste Management Act 1989, which mandated that each city and county achieve a 25% diversion rate by 1995 and a 50% diversion rate by 2000 (California Environmental Protection Agency, 2009). Jurisdictions failing to meet the required diversion rate face a fine of \$10,000 for each day of non-compliance (Ordinance No. 100-09, 2009). In 2001, San Francisco surpassed the mandated rate by achieving a 52% diversion rate.

While the state-mandated diversion target has remained at 50%, San Francisco adopted a goal of 75% waste diversion by 2010 as well as a resolution to achieve the goal of zero waste by 2020 (Resolution No. 679-02, 2002; Resolution No. 002-03, 2003). San Francisco surpassed its 75% goal by achieving a 77% diversion rate in 2010 (SFDOE, 2010b). Currently, San Francisco's diversion rate is 80%, which is the highest rate of any city in North America (SFDOE, 2012). As this diversion rate is for all sectors, it does not reveal anything specific about waste diversion in MF buildings. Unfortunately, performance measures specific to MF buildings are not available.

Interventions

San Francisco's waste diversion strategy combines service design elements, educational outreach, and incentive-based interventions.

Service Design

Upon implementation of the program, SF households and small businesses received colour-coded outdoor bins, mini-bins, as well as information about the program. Whether the door-to-door strategy was used to deliver these supplies is not clear based on the available information. Residents also received a follow-up call to confirm receipt of the supplies and that they understood the program (CDRRR, 2002).

MF buildings interested in organic waste diversion need to register for the service. Upon registration, Recology provides the building with colour-coded communal bins as well as a mini-bin for each suite. Volunteers go door-to-door to distribute the mini-bins and information about the program, as well as answer any questions (Recology, n.d.c).

Upon implementation of the Recycling and Composting Ordinance, building managers are required to provide adequate collection services, supply communal bins that are appropriate in size, colour, and bearing appropriate signage regarding acceptable materials, as well as ensure communal bins are placed as close together as possible to provide equal convenience (Ordinance No. 100-09, 2009). For buildings with garbage chutes, this can mean placing communal recycling and organic bins on each floor (Yepsen, 2009). As a means of holding building managers accountable to these provisions, MF residents can anonymously report any violations to SFDOE. SFDOE will contact the building manager and provide free assistance in managing the program (SFDOE, n.d.c). In addition, building managers are required to provide information and training to new tenants as well as re-educate existing tenants at least once a year (Ordinance No. 100-09, 2009).

Education

A variety of educational tools are used to improve participation in organic waste diversion. Education strategies aimed at residents include door-to-door visits, as mentioned above, where residents are provided with a complimentary mini-bin as well as information on how to participate. Residents are advised of the visits through a notification letter. This letter also serves an educational purpose by outlining reasons why the resident should participate.

One reason mentioned is the benefit of returning nutrients to local farmers who use the compost to grow the food we eat. Therefore, participation in organic waste diversion creates a sustainable closed loop composting system that is good for farmers as well as good for the local economy (Recology, n.d.c; Recology, n.d.d). A focus on the end use of compost by local farmers is a prominent message in much of the educational material as well as news articles (eg. Recology, n.d.b; Recology, n.d.c; Sullivan, 2011; Wildermuth, 2010).

A variety of educational resources are also available to building managers. SFDOE and Recology's websites have printable signs and posters, sample letters to tenants about the program, and a step-by-step implementation brochure (Recology, n.d.d; SFDOE, n.d.a). SFDOE additionally offers free assistance to MF buildings through customized outreach materials, including signs and stickers, as well as multi-lingual training sessions for building staff and tenants (SFDOE, n.d.a). In addition, SFDOE and Recology offer on-site waste assessments. City or Recology staff, along with the building manager, do a walkthrough of the building to inspect existing containers, assess space for the organic bins, and look for opportunities to improve diversion (Recology, n.d.d; Yepsen, 2009).

Incentives

The primary means by which San Francisco creates an incentive for improving waste diversion in MF buildings is through its Recycling Incentive Program. The program establishes a pricing incentive – similar to pay-as-you-throw pricing where residual waste collection is more expensive than organic waste collection. Under the incentive program, waste collection fees are based on two rates: a base rate that covers the fixed costs of collection and a variable rate based on the volume of waste collected from all three waste streams. A discount is applied to the variable rate based on the diversion rate of the building, up to a 75% diversion rate. Upon collection, the volume of waste in each stream is estimated based on the capacity of the bins (Recology, n.d.a). For example, if a MF building has three bins of equal size – one for organic waste, one for recyclables, and one for residual waste – then the proportion of waste diverted is 67% and a discount of 67% applies to the variable rate portion of the service charge. The rate structure provides building managers with an incentive to adopt and encourage the diversion of organic waste and recyclables so as to benefit from reduced waste collection charges.

Enforcement of the Mandatory Recycling and Composting Ordinance, through written notifications and fines up to \$1000 for non-compliance, also provides an incentive to building managers to adopt organic waste collection services. A building is considered non-compliant for failing to provide properly labelled communal bins or for failing to provide education to tenants on how to use the program. MF buildings are not considered non-complaint based on contamination in the bins (Platt, 2012; SFDOE, n.d.d). Non-compliant buildings will receive a number of notifications prior to receiving a fine (Cote, 2009). In addition, fines are levied only in the most serious cases of non-compliance (Cote, 2009; SFDOE, 2010a). SFDOE puts an emphasis on education and assistance over penalties (SFDOE, 2010a). To allow building managers and tenants time to comply, the fines for MF buildings did not take effect until two years after the mandate waste adopted (Cote, 2009).

While fines are not levied for contamination, Recology monitors contamination levels. If high levels of contamination occur, Recology will issue a written notification identifying the contamination issue and requesting the issue is resolved within a reasonable amount of time. If contamination continues to occur, Recology can suspend the building from participating in the diversion incentive program (Recology, n.d.a).

To thank and reward residents and businesses for their participation in diverting organic waste, Recology holds an annual public event each June called "The Great Compost Giveaway" where residents are given between 5 and 10 gallons of compost free. Compost is also donated to local parks. Media coverage of the event reminds non-participating residents of the program with the aim of encouraging their participation (Recology, 2007).

Findings

The most important finding from this case is the stress placed on communication and education efforts. As with Hamilton, door-to-door visits to distribute mini-bins and information are considered an effective strategy for engaging residents and improving waste diversion (SFDOE, n.d.b). In addition, education efforts are continuous and focus on why participation is important as well as how to participate (MCLU and ESA, 2011; Recology, n.d.c).

San Francisco's communication material is very clear and concise (eg. Recology, n.d.c; Recology, n.d.e; SFDOE, 2010a). It's not just the language that is clear but SFDOE's intentions that are clear. For example, a flier regarding the Mandatory Ordinance states, "We strive mainly to educate and assist. Fines may be given only in cases of blatant on-going non-compliance" (SFDOE, 2010a). The city is transparent in its intent primarily to educate and assist without levying a penalty.

Continuous reminders to participate are also seamlessly woven into the balance of interventions in two main ways. The first way is through mandating that building managers provide re-education to tenants at least once a year (Ordinance No. 100-09, 2009). The second way is through promotion and coverage of the annual "Great Compost Giveaway" (Recology, 2007). In addition, San Francisco publicizes its diversion rate in press releases each year, which also serves as a reminder to residents to participate (eg. SFDOE, 2010b; SFDOE, 2012). Educational materials are also continuously available through the SFDOE and Recology websites (eg. Recology, n.d.d; SFDOE, n.d.a).

Another important finding is that SFDOE and Recology both found gaining the support of building managers imperative to establishing successful waste diversion practices in MF buildings (MCLU and ESA, 2011; Yepsen, 2009). SFDOE actively engaged property management companies and individual buildings to join the program (Yepsen, 2009). One effective strategy employed by city staff for gaining building manager support was to appeal to the cost-savings from increasing waste diversion through reduced waste collection fees (MCLU and ESA, 2011; Yepsen, 2009). Awareness of the then-upcoming mandate, along with pressure from tenants, provided a further incentive to building managers to implement the program (Yepsen, 2009).

Appendix C

Summary of Case Study Findings

Category	Criteria	Measure	Hamilton	Halifax	San Francisco
Policy Context	General Regulations	Is there a landfill ban on organic waste?		✓	
		Is there a waste diversion target?	✓	✓	✓
		Is participation in waste diversion mandatory?	✓	✓	✓
Service Design	General Design Conditions	Is waste source-separated into three streams (organics, co-mingled recyclables, residual waste)?			✓
		Is waste source-separated into four streams (organics, two streams of recyclables, residual waste)?	✓		
		Is waste source-separated into five streams (organics, three streams of recyclables, residual waste)?		✓	
		Are MF waste streams collected by one or more private haulers?		✓	✓
		Are MF waste streams collected by a combination public and private haulers?	✓		
		Are all food scraps accepted?	✓	✓	✓
		Are compostable kitchen-bin liners accepted?	✓		✓

Category	Criteria	Measure	Hamilton	Halifax	San Francisco
	Facilitating Access	Are managers required to provide access and adequate service to communal bins?		✓	✓
		Are managers required to locate communal bins in close proximity to each other?			✓
		Are managers required to put adequate signage on the communal bins?		✓	✓
	Implementation Considerations	Upon implementation, is a starter kit delivered by volunteers going door-to-door?	✓		✓
		Upon implementation, is a starter kit delivered by a block leader going?			
		Upon implementation, is a starter kit delivered by the building manager?			
Education	MF Specific "How to Participate" Information and Skills	Is there how-to information, in print or online, specifically for MF residents?	✓	✓	✓
		Is there information, in print/online/other media, specifically for MF managers (including how-to guides, educational posters, signs for the communal bins, template letter to tenants regarding the program)?	✓	✓	✓
		Is there ongoing free training for MF residents and managers?		✓	✓
		Are managers required to educate new tenants?			✓
		Are managers required to periodically re-educate existing tenants?			✓
	MF Specific Feedback Information	Are MF residents provided feedback information (in the form of notifications) regarding waste diversion performance or compliance issues?			
		Are building managers provided with notifications regarding issues of non-compliance?	✓	✓	✓

Category	Criteria	Measure	Hamilton	Halifax	San Francisco
	MF Specific “Why Participate” Information	Is information available, in print/online/other media, regarding why residents should participate?		✓	✓
		Is information available, in print/online/other resources, regarding why building managers should provide access to the program?		✓	✓
	General Public	Is there periodic distribution of a waste diversion related newsletter?		✓	✓
Social Norms	Within MF Buildings	Are residents required to place residual waste in clear bags?			
		Is there a block leader?			
	General Public	Has one or more public event been held to thank or recognize residents for their waste diversion efforts?		✓	✓
		Are diversion rates publicized in annual press releases?			✓
Attitudes	Negative Incentives	Is there a waste collection pricing incentive for MF buildings to divert waste?			✓
		Is there a waste collection pricing incentive for haulers to divert waste?		✓	
		Are MF buildings charged a financial penalty for failing to properly divert waste?	✓	✓	✓
		Are any non-financial penalties (eg. revoking service) applied to MF buildings for failing to properly divert waste?	✓		
	Positive Incentives	Are MF buildings or residents eligible to receive a financial reward for participating in waste diversion activities?			

Category	Criteria	Measure	Hamilton	Halifax	San Francisco
		Are MF buildings or residents eligible to receive a non-financial reward (eg. free compost) for participating in waste diversion activities?			✓
	Responsibility Strategies	Does a local bylaw require residents to participate in source separation?	✓	✓	✓
		Are residents asked to provide a written commitment to divert waste?		✓	
		Are residents asked to provide a verbal commitment to divert waste?			
		Does a local bylaw require building managers to provide access to waste diversion services?		✓	✓
		Is there an anonymous reporting mechanism available for residents to report building managers who fail to provide adequate waste diversion service access?			✓

Appendix D

Policy Development Methodology

In this section I describe my methodology for developing my policy options. My policy options are based on the findings from my comparative analysis as well as my review of the literature on interventions strategies.

From the Case Studies

In developing my options, I evaluate my case study findings using two criteria. Using my case study summary matrix, I first identified the interventions that directly apply to MF buildings and that have been implemented by at least one jurisdiction. For example, I eliminated San Francisco's "Great Compost Giveaway" because the positive incentive does not have a direct application to MF buildings. In addition, I eliminated the clear bag policy because no jurisdiction used the mechanism.

Next I identified all the interventions that were deemed effective and eliminated the remaining interventions from consideration. I assessed the effectiveness of the interventions based on a key word search of my data for terms such as "success" and "effective" as attributed to the interventions. In doing so it became apparent that in places I have mapped discrete components of a unified intervention in my summary matrix. For example, San Francisco's Mandatory Ordinance is comprised of several requirements: requiring residents to participate in source separation, requiring building managers to provide access, requiring building managers to re-educate tenants, and requiring building managers to put communal bins in close proximity to each other.

In order to make my decision regarding what was deemed effective and what was not, I used the following rule: If the unified intervention is deemed effective, then each component of that intervention is considered effective and is not eliminated. For example, San Francisco's mandatory ordinance is considered effective, therefore each part of the Ordinance is considered effective. Similarly, the door-to-door strategy is considered effective, therefore each part – the face to face communication, the mini-bin, and the how-to information – is considered effective. It's possible that only some components of the intervention are significantly effective while others have no impact or even detract from the overall effectiveness. However, given the imperfect nature of the available information, I am making the simplifying assumption that each component is effective.

As a result of my evaluation of the selected cases, I have identified three options from my case studies on which I will base my policy options: mandating building managers provide access to organic waste collection services, pricing incentives, and the door-to-door outreach strategy.

From the Literature

In addition, I consider the findings from my review of the interventions literature.

I first eliminate strategies I am already considering based on my case study findings and transform the remaining interventions into versions applicable to a MF setting. The remaining interventions include persuasive messaging, feedback strategies, reward strategies, the block leader approach, and commitment strategies.

Next I consider the theoretical and empirical findings regarding the effectiveness of these interventions. There is strong evidence to suggest commitment strategies are effective; there is also strong evidence to suggest persuasive information is a necessary component. There is not strong evidence to support the

effectiveness of reward approaches. In addition, reward-based approaches require monitoring of performance which is costly at the building level and especially costly at the individual suite level. Feedback approaches, whether delivered to the building as a whole or individual suites, like rewards-based approaches, also lack sufficient evidence relating to their effectiveness as well as require costly monitoring.

While empirical evidence suggests the block leader strategy is effective, this strategy is partially confounded with the volunteers' role in the door-to-door strategy as well as the building manager's role of educating new tenants under the mandatory access regulation. Unless the block leader is the building manager, the position would be costly to maintain and difficult to enforce. Therefore, I will not directly consider the block leader intervention in my policy options. In the event a resident volunteers to provide the extra support, it would certainly complement the door-to-door strategy as well as alleviate some of the responsibilities placed on the building manager.

As a result of my evaluation of the interventions literature, my policy options will also incorporate persuasive messaging and a commitment strategy.

Appendix E

Explicit Incentive Offsetting Methodology

To illustrate how the variable rate is constructed to offset the discount, I will make two simplifying assumptions: the only variable costs incurred by private haulers are tipping fees, and the volume of each bin is one tonne. I will also use the current Metro Vancouver tipping fees of \$107 per tonne for residual waste, \$71 per tonne for organic waste, and \$0 for recyclables.

To illustrate how the variable rate offsets the discount, let's take a MF building that has two residual waste bins and two organic waste bins. The total tipping fee faced by the private haulers is \$365 ($\$107 + \$107 + \$71 + \71). To get the appropriate variable rate, sum the organic waste tipping fees ($\$71 + \$71 = \$142$) and divide by the number of residual waste bins ($\$142 / 2 = \71). Add the product of the last equation to the residual waste tipping fee ($\$107 + \$71 = \$178$). The variable rate for each bin that offsets the discount is \$178. Sum the total variable rate ($\$178 * 4 = \712) and apply the discount of 50% ($\$712 - (\$712 * .5) = \$365$). The total variable rate charged to the building of \$365 is the same as the total tipping fee charged to the private hauler. Table 11 illustrates the discrete offsetting methodology.

Table 11. Example of Discrete Offsetting

Bin Types and Tipping Fee per Bin				Total Tipping Fee	Diversion Rate	Variable Rate per Bin	Total Variable Rate	Discounted Rate
Black \$107	Black \$107	Black \$107	Black \$107	\$428	0%	\$107	\$428	\$428
Black \$107	Black \$107	Black \$107	Green \$71	\$392	25%	\$131	\$523	\$392
Black \$107	Black \$107	Green \$71	Green \$71	\$356	50%	\$178	\$712	\$356
Black \$107	Green \$71	Green \$71	Blue \$0	\$249	75%	\$249	\$996	\$249
Total:				\$1,425	x	x	x	\$1,425

In practice, however, the variable rate per bin would not be calculated based on a single client's combination of bins. The variable rate would be determined based on an estimation of the total combination of bins serviced. For example, if the private hauler estimates that they service 16 bins – 10 bins for residual waste, 5 bins for organic waste, and one bin for recyclables – then the hauler totals the tipping fees for the total number of bins ($\$428 + \$392 + \$356 + \$249 = \$1,425$) and divides by the number of residual waste bins ($\$1,425 / 10 = \142.50). Using a system-wide average for the variable rate removes the

price discrimination present in the previous methodology so that the private hauler charges the same variable rate per bin to each client. Table 12 illustrates the system-wide offsetting methodology.

Table 12. Example of System-Wide Offsetting

Bin Types and Tipping Fee per Bin				Total Tipping Fee	Diversion Rate	Variable Rate per Bin	Total Variable Rate	Discounted Rate
Black \$107	Black \$107	Black \$107	Black \$107	\$428	0%	\$142.50	\$570	\$570
Black \$107	Black \$107	Black \$107	Green \$71	\$392	25%	\$142.50	\$570	\$427.50
Black \$107	Black \$107	Green \$71	Green \$71	\$356	50%	\$142.50	\$570	\$285
Black \$107	Green \$71	Green \$71	Blue \$0	\$249	75%	\$142.50	\$570	\$142.50
Total:				\$1,425	x	x	x	\$1,425

Appendix F

Summary of Criteria and Measures

Criteria	Measure	Values
Overall Effectiveness	Number of barriers removed by intervention	0 - 10 Barriers
Discrete Effectiveness*	Estimated change in participation rate	0 - 100%
Discrete Effectiveness**	Net level of relative convenience in participating Based on four key actions required to participate	Action is convenient = 1 Action is neutral = 0 Action is not convenient = -1
Implementation Cost	Estimated change in government operating and capital costs	Total change in costs represented in \$
Implementation Feasibility	Number of external entities involved in implementation and enforcement	0 - 6 External Entities
Stakeholder Acceptance	Net Level of Support among four identified stakeholder groups	Support = 1 Neutral = 0 Oppose = -1
<p>*Note: This measure applies only to the explicit incentive and mandatory access options.</p> <p>**Note: This measure applies only to the starter kit and commitment strategy options.</p>		

Appendix G

Summary of Analysis

Policy Options	Criteria				
	Overall Effectiveness	Discrete Effectiveness	Implementation Cost	Implementation Feasibility	Stakeholder Acceptance
	0 to 10 barriers	% change; -4 to 4	\$	0 to 6	-4 to 4
Status Quo	0	0%; -4	\$0	0	-1
Explicit Incentive	3	5% to 13%	\$570,000	3	1.5
Mandatory Access	2	10%	\$570,000	3	1.5
Starker Kit	6	-2 to 1	\$1,108,498	3	4
Commitment Strategy	7	2	\$839,498	3	3.5