

# Multi-Tenant Recycling Literature Review

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# Table of contents

Executive summary .....	1
1. Introduction.....	3
2. Methods .....	3
2.1 Scope of the review .....	3
2.2 How to assess multi-tenant recycling program performance .....	2
3. Findings .....	2
3.1 Behavior .....	2
3.1.1 Demographics: addressing specific groups .....	3
3.1.1.1 The commercial sector.....	3
3.1.2 Recycling motivators.....	4
3.1.2.1 Convenience .....	4
3.1.2.2 Incentives.....	5
3.1.2.3 Goals.....	5
3.1.2.4 Feedback.....	6
3.1.3 Recycling education and outreach.....	6
3.1.3.1 Print media.....	7
3.1.3.2 Other media .....	8
3.1.3.3 Face-to-face .....	1
3.1.3.4 Appealing to pro-environmental attitudes .....	13
3.2 Collection system .....	13
3.2.1 Materials collected.....	14
3.2.2 Receptacles .....	15
3.2.2.1 In-unit collection and transport.....	15
3.2.2.2 Shared receptacles for communal collection .....	16
3.2.2.3 Standard receptacles colors .....	17
3.2.3 Material collection areas.....	17
3.2.3.1 Space for in-unit collection.....	17
3.2.3.2 Communal outdoor collection areas .....	18
3.2.3.3 Indoor rooms and chutes.....	18
3.2.3.4 Safety and security in collection areas.....	18
3.2.3.5 Design standards.....	19
3.2.4 Collection area signage.....	19
3.2.5 Collection methods .....	20
3.2.5.1 Collection stream sorting.....	20
3.2.5.2 Volume and frequency of collection .....	22
3.2.5.3 Route logistics .....	22
3.2.5.4 Tracking, reporting and enforcement .....	22
3.3 Policy.....	23
3.3.1 Municipal and private collection .....	24
3.3.2 State policies and city ordinances.....	25
3.3.2.1 Mandatory participation .....	25
3.3.2.2 Incentives and goals.....	26
3.3.2.3 Materials collected.....	27
3.3.2.4 Material collection-area space ordinances.....	27
3.3.2.5 Tracking, reporting and enforcement .....	27
3.3.2.6 Waste disposal fee structures.....	28
3.3.2.7 Flat fees .....	29
3.3.2.8 Variable-rate structures.....	29
3.3.2.9 Weight-based programs.....	29

3.3.2.10	Volume-based programs.....	30
3.3.2.11	Hybrid program .....	30
3.3.2.12	Materials tipping fees .....	31
3.3.2.13	Extended producer responsibility laws.....	31
4.	Discussion.....	31
4.1	Limitations.....	31
4.2	Recycling opportunities.....	31
	References .....	34
	Appendix A .....	39
	Appendix B.....	39
	Appendix C.....	39
	Appendix D .....	40

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# Executive summary

In response to changes in Oregon’s recycling laws, the opportunity to recycle is being extended to all residential and commercial tenants of multi-tenant properties. The change will require cities and counties to ensure properties with tenants that share garbage collection service also receive recycling collection by July 2022. This requirement is for cities with 4,000 or more residents, cities within the Metro Service District and counties which manage programs within those cities’ urban growth boundaries. In order to support implementation, Oregon Department of Environmental Quality researchers Oregon Department of Environmental Quality conducted this literature review to discuss research, experiences and tools that might aid in the implementation of the new requirements.

The overarching shared recycling goals of communities across the country are to shift solid waste trends towards minimization and to use landfills only as a last resort. This goal can be achieved when programs find the right combination of tools that provide residents and businesses with access to recycling, the understanding of how to participate, the realization of its environmental and monetary value, and the importance of tracking and reporting progress. It is clear that communities which have reduced the flow of materials to landfills and significantly increased their rate of recycling, have invested time and resources in the three main elements of successful recycling programs:

- Behavior — strategies or infrastructure intended to affect tenant behavior
- Collection system — systems or infrastructure that supports the collection of materials
- Policy — laws, ordinances, codes, management directives or similar that support recycling

While the weight of these three main elements are not equally divided, successful programs have invested in developing all of them to ensure that residents and businesses have access to recycling, understand how to participate, realize its value, contribute financially, and communities can track and report on their progress.

From the studies and experiences discussed in this literature review, it is clear that high-recovery communities have employed many of the below-mentioned strategies, and invested time and resources into the three main elements of successful recycling programs. Recycling programs that address barriers to good recycling behavior, improve recycling collection systems and use supportive recycling policies, have been shown to have greater success than programs with less holistic approaches. The programs that have invested in these three main elements, and used a variety of the 19 beneficial strategies summarized here, are more likely to have recovery rates greater than 20 percent — see Table 1. The strategies are organized by the main element they are aligned with as well as other elements they might relate to.

**Table 1:** A summary of the 19 beneficial multi-tenant recycling strategies and which elements they impact

Beneficial strategy		Behavior	Collection	Policy
<b>Recycling behavior</b>				
1	Use outreach messages tailored to specific groups of people.	X		
2	Conduct effective commercial recycling program outreach and education.	X		
3	Increase convenience of recycling.	X	X	
4	Provide feedback.	X	X	
5	Use several types of media for recycling education and outreach and repeat quarterly.	X		
6	Conduct face-to-face outreach.	X		
7	Use inclusive messaging.	X		
<b>Recycling collection system</b>				
8	Increase number of materials collected.		X	X

## Multi-Tenant Recycling Literature Review

<b>Beneficial strategy</b>		<b>Behavior</b>	<b>Collection</b>	<b>Policy</b>
9	All shared receptacles should be color coordinated, clearly labeled and have sufficient capacity for the building.		X	X
10	Adopt ordinances or new building guidelines to set aside adequate space for shared material collection areas. Provide sufficient in-unit space for collection.		X	X
11	Adopt city code that requires signage includes instructional images as well as multiple languages.		X	X
12	Require diligent recordkeeping and separate tracking of multi-tenant recycling tonnage collected.		X	X
<b>Recycling policy</b>				
13	Use contracts (with private firms paid by the local government) to collect residential solid waste.			X
14	Require mandatory provision of multi-tenant recycling programs. Include mandatory multi-tenant recycling in collection service provider contracts and franchise agreements.		X	X
15	Mandate commercial wasted food recovery programs.			X
16	Require diligent tracking of program performance. Track multifamily tonnage separately.		X	X
17	Enforce activities at the building level and at the collection service provider level.		X	X
18	Use a variable-rate hybrid fee structure.		X	X
19	Increase garbage tipping fees.			X

These strategies might have equal applicability for residential and commercial multi-tenant properties, however since the bulk of the literature was about multifamily recycling, it should not be assumed that the findings apply to multi-commercial properties. Additionally, much of the foundation research was conducted between 10 and 20 years ago. There might be limited applicability to all sectors.



# 1. Introduction

This report is prepared for the benefit of stakeholders in order to determine solutions that could be helpful to cities and counties that need to implement multi-tenant recycling by 2022. Stakeholders could include but not limited to garbage and recycling collection companies and associations, developers and builders, local and regional governments, materials management programs, multi-tenant property owners, property managers, planners, recycling processors, tenant and tenant associations, and others.

The Recycling Opportunity Act was passed in 1983, with the intent that everybody in Oregon should be provided with an opportunity to recycle. In cities of 4,000 or more populations and within the Metro area, that opportunity meant regular on-route collection of recyclable materials from all collection service customers, or an equivalently-effective program. However, as the law was interpreted and implemented, many residential and commercial tenants ended up being denied an opportunity to recycle because it was the landlord, rather than the tenants, who were considered to be the collection service customers. If the landlord decided not to use a recycling service, then the tenant did not have an opportunity to recycle. In 2015, the legislature corrected this with the passage of Senate Bill 265. One provision of this law is that by July 1, 2022, tenants will also be considered to be collection service customers, and so must directly be provided with the opportunity to recycle by their landlords and collection service providers.

By July 1, 2022, local governments will need to ensure that the opportunity to recycle is extended to residential and commercial tenants of multi-tenant properties. Local jurisdictions affected include cities with 4,000 or more residents, cities within the Metro Service District and counties which manage programs within those cities' urban growth boundaries.

In order to help guide implementation of the updated recycling law, the Oregon Department of Environmental Quality conducted a literature review to summarize theory and experience from communities around the world. This literature review aims to provide valuable insight into the common practices, useful policies and programs, and convenient collection system designs of multi-tenant recycling programs. The scope of the review spans peer-reviewed journal articles, policy documents and templates, news articles and city reports. Whenever available, it highlights scientific, peer-reviewed studies that demonstrate statistically significant increases in the recycling rate of communities over time. The reviewed research materials have been organized into three main sections:

- Recycling behavior
- Recycling collection system
- Recycling policy

## 2. Methods

Literature about multi-tenant recycling was examined from a variety of sources including online and print sources. Attempts were made to find information relevant to both residential and commercial recycling programs for tenants.


### 2.1 Scope of the review

The summary and discussion of the articles reviewed here provide some quantitative assessment of results and give preference to studies that include a baseline or a control group. News articles and anecdotal reports are also discussed. Throughout the report, an effort is made to call attention to the source of information being shared. The text will state whether significant results from a peer reviewed journal or beneficial strategies from a more general city report are being presented. As with most complex, social sciences many of the studies related to improving participation in recycling programs have not been able to measure significant changes in recycling rates. However, this does not necessarily mean that the information is not useful. The challenge of improving recycling

rates nationwide requires looking at the issue from many different angles and calls for new creative approaches to old problems.

## 2.2 How to assess multi-tenant recycling program performance

To qualify differences in performance this report will distinguish between three program categories, which will be referred to as low, medium and high-recovery programs. These categories were established in the 2001 EPA multifamily recycling program report and correspond to material recovery rates from the solid waste stream of less than 10 percent, 10 to 20 percent and more than 20 percent, respectively (B. J. Stevens 1999; U.S. EPA 2001; Michigan DEQ 2016). These categories address the effectiveness of a program, which refers to how well a program meets policy objectives, such as recovery rates. Further assessment of performance might include discussions around program efficiency. Efficiency refers to the productivity of collection crews — higher productivity means there is a lower cost per ton collected. Ideally, programs will be both effective and efficient — measuring high recovery rates and low unit costs (Stevens, 1999). In addition to effectiveness and efficiency, the quality of a recycled material stream may also be used as a metric of program performance (Schultz, Oskamp, & Mainieri, 1995). Reducing contamination by ensuring only the right materials are being recycled improves the quality of materials and their value after processing.

 Green star icons (shown left) will be used throughout the literature review to highlight practices that have been shown to have a positive impact (statistically significant) on recycling rates.

In section 4 Discussion, specific beneficial strategies will be summarized.

# 3. Findings

## 3.1 Behavior

Recycling can be described as a classic collective-action problem. To achieve the widespread benefits of recycling, a significant portion of the population must participate. Assuming that recycling does produce environmental benefits — such as producing feedstock for manufacturing, reduced emissions from landfills, fewer emissions from incineration, less extraction of virgin natural resources and reduced landfill use — these benefits are usually perceived as being for the common good and not seen as producing any substantial, immediate benefit to the individual (Carlson, 2001). Recycling aims to protect “commons” resources, and, as the theory of the tragedy of the commons explains, since no one owns these resources, no one has a personal incentive to conserve them. As a result, they face abuse (Carlson, 2001; Hardin, 1968). Improving the recycling behavior of citizens requires overcoming the rational self-interest of a huge number of people, and then continuing to motivate and monitor their actions. It is therefore a particularly daunting challenge and requires careful thought and consideration. This section presents information about various possible channels of influence on recycling behavior. First, the importance of identifying a focus audience and understanding the demographics of a community are introduced. Second, strategies related to education and outreach are discussed, including distributing print media, direct face-to-face contact and appeals to pro-environmental behavior. Third, the impact of alternative methods of influencing behavioral shifts, such as changes in convenience or motivation, are considered.

### 3.1.2 Demographics: addressing specific groups

★ It is important to identify the focus audience of an outreach campaign early on, since messages that are tailored to a specific group, rather than a general outreach strategy, have been shown to be significantly more effective (Timlett & Williams, 2008; Nixon & Saphores, 2009; Schultz, Oskamp, & Mainieri, 1995). In the case of multi-tenant recycling programs, because they encompass many diverse building types and people, there are likely several different focus audiences (Schultz, Oskamp, & Mainieri, 1995). In many city reports compiling interviews with building managers and property managers in multifamily communities, it has been recommended that outreach messages be tailored to at least two different groups; property managers and residents (Campbell Delong Resources, Inc., 2014; Michigan DEQ, 2016; City of Calgary, 2012; Cascadia Consulting, 2014). For properties with multiple commercial tenants or multi-commercial buildings, outreach should be directed to the property manager and to the business managers.

Identify the focus audience of an outreach campaign early on, since messages that are tailored to a specific group are more effective.

Outreach efforts to residents should reflect the fact that different populations have different structural or psychological barriers to recycling (Dietz, 2002; Cascadia Consulting, 2014). There are also cultural and socioeconomic factors that influence recycling behavior. Language barriers may prevent would-be recyclers from understanding outreach materials and fully participating in the recycling program (Dietz, 2002; Cascadia Consulting, 2014; Eureka! Recycling, 2004; Washington Multifamily Recycling Study Group, 2014). Non-native English speakers, elderly or disabled populations, may require different signage or access considerations than other populations. Contamination may also become an issue if signage is only in English (Fish, 2015; Metro , 2017; Campbell Delong Resources, Inc., 2014) Enlisting the assistance of groups that already work within specific focus communities can lead to a better understanding of their specific barriers to recycling (Washington Multifamily Recycling Study Group, 2014). A collaboration such as this can produce educational materials that address real versus perceived needs of a specific group (Dietz, 2002; Eureka! Recycling, 2004; Georgia Recycling Coalition, 2010). More detailed information on effective content for outreach material is included in section 3.1.3 Recycling education and outreach, and additional educational resources are included in Appendix C.

#### 3.1.2.1 The commercial sector

Outreach and education to the commercial sector is a particular challenge. There is very little research and information that is specific to multi-commercial properties. The issues facing recycling at multi-commercial properties could be as complex as, and produces more waste than multifamily properties (Oregon DEQ, 2016; Stopwaste.org, 2008). Different types of businesses might require different levels of service and information specific to the discarded materials streams they produce in high volumes. For example, resource needs are different for restaurants, which produce large quantities of compostable waste, than of copy or print shops that produce significant amounts of recyclable paper. Additional resources should be allocated to uncovering the challenges that are unique to multi-commercial recycling. General recommendations are sometimes found in city solid waste management plans (Environmental Services Department, 2008; City of San Jose, 2011).

★ In 2008, the City of San Jose, California put together a commercial recycling program redesign team. The city undertook an extensive stakeholder outreach process to better understand the needs of the business community and the challenges that both businesses and contractors faced when trying to increase recycling (San Jose 2008). Two main recommendations made were to:

1. Provide recycling education and offer more robust technical assistance to focus businesses to maximize solid waste recovery efforts.
2. Evaluate requiring covered garbage and recycling at all facility enclosures to minimize blowing debris (Environmental Services Department, 2008).

## Multi-Tenant Recycling Literature Review

San Jose anticipated that if the commercial sector could realize its full recycling potential, the City's overall recovery rate could increase to 75 percent (Environmental Services Department, 2008). Commercial sources account for nearly half (44 percent) of the solid waste disposed from the Portland Metro region (Metro, 2008). If outreach efforts to the commercial sector, similar to those made in San Jose, could be coordinated to improve the recycling behavior of this sector across local jurisdictions in Oregon, substantial increases in the state's recycling rate could be achieved (Oregon DEQ, 2017; Stevens B. , 1994).

### 3.1.3 Recycling motivators

Recycling program outreach efforts often make appeals to the public's logical or emotional conscience, but there are also other channels by which to influence recycling behavior. The following subsections address changes in physical or perceived surroundings and the use of incentives and feedback as motivational tools for improving recycling behavior.

#### 3.1.3.1 Convenience

★ Convenience can be defined as parameters pertaining to recycling logistics, such as access to receptacles, adequate space for storage of recyclables, and the overall ease of using a recycling system (DiGiacomo, et al., 2017). In addition to access to information, convenience is commonly cited as a significant predictor of recycling behavior (Nixon & Saphores, 2009; Barr, 2004; Oom do Valle, Reis, Menezes, & Rebelo, 2004; Davis, Phillips, Read, & Iida, 2006). There is much compelling evidence that the more convenient recycling is, the more likely people are to participate (Oom do Valle, Reis, Menezes, & Rebelo, 2004; Nixon & Saphores, 2009; Derksen & Gartrell, 1993).

Even people with very low concern for the environment will recycle if it is convenient enough. The more convenient recycling is, the more likely people are to participate.

With this in mind, it is important to highlight that multi-tenant recycling programs are almost always less convenient than individual recycling programs, and it follows that multifamily recycling programs also have lower recycling rates than single-family recycling programs (U.S. EPA, 2001). This correlation between convenient access and recycling rates is no coincidence (Nixon & Saphores, 2009; DiGiacomo, et al., 2017; Fallde, 2015; Ando & Gosselin, 2005; Derksen & Gartrell, 1993; Margai, 1997). The results of a survey on recycling behavior found that 28 percent of respondents believed increased convenience would enable them to recycle more (Wagner & Bouvier, 2011). In another survey conducted with 2,093 residential customers of a national recycling company in Portugal, the top finding was that respondents from households that did not participate in recycling systematically reported a lower satisfaction level with all the items related to the collection system, or the overall lack of ease and convenience of use. The company concluded that special attention must be paid to the disposal receptacle location and the availability of support services (Oom do Valle, Reis, Menezes, & Rebelo, 2004).

The implications of the surveys described above have also been corroborated by studies that measured increased recycling rates as a result of more convenient access to recycling receptacles (Bernstad, 2014; Reschovsky & Stone, 1994; DiGiacomo, et al., 2017; Oom do Valle, Reis, Menezes, & Rebelo, 2004; Smith, 2014). In a recent study conducted in large, multifamily complexes and university residences, it was found that when compost receptacles were placed on each floor in a multifamily residence, instead of on the ground floor, composting rates increased by 70 percent (DiGiacomo, et al., 2017). When recycling receptacles were placed close to the front doors of student residence suites, instead of in the basement, recycling increased by 147 percent (containers), and 137 percent (paper), and composting increased by 139 percent. However, the other less-convenient treatments did not produce a significant increase in recycling and composting (DiGiacomo, et al., 2017). A Swedish study of 1,632 rental units also found that composting rates increased by 30 percent after residents were provided with disposable wasted food sorting equipment for under their kitchen sinks (Bernstad, 2014). Ideally, multifamily recycling programs will be made so convenient that recycling becomes the default option (Smith, 2014).

## Multi-Tenant Recycling Literature Review

Results from the research reviewed above suggest that a simple infrastructure change that crosses a certain “convenience threshold” can have a significant effect on pro-environmental behavior (DiGiacomo, et al., 2017). In one study where research results did not reflect the superior influence of convenience over altruistic variables, all of the participants had access to curbside recycling (Ewing, 2001). This suggests that convenience might have played a greater role if the study had included recycling programs with more variety of access (Ewing, 2001). There is general agreement in the literature that increasing the convenience of recycling improves recycling behaviors more per dollar spent than campaigns aimed at recycling education and outreach (Oom do Valle, Reis, Menezes, & Rebelo, 2004; Hage, Söderholm, & Berglund, 2009; De Young, et al., 1995; U.S. EPA, 2001). The research suggests that it is most important to invest in infrastructure to improve the convenience of recycling for tenants and collection service providers. However, some communities have greater infrastructure needs than others (such as cities with inclement weather, or rural locations with no curbside pick-up), and cost/benefit analyses vary depending on the city (Fish, 2015).

### 3.1.3.2 Incentives

Incentive or reward programs use monetary gains to improve participation in multi-tenant recycling programs. Incentives might include cash, coupons, rebates, bus passes, gifts or prizes. The promise of rewards has been shown to increase recycling rates (Osbaldiston & Schott, 2012; Slavin, Wodarski, & Blackburn, 1981; Hake & Zane, 1981; Diamond & Loewy, 1991). However, the effects of incentives are often short-lived, returning to baseline when the rewards are removed (Schultz, Oskamp, & Mainieri, 1995). It is also challenging to develop an incentive program that will not lose its appeal over time and that promises rewards that are interesting to diverse groups of people (Schultz, Oskamp, & Mainieri, 1995). Furthermore, the cost of the program may ultimately outweigh the economic benefits of recycling.

Despite these challenges, some communities have used incentives to increase recycling rates to become high-recovery multi-tenant recycling programs. For example, the London Borough of Bexley, in partnership with Green Rewards Inc., launched an incentive program to encourage recycling and reward residents of multifamily properties for reducing solid waste. The incentive program was piloted with 2,000 flats in October 2011. It was successful enough that, as of June 2012, it was expanded to all 17,000 flats in the borough. More than 30 percent of residents in the pilot area had signed up to participate and were eligible for local retail discounts and quarterly rewards. Garbage tonnage went down on average, from the baseline, with no discernible increase in illegal dumping or contamination of recycling. The tonnage of recycling collected increased an average of 70 percent over three years. The cost of managing the program and of the reward pay-outs were covered by the cost savings resulting from reduced solid waste disposal. Cost savings from solid waste reduction totaled \$2,428 in the first three months of the program. Participating households each received a portion of the savings equal to four dollars in Green Points, approximately half of which were donated to local charity projects (Cascadia Consulting, 2012). Several high-recovery multi-tenant recycling programs across the United States have also achieved greater than 25 percent recycling rate by using incentive schemes (U.S. EPA, 2001).

### 3.1.3.3 Goals

Goal setting, as the name implies, involves setting a program goal that the community strives to achieve. In a meta-analysis of environmental psychology studies focusing on pro-environmental behaviors, it was shown that, while goal setting on its own was not among the top four effective strategies to encourage PEB, when combinations of treatments were considered, goal-setting appeared in three of the top six combinations of effective strategies. Those combinations included:

- Commitments and goals
- Dissonance (such as encouraging behavior that is in line with preexisting beliefs to minimize cognitive dissonance) and justifications
- Instructions and goals
- Prompts (such as, visual reminders like posters) and making-it-easy
- Prompts and justifications
- Rewards and goals (Osbaldiston & Schott, 2012)

Goal setting has also been combined with incentives. For example, in an effort to boost multi-tenant recycling participation, the City of Seattle, Washington developed an ambitious incentive program for collection service providers. Collectors achieving less than 70 percent participation in recycling by customers were threatened with a fine, and those who reach the 80 percent participation goal were promised a bonus (Touart, 2000). These strategies are best used in combination with other education and outreach methods (Dietz, 2002).

### 3.1.3.4 Feedback

★ Providing feedback to property managers and tenants of multifamily recycling programs has been shown to be both effective and more cost-efficient than other incentive programs (Timlett & Williams, 2008; Osbaldiston & Schott, 2012; Thøgersen, 1994). There has also been successful research showing significant increases in recycling and decreases in contamination in response to feedback techniques. For example, in a study that involved three projects, each examining a different behavior change approach, the impact of each technique was estimated by comparing recovery and contamination rates before and after each project approach was tested (Timlett & Williams, 2008). The techniques included a door-to-door method, an incentives-based approach and the mailing of personalized feedback to residents. The projects were completed in Portsmouth, England and measured in 4,000 to 5,000 households each, over the course of 10 rounds of collection service. It was shown that residents responded well to the incremental feedback, which was also specific to their household. Especially for non-recyclers, feedback stating “participation in your neighborhood is worse/better than X” was an effective motivator. The findings showed that personalized incentives and feedback were highly effective at reducing contamination. Both methods resulted in 50 percent reduction in the number of households setting out contaminants on collection day. The feedback approach was also considerably more cost-effective than the other two approaches (Timlett & Williams, 2008). In another study comparing commitment cards, feedback, and general newsletters, all three treatments reduced contamination compared to the control, but none of the treatments increased recycling rates overall (De Young, et al., 1995).

Provide feedback to property managers and tenants.

While these studies were conducted in single-family households, these methods could be adapted to provide building level feedback for multi-tenant properties. In the multifamily recycling report by the City of Calgary, Alberta, it was recommended that managers and collection service providers communicate the successes and failures of a program to residents using a newsletter, a post card, or a tenant meeting. Feedback could serve both as a prompt to perform recycling behavior and to provide additional instruction on proper recycling practices (such as, rinsing receptacles, caps on or off, etc.).

### 3.1.4 Recycling education and outreach

★ There is a general consensus in the literature that recycling rates are positively correlated with education and outreach, which supports the importance of strong outreach campaigns (Oskamp, et al., 1994; Callan & Thomas, 1997; Nixon & Saphores, 2009; De Young, et al., 1995; Barr, 2004; Kennedy, Beckley, McFarlane, & Nadeau, 2009; Schultz W. , 2002; Lakhan, 2014; Nyamwange, 1996). Educating property owners, property managers, and commercial and residential tenants about how and where to recycle, and what the benefits are, has been shown to be part of most multi-tenant recycling programs (U.S. EPA, 2001). However, it is important to note that the positive effects of educational campaigns can only be realized if; a) the only barrier to recycling is a lack of knowledge or, b) the other significant barriers are also removed (Dietz, 2002). Outreach and education has been found to be ineffective if sufficient receptacle capacity and collection frequency are not provided (Cascadia Consulting, 2014; Consulting, 2006; Dietz, 2002).

Education and outreach campaigns support increased recycling rates.

As an example, in a study of 98 multifamily complexes in Ann Arbor, Michigan, three different forms of tenant education and outreach (written commitment, postcard feedback, and newsletter feedback) proved useful in



## Multi-Tenant Recycling Literature Review

reducing recycling contamination, but not in increasing measured rates of recycling (De Young, et al., 1995). In another study of recycling in 12 multifamily buildings in Ontario, Canada, it was found that retrofitting buildings with garbage and recycling chutes alone, did not lead to significant increases in recycling rates (Lakhan, 2014). Only the treatment that combined the placement of blue bins in the building lobbies (a visual outreach strategy) with the installation of chutes produced significant increases in building recycling rates (Lakhan, 2014). Many other research studies have also found positive relationships between educational recycling outreach through radio, television, and newspaper ads, and participation in household solid waste recycling (Perrin & Barton, 2001; Williams & Taylor, 2004; Spaccarelli, Zolik, & Jason, 1989).

Recommendations compiled in city and state reports have also emphasized the importance of outreach and education. For example, a multifamily recycling handbook produced by the State of Georgia stated that when a good recycling program is in place, a consistently applied outreach message should result in improved recycling rates and decreased contamination (Georgia Recycling Coalition, 2010). In the Portland Metro Regional Solid Waste Management Plan 2008-2018 Update, solid waste reduction goals included the provision of annual regional education and outreach for multifamily residential recycling, business recycling and commercial organics collection (Metro, 2008). Additionally, a comprehensive multifamily recycling report for the Portland Metro region claimed that, if education efforts of recycling programs were complemented by efforts to remove other barriers to recycling (such as, updates to infrastructure and changes in policy), a good community-based social marketing and education campaign could improve recycling rates (Metro, 2007). It is also important to note that simply providing practical information about recycling may have no impact on behavior if education campaigns do not build on the knowledge accumulated in the environmental psychology literature. Many campaigns fail because they underestimate the barriers that need to be overcome for behavior to change, and because they ignore “the rich mixture of cultural practices, social interactions, and human feelings that influence the behavior of individuals” (Costanzo, Archer, Aronson, & Pettigrew, 1986; McKenzie-Mohr, 2000). Therefore, it makes sense to combine knowledge from environmental psychology and from community-based social marketing to tackle recycling challenges (Geller, 1989; Nixon & Saphores, 2009).

Community-based social marketing strategies focus on a specific audience, providing tailored solutions to problems and group specific messaging (McKenzie-Mohr, 2000; Kennedy A. L., 2010). At the heart of a community-based social marketing message is that the desired action, in this case effective participation in multifamily recycling programs, is a positive and normal behavior (such as, “Everyone is doing it.”) (Metro, 2007). This concept is supported in Thomas Dietz’s book, “New Tools for Environmental Protection”, which states that tenants need to be assured that recycling is worthwhile, and that taking action is, easy, beneficial and satisfying (Dietz, 2002). Repetition was also highlighted as an important factor, because not only does it address high turnover of managers and tenants, but it also helps reinforce messages over time (Dietz, 2002).

Study findings have also shown that the cumulative expenditure on recycling education is positively correlated with increasing recycling rates. Data has shown that spending one dollar per person per year will increase the rate of recycling by approximately 2 percent (Sidique, Joshi, & Lupi, 2010; Callan & Thomas, 1997). A Michigan DEQ report recommends that communities have a dedicated recycling education budget of \$2 to \$2.50 per household, which should be used for more extensive outreach delivery (such as, additional materials to customers, school programming and education events) (Michigan DEQ, 2016).

### 3.1.4.1 Print media

From a unique dataset collected through a 2006 national survey of U.S. households, a study was conducted to understand which information source (print, television, radio, family or friends, work or school, or other) had the biggest impact on getting households to start recycling (Nixon & Saphores, 2009). The effectiveness of various combinations of information sources was also analyzed. Print sources (for example newspapers, mailings or posters) were by far the most common source of recycling information. Seventy-seven percent of the respondents indicated that they received recycling information from these sources. It was also shown in a study in the U.K., which included a three-part survey to 502, 2,002 and 961 citizens, that printed materials were the most common outreach tools used to promote recycling (Mee & Clewes, 2004). Furthermore, citizens indicated that they preferred to receive information through a newsletter (70 percent) or personalized letters (22 percent), while only

## Multi-Tenant Recycling Literature Review

one percent preferred to use a website (Mee & Clewes, 2004). Many multifamily recycling “best practices” reports have also recommended providing new tenants with recycling packets, containing all the necessary information (Eureka! Recycling, 2004; City of Des Moines, 2015; Stopwaste.org, 2008; Beck, 2008).

In a study of the effectiveness of promotional material in three communities in England, the distribution of a leaflet or an environmental newsletter by the local recycling authority was identified as an effective way of promoting recycling (Evison & Read, 2001). Tailored, specific messages delivered to a certain group or community have also been shown to be more successful than broad, general campaigns (Dietz, 2002; Timlett & Williams, 2008; Nixon & Saphores, 2009). Alternatively, it has been argued that the most cost-effective way of informing households about recycling was to mail a feedback card, clearly indicating the type of materials accepted and collection dates for recycling (Timlett & Williams, 2008). Section 3.1.2.3 Feedback, includes a more detailed discussion of using feedback as an incentive strategy to increase recycling behavior.

Without delving into the realm of marketing and advertising, it cannot be definitively concluded what images and information are best included on outreach and education materials (Pulley, Dennings, & Phelps, 2015; Geller, 1989; Kennedy, Beckley, McFarlane, & Nadeau, 2009). Anecdotally, it has been shared that brochures, door hangers and mailers should include:

- Which types of items can be recycled — pictures are helpful and reach a broader audience.
- Instructions on sorting — flattened cardboard, including caps on bottles or not, etc.
- Designated location information for special drop-off recycling centers and contact information for central services and complaints.
- Periodic feedback — keep tenants informed on how their building is performing.
- Messages about why recycling makes a difference — the economic and environmental impacts.
- A consistent look across all pieces (such as, use the same font, colors, logo, mascot, etc.).

Tenants and customers will eventually recognize these as recycling information pieces and will hopefully save them and reference them when needed (Beck, 2008; Smith, 2014; Lane & Wagner, 2013a).

Print media that is specifically designed as directional or informational signage is discussed in Section 3.2.4 Collection area signage. Good examples for print media outreach materials are included in Appendix C.

### 3.1.4.2 Other media

The widespread use of other means of communication may still be ahead of the research on the subject, but it is nonetheless worth mentioning that there are many channels of communication, other than print media, that could be utilized for media campaigns to promote recycling programs. Almost every multi-tenant recycling program has an online presence in the form of a website, where other resources, like a recycling hotline might be advertised. Airtime on local radio stations could be utilized, and billboard advertisements, posters on buses, bus shelters or collection truck panels might also be considered as possible venues to disseminate recycling program information (Metro, 2017; City of Calgary, 2012).

★ Multiple studies confirm that it is best to combine several types of media communication and outreach efforts (Cascadia Consulting, 2012; Burn & Oskamp, 1986; Stevens B. J., 1999). In one national survey of U.S. households in 2006 different recycling information sources were compared to evaluate which had the biggest impact on getting households to start recycling (Nixon & Saphores, 2009). Individuals who received information from three sources were 3.78 times more likely to recycle, while those who received information from four or five/six sources were 3.73 and 4.44 times more likely to recycle, respectively. Recycling rates have also been found to improve when a variety of media are used to deliver information (Speirs & Tucker, 2001). Multifamily recycling guidelines published by the City of Calgary recommend that education and outreach campaigns consider several of the following channels for communication of recycling outreach messages;

It is best to combine several types of media communication and outreach efforts.



## Multi-Tenant Recycling Literature Review

- Meetings
- Canvassing
- Tabling at public events
- Website
- Online ads
- Radio and TV ads
- Move-in kits
- Mailings
- Newspaper ads
- Posters and signage
- Labels on collection receptacles
- Billboards and other public notices (City of Calgary, 2012)

Several city reports also call for clear, concise and consistent messages that are repeated through multiple media channels to confirm the value of recycling (Metro , 2007; Dietz, 2002; Eureka! Recycling, 2004; Environmental Services Department, 2008).

### 3.1.4.3 Face-to-face

Face-to-face communication has been shown to increase recycling behavior more than print media, but it is also more costly (Schultz, Oskamp, & Mainieri, 1995; Nixon & Saphores, 2009; Stopwaste.org, 2008; Cascadia Consulting, 2012). In a report of innovative multifamily recycling programs around the world, a number of face-to-face contact approaches that helped form high-recovery multifamily recycling programs were highlighted:

- Door-to-door outreach to multifamily residents paired with distribution of reusable tote bags
- Programs that recruit and train resident recycling champions who, in turn, train fellow residents and lead efforts to organize and provide education in their own buildings
- Culturally competent outreach campaigns that teach recycling through community member designed and delivered projects or initiatives that address the needs of the community — this approach may require partnering with community organizations already operating in communities where multifamily complexes are located (Cascadia Consulting, 2012)

★ These innovative strategies could be adapted, singly or in combination, into pilot projects to test their potential effect on multifamily recycling (Cascadia Consulting, 2012). For example, one door-to-door canvassing pilot campaign included distribution of recycling tote bags and promotional recycling calendars and site-specific brochures to 7,000 residents in 115 apartment complexes in Bristol, United Kingdom. This incredibly successful effort increased the weight of recycling collected an average of 70 percent over three years (Cascadia Consulting, 2012). Similarly, a long-term, values-based, community-engagement campaign was launched in West London, United Kingdom.

This approach aimed to change behavior by addressing issues important to the community, rather than focusing only on recycling. Fifty-one initiatives, reaching 3,200 residents in 13 public housing complexes, were designed and delivered by 67 resident volunteers, in collaboration with program staff. The total volume of recycling collected increased by an average of 21 percent in pilot complexes and observable contamination decreased by an average of 14 percent (Cascadia Consulting, 2012). It is very challenging to identify the exact components that lead to the success of these campaigns, but it is clear that they both used a multi-faceted approach, including elements of face-to-face outreach and community-based social marketing.

If the resources are available, face-to-face outreach should be employed.

In contrast to the two programs mentioned above, in Toronto, Canada, a community-based social marketing campaign was combined with a training program for residents to become recycling ambassadors, and increased recycling by only four percent over two years, from 2009 to 2011 (Cascadia Consulting, 2012). In another study, a street-canvassing campaign promoted recycling in two adjoining neighborhoods, in Manchester, United Kingdom. In the intervention group, 2,129 households were contacted. Recycling rates rose 5.4 percent immediately after canvassing, compared to the control, but sank to 1.7 percent greater than the control in the three months after (Cotterill, John, Liu, & Nomura, 2009). All four of these programs were, in their own right, considered a success, but clearly the first two programs had a larger impact on recycling rates in their communities. Unfortunately, the many confounding variables make it impossible to isolate the exact program

features that increased recycling participation. Broadly speaking, sources in the literature indicate that if the resources are available, face-to-face outreach should be employed, as it is more effective than print media alone.

### 3.1.4.4 Appealing to pro-environmental attitudes

Connections between pro-environmental attitudes and recycling behavior has been a topic of environmental psychology research for quite some time (De Young, et al., 1995; Burn & Oskamp, 1986; Diamond & Loewy, 1991). Much of the research in this field conducted prior to 1990 found a significant positive relationship between pro-environmental attitudes and recycling (Schultz, Oskamp, & Mainieri, 1995). However, in more recent studies, the significance of that relationship has not been observed (Nixon & Saphores, 2009; Oom do Valle, Reis, Menezes, & Rebelo, 2004). It is possible that, as recycling programs become more widespread and even commonplace, the degree of personal environmental consciousness is not as important as convenience (Schultz, Oskamp, & Mainieri, 1995; Nixon & Saphores, 2009).

★ While the general environmental consciousness of the individual may no longer be a reliable predictor of recycling behavior, holding specific positive attitudes towards recycling has been shown to be positively correlated with recycling participation (Oom do Valle, Reis, Menezes, & Rebelo, 2004). From data collected in a 2006 national survey of U.S. households, it was found that respondents who indicated feeling morally obligated to recycle were 7.2 times more likely to recycle than those who did not (Nixon & Saphores, 2009). This relationship was also found in national study of 2,093 households in Portugal comparing motivations for recycling of household packaging waste (Oom do Valle, Reis, Menezes, & Rebelo, 2004). These two surveys, as well as other research studies, have also identified the impact of social norms and the influence of peer pressure as significant factors influencing recycling behavior (Nixon & Saphores, 2009; Barr, 2004; Oom do Valle, Reis, Menezes, & Rebelo, 2004; Mee & Clewes, 2004; Timlett & Williams, 2008; Osbaldiston & Schott, 2012; Burn & Oskamp, 1986). The conclusions of these studies suggest that there could be a significant impact of creating an atmosphere in multi-tenant buildings, where tenants support and promote recycling. Recycling in multi-tenant buildings is typically anonymous, removing peer pressure to recycle. However, when living in multifamily housing, or sharing a multi-commercial building, tenants are still part of a broader community identity. Therefore, the implications of the research reviewed here is that it is especially important that multi-tenant recycling program messaging be inclusive, (for example, “our building recycles” or “please don’t trash our recycling”). Inclusive messaging could help to build a social norm around recycling and is more likely to generate compliance (Osbaldiston & Schott, 2012; Hornik, Cherian, Madansky, & Narayana, 1995; Tonglet, Phillips, & Bates, 2004; Guerin, Crete, & Mercier, 2001; Bernstad, 2014; Metro , 2007).

Use inclusive messaging such as “our building recycles” to create a social norm and a spirit of community.


## 3.2 Collection system

At its core, a recycling collection system is designed and built to divert solid waste from landfills and to generate valuable streams of material resources for reuse. Collection and marketing of recyclables saves energy and virgin natural resources — supporting good environmental stewardship. Most customers who receive recycling collection services never consider the elaborate design and costly effort that is made on the part of buildings, collection service provider, and local jurisdictions to influence their (customer) behavior and promote proper recycling practices. This section covers the infrastructure and logistics associated with multi-tenant recycling collection systems and how they are used to increase recycling rates in multi-tenant buildings. First, the types and number of materials collected, and the receptacles and spaces associated with shared collection systems will be discussed. Next, visual communication tactics associated with sorting, such as signage and color coding are addressed. Finally, multi-tenant recycling program materials collection methodologies are considered.

### 3.2.2 Materials collected

Across the country the number of materials collected by multifamily recycling programs are highly variable, usually between one and 16 (U.S. EPA, 2001). However, the majority of programs collect the same core materials. These include aluminum, steel cans, glass and newspaper. Eighty percent reported including PET and HDPE, less than 50 percent collected mixed paper, and other plastics were collected by only 16 percent (Skumatz & EPA, Nation Wide Diversion Rate Study: Quantitative Effects of Program Choices on Recycling and Green Waste Diversion; Beyond Case Studies, 1996). The mean number of materials collected is 9.4 (U.S. EPA, 2001). Commercial recycling programs have not been documented and studied to the extent of the residential sector (Bacot, McCoy, & Plagman-Galvin, 2002; Oskamp, et al., 1994). Although their solid waste streams are larger, and may be less heterogeneous at times, they are also limited by the materials accepted by recycling facilities. The following is a list of materials collected by recycling programs across the United States — excluding wasted food and yard debris — in descending order of prevalence:

- Old newspapers (ONP) — 100 percent of communities
- Aluminum and ferrous cans — 95 percent
- Clear and green glass — 95 percent
- Brown glass — 92.5 percent
- Polyethylene terephthalate (PET) plastic — 87.5 percent
- High-density polyethylene (HDPE) plastic — 85 percent
- Old corrugated cardboard (OCC) — 67.5 percent
- Mixed waste paper — 42.5 percent
- Magazines and phone books — 37.5 percent
- Others — usually aseptics, gable tops, etc. — 22.5 percent
- Plastics other than #1 and #2 — 12.5 percent
- Fibers (such as, textiles and fabric) — five percent
- Ferrous scrap metal — five percent
- Used oil — five percent (U.S. EPA, 2001)

 It has been shown repeatedly that the more materials collected, the higher the material recovery rate (Skumatz & EPA, Nation Wide Diversion Rate Study: Quantitative Effects of Program Choices on Recycling and Green Waste Diversion; Beyond Case Studies, 1996; U.S. EPA, 2001; Metro, 2008). In a study including data from 500 communities, it was shown that the addition of mixed paper into the recycling stream could increase the recyclables recovery rate significantly (Skumatz & EPA, Nation Wide Diversion Rate Study: Quantitative Effects of Program Choices on Recycling and Green Waste Diversion; Beyond Case Studies, 1996). In the 2001 U.S. EPA national study on multifamily recycling programs, 82 percent of the high-recovery communities included mixed paper, OCC, magazines and phone books (U.S. EPA, 2001). Many high-recovery communities continue to expand the types of materials collected for recycling (Stopwaste.org, 2008; Metro, 2008; CalRecycle, 2016). For example, in the Portland, Oregon metropolitan area, the updated Regional Solid Waste Management Plan was updated policy and program direction for the decade from 2008-2018 (Metro, 2008). The plan included solid waste reduction goals for multifamily residential, business and commercial organics material recovery programs such as:

- Enhance access to organics recovery services throughout the region
- Implement organic waste recovery programs at government facilities where feasible
- Work to ensure that compost products are specified for use in government projects
- Implement solid waste reduction and sustainable practices at government facilities
- Identify and implement opportunities for increasing recovery in the business sector, including service provision options, incentives for recycling and regulation
- Periodically review end-use markets to assess cost-effectiveness, material quality and capacity
- Identify and evaluate new collection technologies for implementation on a cooperative region-wide basis

The more materials are collected, the higher the recovery rate will be.

★ In the 2001 EPA national study mentioned above, it was also observed that, along with additional materials collected, increasing the number of materials that are collected separately increased the recycling rate in multifamily buildings, and possibly served to reduce contamination, which was a frequently cited problem for multi-tenant recycling programs (U.S. EPA, 2001). This was an important finding since, in the eyes of local government staff and recycling professionals — collection service providers and processors — some of the primary challenges to recycling at multifamily properties include contamination and space constraints (Stevens B. J., 1999; Campbell Delong Resources, Inc., 2014).

Increasing the number of materials collected *separately* increases the recycling rate in multifamily buildings.

### 3.2.3 Receptacles

#### 3.2.3.1 In-unit collection and transport

While some local governments in the United States and Canada have distributed personal recycling receptacles as part of their multifamily programs, it is a rare occurrence (Smith, 2014; Lane & Wagner, 2013a). At present, it does not appear that any scientific studies have shown that providing personal recycling receptacles to multifamily tenants increases recycling rates (Smith, 2014). One study of 214 multifamily households in Urbana, Illinois, found that households with adequate interior space for collection were more likely to recycle (Ando & Gosselin, 2005). There are also many non-academic articles and local government reports that encourage provision of recycling receptacles in multi-tenant buildings (Eureka! Recycling, 2004; City of San Jose, 2011; City of Portland, 2008; Georgia Recycling Coalition, 2010; Cascadia Consulting, 2014). Despite the inconclusive evidence that providing in-unit receptacles improves recycling practices, the lack of appropriate storage space and receptacles have been cited as significant barriers to recycling by tenants. Careful consideration of appropriate in-unit storage spaces and receptacles should be addressed by property managers, collection service providers, local governments or a combination of parties (Skumatz & EPA, 1996; Smith, 2014; Fish, 2015; Stevens B. , 1994).

A detailed study of in-unit recycling receptacles for multifamily tenants identified design and distribution as the two major considerations. The important criteria for receptacle design were described as capacity, message, color, form and handles. The criteria for distribution were defined as distributor, method of obtainment and cost. The ‘ideal’ receptacle design was found to be blue (or followed a preexisting color scheme, if one existed), with 8.5-gallon capacity, included handles, and was either a rigid plastic receptacle or a polypropylene reusable tote bag. If a tote was selected, adding handles to the bottom of the bag for easy emptying was also suggested. Additionally, it was recommended to use the sides of the receptacle to display recycling information, consistent with other program messaging, including details about what can and cannot be recycled, program or collection service provider contact info, and set-out requirements, using pictures and graphics where possible, as well as multiple languages (Smith, 2014). The ‘ideal’ distribution involved personal contact and delivery by the property manager when new tenants move in, with the cost of the receptacle paid for by local governments, collection service providers or property managers. To encourage retention and cover the cost of replacement, it was suggested that a deposit or fee-clause be built into leasing agreements for garbage and recycling services (Smith, 2014).

**Figure 1:** Examples of the ‘ideal’ in-unit recycling collection receptacle. Image credits: (Chittenden Solid Waste District, 2015; St. Mary's RC Langley, 2017).



### 3.2.3.2 Shared receptacles for communal collection

★ The type of receptacle used for shared collection has a significant impact on recovery rates. High-recovery programs are more likely to use 90-gallon roll carts (U.S. EPA, 2001). The 90-gallon roll carts have several advantages, including mobility, low square footage and compatibility with semi-automated side loading compartmentalized trucks frequently used for single-family recycling (U.S. EPA, 2001). It has also been observed that higher recovery programs serve fewer households per set of recycling receptacles than lower recovery programs (U.S. EPA, 2001). Less sharing of receptacles also means each set is located closer to each apartment unit, making it more convenient for residents to drop off their recyclables (U.S. EPA, 2001).

High-recovery programs are more likely to use 90-gallon roll carts and serve fewer households per set of recycling receptacles.

Depending on the number of units, size and type of business, number of materials collected, and the available space, several receptacle options for shared material collection exist and may be recommended by collection service providers:

- 64 or 96-gallon roll carts
- 1 to 8-cubic yard containers
- 15 to 40-cubic yard roll-off containers
- 24 or 36-cubic yard compactors (single-stream)
- Other custom made receptacles (Georgia Recycling Coalition, 2010)

A general guideline for choosing receptacle sizes in multifamily residential settings is to provide 50 gallons of receptacle capacity for every three residents per week including all types of discards (Stopwaste.org, 2016). This capacity can be scaled to the appropriate weekly volume for the property and divided among garbage, recycling and organics. For weekly collection services, common estimates for waste composition in multifamily complexes are 40 percent garbage, 40 percent recycling and 20 percent organics, if a yard waste or organic collection program is available (Beck, 2008; Stopwaste.org, 2016).

In a commercial setting, there is no rule of thumb for receptacle volume — different types of commercial activities generate very different volumes of solid waste. The relative amounts of each stream (recyclables, organics and garbage) vary as well (CalRecycle, 2016; Stopwaste.org, 2016).



Receptacles are an important consideration for multi-tenant recycling programs. In the national EPA study of multifamily recycling programs, receptacles were cited as one of the most common aspects that programs wanted to revisit (U.S. EPA, 2001). More than one-third of communities said they would use different receptacles and try to avoid manual loading. Although the preferred receptacle differed from community to community, none indicated a desire to switch to single-family receptacles (U.S. EPA, 2001).

### 3.2.3.3 Standard receptacles colors

Many city reports have recommended color-coding recycling receptacles, or at least the lids of the receptacles (City of Portland, 2008; Michigan DEQ, 2016; Stopwaste.org, 2008; City of Calgary, 2012; Metro, 2007; Campbell Delong Resources, Inc., 2014). Of the 20 cities that were included in Metro's 2016 multifamily recycling study, 14 had color-coded receptacles (Metro, 2017). The final report of that study recommended that, as part of its regional waste plan, standard receptacles colors be adopted (Metro, 2017). Color-coded receptacles, or receptacles with color-coded lids, have reportedly been used all over Canada (City of Calgary, 2012).

★ A study observing 10 waste stations in an academic building used specialized receptacle lids (with holes for beverage containers) at half of the stations (Duffy & Verges, 2009; Pulley, Dennings, & Phelps, 2015). The presence of specialized lids increased the recycling compliance rate by 34 percent and reduced the amount of contaminants entering the recycling stream by up to 95 percent (Duffy & Verges, 2009; Lane & Wagner, 2013b). The use of various visual prompts, like signage, color and holes in receptacle lids, have been validated by research as an effective way to increase recycling rates (Duffy & Verges, 2009; Pulley, Dennings, & Phelps, 2015; U.S. EPA, 2001; Lane & Wagner, 2013b).

Using visual prompts, like signage, color and holes in receptacle lids, can increase recycling rates.

### 3.2.4 Material collection areas

Depending on the building layout and whether the building is multifamily, multi-commercial or mixed use, different arrangements and designs for in-unit and shared material collection areas may be preferred.

#### 3.2.4.1 Space for in-unit collection

★ The lack of appropriate storage space within multifamily units has been cited as a significant barrier to recycling by tenants (Skumatz & EPA, 1996; Smith, 2014; Stevens B., 1994). Careful consideration of appropriate in-unit storage spaces should be addressed by property managers, collection service providers or local governments. A research study of 214 multifamily households in Urbana, Illinois, found that households with adequate interior space for collection were more likely to recycle (Ando & Gosselin, 2005). In a survey conducted with 2,093 residential customers of a national recycling company in Portugal, the responses revealed that residents who had any available interior space to store recyclable materials were significantly more likely to recycle (Oom do Valle, Reis, Menezes, & Rebelo, 2004). Additionally, cities have also found that providing in-unit bins has improved recycling participation. The City of Calgary reports that adequate space for internal collection of recyclables is essential to a multifamily recycling program (City of Calgary, 2012). In 2016 the City of Austin, Texas hired a group of "innovation fellows" to help them make progress on priority issues. One of their projects included going into the homes of 48 multifamily residents to collect first-hand information on the barriers to recycling. To improve recycling in multifamily communities, one of the top suggestions the innovation fellows made to the city was to provide stackable receptacles for small apartments, with recycling on top and garbage on the bottom (Rockwell, 2017).

Households with adequate interior space for collection were more likely to recycle.

### 3.2.4.3 Communal outdoor collection areas

Communal outdoor collection areas are sites on the property where tenants take materials for collection. They may be completely open, enclosed on three to four sides, or enclosed and covered, and sometimes even locked. Important design considerations are location, protection from weather, accessibility for tenants and collection service providers, signage safety, fire codes, accessibility requirements, construction materials and the collection technology employed for collection (Georgia Recycling Coalition, 2010; California EPA, 1993).

A well-designed exterior enclosure system will have the following features:

- Pedestrian entrance
- Lever-style door handle that can be operated with full hands
- Wall space for instructional signage
- Smooth floor that can be swept or mopped if necessary
- Sufficient space to move receptacles as needed for easy access by users
- Wheel-stops near walls to prevent damage to walls, if necessary
- Adequate lighting to read signs, sort materials and enhance safety
- Architectural features that match the main building
- Short walking distance from all units (Stopwaste.org, 2016)

No one specific material collection area arrangement has produced higher recovery rates over another, however, convenience and sufficient volume of collection has been shown to have a significant impact on recycling behavior (Davis, Phillips, Read, & Iida, 2006; Oom do Valle, Reis, Menezes, & Rebelo, 2004; Barr, 2004; DiGiacomo, et al., 2017). For example, in Babylon, New York, garbage customers using large roll-off containers were twice as likely to recycle as were customers using smaller containers of one-to-eight cubic-yard capacity (Stevens B. , 1994). In San Jose, California, customers on suburban routes with more space were almost 20 percent more likely to recycle than customers in the more space-constricted areas of the city (Stevens B. , 1994).

### 3.2.4.4 Indoor rooms and chutes

Indoor rooms and chutes are located within a building and usually contain receptacles for garbage and recycling. Space and health considerations are especially important for indoor collection areas since they are located within tenant-occupied buildings. Chutes are also common in large apartment buildings or high-rises. Traditionally, chutes were used for garbage disposal, but in newer buildings there are often recycling chutes for commingled recycling located alongside the garbage chute. New innovations are becoming available to upgrade garbage chute designs. For example, buildings in New York City have installed “carousel” or “diverter” chutes that can accept garbage and different recycling streams through a single chute, which then fall into a rotating receptacle in a collection area on the ground floor (Gabarine, 1998; Wood, 1991). Even more technologically advanced is the Smart Chute proposed by a design team from Side Walk Talk (Shapins, 2017). The chute is operated by a tablet and can record data on each tenants’ waste disposal habits. A strong and clear connection has been made between convenient access to recycling and increased recovery rates (DiGiacomo, et al., 2017; Smith, 2014). Innovations, like the Smart Chute, which strive to improve traditional garbage room arrangements could contribute to improving multi-tenant recycling program participation.

### 3.2.4.5 Safety and security in collection areas

There are a number of safety and maintenance issues associated with material collection areas that are commonly cited by tenants, property managers and collection service providers, which usually include:

- Illegal dumping by non-tenants
- Not enough space
- Receptacles are too full (Metro , 2017; Cascadia Consulting, 2014; Stopwaste.org, 2008)

In interviews with Washington State property managers, illegal dumping was identified as the second most prevalent challenge to recycling, after the culture and habits of residents (WAMRS, 2014). Managers also said that assistance to reduce illegal dumping was the third best strategy for improving recycling at their properties (WAMRS, 2014). Other than the frequent mention of illegal dumping as a top concern, there are no proposed

effective solutions to this problem cited in the literature. While monitoring of the collection area or locking the enclosure have been attempted, no data shows that these efforts produce a measurable effect on illegal dumping (Fish, 2015; Metro , 2017; Stopwaste.org, 2008; WAMRS, 2014; Stevens B. J., 1999; Cascadia Consulting, 2014).


### 3.2.4.6 Design standards

Cities have increasingly adopted building guidelines or ordinances for new construction or major renovations, which include requirements for interior storage of recyclables and for communal material collection areas (Reid, 2016). Minimum space requirement ordinances and building design guidelines are tools that can be used by communities to ensure that properties are providing adequate material collection areas for their tenants (Eureka! Recycling, 2004; Michigan DEQ, 2016; Sidique, Joshi, & Lupi, 2010 ; Alcoa Foundation, 2016). This type of ordinance typically encourages or requires developers to provide a minimum square footage for storage of recyclables. For example, the City of San Diego, California, requires all individual dwelling units within a multifamily complex to be equipped with an interior garbage and recyclable material storage area of at least five cubic feet (California EPA, 1993). The storage area must consist of at least 2.5 cubic feet for recyclable material and at least 2.5 cubic feet for garbage. For multifamily high-rises, interior storage requirement ordinances typically recommend that developers provide areas for recycling collection containers on each floor. These provisions are typically written in general fashion and do not include specific requirements regarding the collection areas or receptacles (Beck, 2008). Ordinances can even go so far as to require recycling site plans, which might include the general layout and design of property itself, along with a statement of recycling that could include:

- Analysis of the expected composition and amounts of solid waste and recyclables that will be generated and collected at the development
- Location, design specification and number of recycling and garbage storage areas, receptacles and enclosures that adequately meet the volume and material requirements of the development
- Signage that will be used to clearly identify the recycling area and receptacles and materials collected
- Educational outreach program that explains education of owners, tenants and occupants

Beyond tenant interactions with the material collection areas, the areas must also meet the needs of the collection service providers. Engineering and site design requirements must be considered in areas associated with loading recyclables, such as height clearance, grading, turnaround area, slope and the composition of driveways. Specifications for these appear in the model space ordinances available in Appendix B.

### 3.2.5 Collection area signage

 Basic signage includes receptacle decals, color-coding of receptacles, instructional signage, directional signage and illegal dumping warnings (Cascadia Consulting, 2014). Graphic content and distinctive color coding in the design of the outreach materials are key features that allow residents to quickly distinguish between correct and incorrect recycling practices (Metro , 2007). The majority of multi-tenant recycling programs agree that clear signage for receptacles and collection areas are important, however, it is difficult to distinguish from the literature if there is any consensus on what the best “clear” signage would include or how much recovery rates truly increase from improved signage.

The majority of multi-tenant recycling programs agree that clear signage for receptacles and collection areas are important.

For example, a telephone survey of 316 Oregon residents was conducted in 2007 and found that 69 percent of respondents look at stickers or labels on receptacles to discern which receptacles are used for recycling instead of garbage (Metro , 2007). It is tempting to conclude that these findings indicate that clear, consistent, descriptive decals and signage at the point of separation for recycling are extremely important. While this may be true, without a correlated measure of materials recycled by participants or contamination rates, no such definitive



## Multi-Tenant Recycling Literature Review

conclusion can be made from this self-reporting survey. There have, however, been successful studies examining the effects of prompts (simple visual reminders to perform a certain task) on recycling behavior. In a study that aimed to isolate the impact of improved visual communication on recycling, signs prompting correct use of garbage and recycling were hung in a large university setting. One green sign reading “recyclable materials” and one red sign reading “trash” were hung directly above their corresponding receptacles (which were a box and a tall garbage can, respectively). The recycling behaviors of 217 people were recorded in relation to baseline. Recycling improved by 54 percent in one trial and 29 percent in the replicate (Austin, Hatfield, Grindle, & Bailey, 1993). Many other studies have also measured the combined effect of multiple outreach efforts (Schultz, Oskamp, & Mainieri, 1995; Fallde, 2015; Cascadia Consulting, 2012). In the City of Bristol, United Kingdom, the combined implementation of instructional signage and door-to-door canvassing to distribute tote bags to 7,000 residents in 115 apartment complexes was shown to be incredibly successful (Cascadia Consulting, 2012). The weight of recycling collected increased from 272 tons in year one to 485 tons in year three — an average 70 percent increase.

The common conclusion of studies such as these is that prompts on their own are not as effective as other approaches in increasing recycling behavior (Schultz, Oskamp, & Mainieri, 1995). Furthermore, there are no results, other than anecdotal summaries, that demonstrate what the most effective signs would look like or what information should be included. In the national EPA study of multifamily recycling programs in 40 different communities, clear signage was seen in only 13 percent of medium-recovery programs and in zero percent of the high-recovery programs (U.S. EPA, 2001). Research in the fields of marketing and behavioral science might help to develop criteria and implementation guidance for best practices with regard to prompts for improving waste reduction and recycling behavior (Fish, 2015; Cascadia Consulting, 2012).

Despite the lack of recommendations for the improvement of instructional signage in material collection areas and for labeling receptacles, local jurisdictions are being proactive on the issue and have included standards for signage in their recycling codes. In four out of 20 city multifamily recycling programs interviewed, city code required that signage include instructional images as well as multiple languages (Metro, 2017). The use of multilingual educational and communication materials, including images on receptacles and in the recycling areas, has been identified as an important element for underrepresented language groups and children (Olson, Powers, Rheineck, Sexton, & Yew, 2010; Kennedy A. L., 2010). In contrast, while best practice recommendations often include improvements to signage, they also state that, if program resources are scarce, the resources would be better spent on improvements to infrastructure (Stevens B. J., 1999; Skumatz & EPA, 1996; Fish, 2015).

Further discussion of signage content considerations appears in section 3.1.3.1 Print media. Print media resources are also included in Appendix C.

### **3.2.6 Collection methods**

Collection methods refer to the logistics of how garbage and recycling collection service providers collect and transport the materials set out by customers. The different aspects of material collection include how materials are sorted, how often and on which routes they are picked up, and how collection service providers enforce compliance with collection rules.

#### **3.2.6.1 Collection stream sorting**

There are several ways to collect recycling including varying degrees of commingling them in one to separating them by type in several containers. The national trend since early 2000 shows that single-stream recycling, which collects all recyclable containers and fibers in one single receptacle, has been widely adopted across the U.S. More than 50 percent of recycling programs are now single-stream (Morawski, 2010; SERA, 2004; WAMRS, 2014).

##### **Single-stream**

In a single-stream system, all fiber grades (such as paper products) and recyclable containers (such as plastic, metal and glass) are collected together in a single-compartment truck (Michigan DEQ, 2016; Container Recycling

## Multi-Tenant Recycling Literature Review

Institute, 2009). This system has been described as more efficient for the collection service providers because each collection vehicle can remain on route until the truck is completely full. Furthermore, single-compartment trucks can collect recyclables and, at a later time, also be used for garbage collection. For single-stream collection, truck drivers make one pass at each stop, saving time and labor costs, as well as reducing greenhouse gas emissions (Fitzgerald & Themelis, 2012). Additional time can be saved if the truck is fitted with mechanical loading equipment (Michigan DEQ, 2016).

Over the past fifteen years, an increasing number of communities have shifted to single-stream collection systems. It is now considered to be the “best practice” for high-volume recovery of recyclables (U.S. EPA, 2001; Morawski, 2010; WAMRS, 2014). The prevalence of single-stream collection was first evaluated in a 2000 survey for the Paper Industry Association Council, and has continued to be evaluated in subsequent surveys (Morawski, 2010). In 2005, only 29 percent of recycling programs were single-stream and by 2010 that number had increased to 64 percent. Some argue that this widespread adoption of single-stream systems has largely been due to the cost savings it affords collection service providers, and not because of improvements in recycling rates or benefits to the recycled material market (Morawski, 2010; SERA, 2004). For example, in a 2004 report on paper mills, it was found that, with the growth of single-stream collection, paper manufacturers saw their costs climb due to contaminated recycled paper sources. Furthermore, findings showed a strong correlation between using recycled content in production and increased production costs, which presented an economic disincentive for the use of recycled content (Morawski, 2010; SERA, 2004).

Other observations have supported that single-stream systems increase recovery rates overall. On average, single-stream recycling collects 50 percent more tonnage than dual-stream (Fitzgerald & Themelis, 2012). For example, in Los Angeles, California, recycling rates increased from 21 percent in 1990 to 59 percent in 2000. In 1998, the conversion of the Los Angeles residential collection system to single-stream was completed. With the new system, residential participation increased from 30 percent to 80 percent, and the quantity of recovered materials increased by 150 percent. However, during this time, Los Angeles also reported an increase in contamination from 10 to 20 percent (Barlaz, Loughlin, & Lee, 2003).

### Dual-stream

A dual-stream system is also called a source-separated system. It generally describes a recycling collection system where the fiber grades and recyclable containers are collected separately (Container Recycling Institute, 2009). Depending on the region, it might also signify that only glass is collected separately from the remaining recyclables (City of Portland, 2008). Source separation usually produces a higher quality and more valuable stream of recovered materials. It does take more effort for the collection service provider to collect separated sources, but it also costs less to process dual-stream collected recyclables, because less contamination usually occurs in this type of collection system (Fitzgerald & Themelis, 2012).

The discussion of how many sorts to use has been further complicated by studies that have demonstrated that recycling participation actually increased with an increase in the number of sorts required (Skumatz & EPA, 1996; U.S. EPA, 2001). Data from the 2001 EPA study of multifamily recycling programs showed that requiring multifamily households to place their recyclables in three or more receptacles was positively correlated with higher recycling rates (U.S. EPA, 2001). The programs with the highest recovery rates averaged 3.2 sorts, while programs with the lowest recovery rates averaged two sorts. The relationship between them showed that as recycling rates increased, the likelihood of a community having single-stream collection decreased from 61.5 percent to 45.5 percent (U.S. EPA, 2001; Michigan DEQ, 2016; Stevens B. J., 1999; Duffy & Verges, 2009). It is possible that the act of placing materials into several different receptacles actually reduces the temptation to contaminate recycling receptacles with garbage. While counterintuitive, as one would expect less sorting to be more convenient, it does appear that the national EPA study found there to be a correlation between the number of materials collected separately and high-recovery rates. It was also observed that increased sorting may have reduced contamination, which is a frequent problem in multifamily recycling (U.S. EPA, 2001).

### 3.2.6.3 Volume and frequency of collection

Providing sufficient capacity for the garbage and recycling produced by a property is an important collection system attribute (Eureka! Recycling, 2004). In the national EPA study of multifamily recycling programs, high-recovery programs were generally found to have a set of receptacles for each 15 to 19 households, as compared to low-recovery programs, where a set was provided for each 26 households (U.S. EPA, 2001). In Portland Metro's multifamily recycling report, which included analysis of over 4,000 multifamily accounts, the median multifamily service provided in the greater Portland area was 40 gallons for garbage, 17 gallons of mixed recycling and three gallons provided for glass per unit per week (Metro, 2017). These volumes were normalized to gallons per unit per week based on the volume of collection, size of property and actual frequency of collection, which varied considerably.

In the comprehensive EPA study of United States multifamily recycling programs, the average number of recycling collections per week was found to be 0.98 (U.S. EPA, 2001). For single-family households, the average number of recycling collections offered per week was found to be 0.9. In another extensive study of 500 communities across the U.S., it was found that high-recovery curbside recycling programs (single-family) collected recycling every week, rather than every other week (or monthly) (Skumatz & EPA, 1996; Jaunich, et al., 2016). However, the decision to take on the significant additional cost in equipment and labor for weekly collection depends on the expected gain in recycling in a specific community. Some communities may find that every-other-week collection leads to a more cost-effective program or saves necessary funds for the purchase of receptacles or upgrade processing capabilities (Skumatz & EPA, 1996; Jaunich, et al., 2016). For example, in communities around the Portland area, the contents of garbage and recycling trucks on residential routes was sampled repeatedly over seven months (Christensen, 2015). Samples of 250 to 300 pounds of garbage or mixed recycling were examined regularly and no statistical difference in recycling recovery rates were found between every-other-week and weekly recycling collection programs (Christensen, 2015). For businesses, depending on the material stream composition and the number of different businesses sharing collection receptacles, the requirements for pick-up may be very different than for residential settings.

### 3.2.6.4 Route logistics

Decisions about external logistics, such as route determination and receptacle locations, need to be made jointly by collection service providers and building management (Olson, Powers, Rheineck, Sexton, & Yew, 2010; Jaunich, et al., 2016). It is preferable to combine multifamily routes with single-family collection, as this will most often increase route efficiency and reduce carbon emissions (Fitzgerald & Themelis, 2012). It is also more efficient to have a single collection service provider serving an entire mixed-use building. However, tracking multifamily recycling tonnage separately from single-family or commercial collection is also a logistical challenge that must be carefully considered (Olson, Powers, Rheineck, Sexton, & Yew, 2010; Fish, 2015).

### 3.2.6.5 Tracking, reporting and enforcement

★ Though it has clearly been shown that higher recovery rates are associated with multifamily programs that have better recordkeeping practices, it is still rare for multifamily recycling program data to be tracked separately from other types of customers such as single-family or single-commercial (U.S. EPA, 2001; Skumatz & EPA, 1996). Record keeping must start at the account level with collection service providers. Multi-tenant customers are designated on the account record somehow that they are different from single-family or standard commercial accounts.

Multifamily programs that have better recordkeeping, have higher recovery rates.

While most multifamily recycling programs are lacking good data to substantiate their performance, there are also examples of programs that are keeping detailed records of multifamily recycling trends (Stopwaste.org, 2008; Environmental Services Department, 2008; Campbell Delong Resources, Inc., 2014). A simple and common method for data collection is a manual record keeping system, where drivers record the volume of materials collected at each building every time they service a property's recycling. Those volume estimates can be entered

## Multi-Tenant Recycling Literature Review

into a database and converted to known weights of full 95-gallon carts of materials to determine the estimated weight of the material (Eureka! Recycling, 2004). The United States EPA provides some standard volume-to-weight conversions, some of which are provided below (Table 2) (U.S. EPA, 2016).

**Table 2:** Standard volume-to-weight conversion factors of recyclable materials\*

Recyclable material	Volume	Estimated weight (lbs.)
<b>Containers (plastic bottles, aluminum cans, steel cans, glass bottles), corrugated containers and paper</b>		
Commingled recyclables	Cubic yard	262
<b>Containers (plastic bottles, aluminum cans, steel cans, glass bottles) and paper</b>		
Campus recyclables	Cubic yard	92
Commingled recyclables	Cubic yard	111
<b>Containers (plastic bottles, aluminum cans, steel cans, glass bottles)</b>		
Campus recyclables	Cubic yard	70
Commingled recyclables	Cubic yard	67
Commercial recyclables	Cubic yard	113
<b>Containers (cans, plastic)</b>		
Campus recyclables	Cubic yard	32
<b>Containers (cans, plastic) and paper</b>		
Residential recyclables	Cubic yard	260
<b>Containers (food and beverage, glass), corrugated containers and paper</b>		
Commercial recyclables	Cubic yard	58-88
Multifamily recyclables	Cubic yard	51-96

\*Adapted from EPA weight-to-volume conversion factors (U.S. EPA, 2016)

There are also collection service providers that are tapping into the newest technologies to track the services they provide. High-tech, weight-based systems have been piloted in the U.S. and are already being implemented overseas. These systems use computers and scales on board trucks to weigh receptacles. The receptacles are marked with radio frequency tags, which electronically identify the household and record data. The data is then translated into a bill to the customer that is based on the actual weight of garbage or recycling set out (Michigan DEQ, 2016). A recent design charrette also tackled the combined challenge of recordkeeping and convenient access to garbage and recycling in large apartment complexes by rethinking the garbage chute. A team of designers spent one week developing a Smart Chute. The chute is operated with a tablet and records data on each tenant's waste disposal habits (Shapins, 2017). Innovations like these could help to provide more accurate data on multi-tenant recycling behaviors and improve service to these notoriously difficult-to-service properties.

The Portland-Metro, Oregon, area uses a software tool, Re-TRAC Connect to measure and monitor the compliance and success of the multifamily recycling (Re-TRAC Connect, 2017). All 55 collection service providers in the region use the system. Regional program managers rely on Re-TRAC's analytics to aggregate jurisdictional data, perform data analysis, and generate reports to submit to Metro (Re-TRAC Connect, 2017). The State of Georgia is also a Re-TRAC subscriber. The Re-TRAC system is explained in detail in the Government Policy section of the Building Multifamily Recycling Programs in Georgia's 2010 toolkit, which is included in the collection service provider and city multi-tenant recycling program tracking tools shared in Appendix D (Georgia Recycling Coalition, 2010). Specific reporting requirements for collection service providers can be found in the contract and franchise agreement templates in Appendix A.

### 3.3 Policy

Fundamentally, the use of policy to increase recycling strives for beneficial outcomes for the environment, at a manageable cost, in the near and long term. This means that waste trends must be shifted towards minimization,

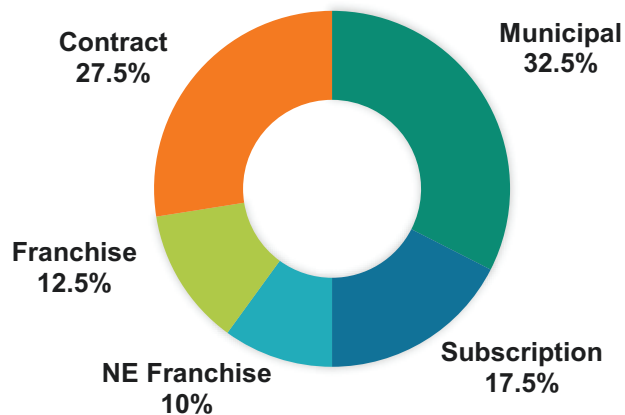
## Multi-Tenant Recycling Literature Review

reuse and recovery, with landfilling used only as the last resort. The topics discussed in this section of the review focus on identifying recycling policies and practices that will help to increase material recovery from multifamily and multi-commercial sectors, thereby contributing to the larger effort to minimize waste on a national scale. This section will first discuss the possible ways in which policy can affect the organizational structure of multi-tenant recycling programs. Next, different approaches to using state policies and city ordinances to increase recycling participation are presented. Finally, possible recycling program cost models are compared.

### 3.3.1 Municipal and private collection

The most basic differentiation that can be made between the organization of recycling collection services is that they can either be provided by employees of local government (municipal service) or by employees of a private firm (private service) (U.S. EPA, 2001). In a nation-wide study conducted by the EPA, 40 communities with multifamily communities, it was found that private firms provide recycling services to 67.5 percent of those communities, and most of those firms were either under contract or held an exclusive franchise agreement with the local government (U.S. EPA, 2001). Only 17.5 percent of the communities relied on subscriptions between private firms and customers (Fig. 1) (U.S. EPA, 2001).

**Figure 1:** Split of organizational arrangements for U.S. multifamily recycling programs — adapted from EPA Multifamily Recycling Report (U.S. EPA, 2001)



Types of collection service:

- Private service — employees of private firm provide service (Stevens B. J., 1999)
- Subscription — private firms are licensed by the local government to compete for the business of any potential customer. Many private firms provide direct subscription service to customers. Typically, there is no rate regulation.
- Municipal service — employees of local government provide service.
- Contract — a local government contracts a single private firm to provide service. The firm submits a monthly invoice and is paid by the local government.
- Franchise — a local government or the state enters into one or more exclusive franchise agreement with a private firm to provide service for a defined geographic area(s). The arrangement can include a license to use a trademark or other identity associated with the franchisor. In exchange, the franchisee pays some form of fee. The offer and sale of franchises is highly regulated by both federal and state laws. The firm bills the customers directly and is not paid by local government.
- Non-exclusive (NE) franchise — the same as exclusive franchise, only that more than one firm is authorized to provide service in a given geographical territory (Stevens B. J., 1999).

★ In an economic study of the organization of local U.S. waste and recycling markets, which examined data from the 1995 International City/County Management Association survey, it was highlighted that contracts (where a firm submits a monthly invoice and is paid by the local government) were identified as the least-costly approach to collecting residential waste (Walls, Macauley, & Anderson, 2005). However, it was also noted that the goals and expectations of contracts and franchise agreements, including outreach frequency, service levels and data collection requirements, were often not specified.

Jurisdictions should be familiar with, and enforce, the elements of their agreements to ensure the agreed-upon services are provided in full. Specifications for the franchise should describe all details of how collection services would be provided, including receptacle location requirements, time of day services are allowed in different areas of the local jurisdiction, and procedures for resolving service issues and complaints. An important feature of the specifications is the requirement that reductions in garbage collection service (frequency or size of receptacles), and thus cost of service, would be accommodated as recycling increases (Michigan DEQ, 2016). Since contracts also come with their own associated costs and unavoidable challenges of enforcement and monitoring, municipal services may become preferable as environmental objectives become increasingly important (Walls, Macauley, & Anderson, 2005).

Other demographic factors that influence the organization of recycling service agreements include population density, funding flexibility, and presence of a government-owned waste or recycling processing facility. Communities with higher population densities are more likely to choose an exclusive contract/franchise or government provider, indicating that above a certain population density a single provider is less costly than multiple private firms (Walls, Macauley, & Anderson, 2005). More budgetary flexibility and the presence of a government-owned and operated landfill or materials recovery facility (MRF) also make it less likely that a community will choose private collection companies.

### 3.3.2 State policies and city ordinances

While multi-tenant recycling programs across the United States have lagged behind single-family recycling programs for decades, in the new millennium, states and cities have been making efforts to change that. Nationally, between 1989 and 2014, a total of 94 recycling ordinances specific to multifamily and/or commercial programs have been passed. Many of these have been adopted in recent years. The number of ordinances approved annually, related to multi-tenant recycling programs, increased by more than 100 percent since 2004 (Reid, 2016). The states leading the way are California, Florida and Pennsylvania, which have adopted 42, 15 and 10 recycling ordinances, respectively (Reid, 2016).

#### 3.3.2.1 Mandatory participation

The most direct example of inducing increases in recycling participation using formal law is through mandatory provision of multi-tenant programs. Mandatory recycling can send a strong message to citizens that recycling is important. Even with little threat of enforcement, a recycling law can help to reconstruct social norms. Laws also encourage cooperation by taking advantage of a more generalized norm of law abidingness (Carlson, 2001; Everson, 2009).

★ A national study of multifamily recycling programs in 40 communities found that multifamily recycling programs were slightly less likely to be mandatory than single-family recycling programs (61.5 compared to 64.1 percent), and generated fewer complaints per household served (0.028 compared to 0.034 per household per year). The study also found that 90 percent of the high-recovery programs (greater than 20 percent recovery rate) were mandatory, and local governments used sanctions for enforcement (U.S. EPA, 2001). Another study looking at county-level recycling

Contracts are the least-costly approach to collecting residential waste.

Mandatory residential recycling ordinances significantly increase recovery rates.

## Multi-Tenant Recycling Literature Review

data across Minnesota, found that the enactment of mandatory residential recycling ordinances significantly increased recycling rates (Sidique, Joshi, & Lupi, 2010 ). Similarly, a large-scale investigation of single-family recycling programs in 500 North American communities (in 1996) found 33 percent of all single-family recycling programs to be mandatory. In these communities, the overall recovery rate was higher where yard waste programs were also mandatory (Skumatz & EPA, 1996). A large percentage of waste has been found to be organic material and if this stream can be diverted from the landfill, material recovery rates could improve dramatically (Metro, 2015; Oregon DEQ, 2017). The Sustainable Materials Management Report has also recommended limiting or banning landfilling and incineration of compostable materials (U.S. EPA, 2009).

There are many possible ways in which mandatory recycling requirements can be imposed, which might include:

- Multifamily buildings — establish an ordinance requiring multifamily buildings to establish recycling programs that collect mixed paper, newspaper and three other materials. Example: The Portland Bureau of Environmental Services found that the proportion of complexes with no recycling program dropped from 10 percent in 1995 to two percent in 1996 as a result of the ordinance. High recovery programs are more likely to report the use of fines, liens or other sanctions against complexes that do not recycle properly (Metro , 2017; Michigan DEQ, 2016).
- Multi-commercial buildings — describe an ordinance that addresses commercial recycling requirements for owners and managers of all commercial business types. The requirement of the ordinance should be to recover materials collected in the local or regional recycling facility (Michigan DEQ, 2016). Example: In the greater Portland, OR area, under state recycling opportunity requirements, collection service providers are required to provide recycling services to businesses that want to recycle, but businesses are not required to recycle except in the City of Portland. Inside the city limits businesses are required to recycle at least 50 percent of their waste (Metro, 2008).
- Collection service providers — establish an ordinance requiring collection service providers to provide multi-tenant recycling service or adopt a contract or franchise agreement specifying mandatory multi-tenant recycling. Example: In Tehema County, Calif., the County's franchise agreement with a local collection service provider requires the collection service provider to provide its multi-tenant building customers garbage service with recycling and yard waste collection at no extra cost. The company must accept certain materials for recycling and must provide receptacles for garbage and recyclables.
- Recycling plans — requiring multifamily owners to develop and file recycling plans stops short of mandatory recycling, but motivates some buildings to sign up for recycling (Beck, 2008).
- Recycling in the lease — recommend that multi-tenant building managers require recycling as part of the lease; if the community requires multi-tenant recycling, be sure tenants understand that recycling is not optional (Georgia Recycling Coalition, 2010; Kennedy A. L., 2010; Eureka! Recycling, 2004).
- Recycled-content mandates — require that products contain a minimum fraction of post-consumer material. The goal of recycled-content mandates is to increase demand for recycled materials, which could also potentially increase material prices (Barlaz, Loughlin, & Lee, 2003).

Model multi-tenant recycling program contracts and franchise agreements, which can include clauses that mandate collection service to multi-tenant buildings and regular bulky waste services, are provided in Appendix A. Model multi-tenant recycling ordinances are also included in Appendix B.

### 3.3.2.2 Incentives and goals

Short of mandating recycling, another popular policy tool for encouraging recycling is goal setting and incentives. A few of the 40 communities included in the national EPA multifamily recycling study have been able to surpass a 25 percent material recovery goal by creating incentives and mandates, which motivate the constituents (U.S. EPA, 2001). In an effort to boost multi-tenant recycling participation, the City of Seattle developed an ambitious incentive program. Collection service providers who achieved less than 70 percent participation were fined and those who reach an 80 percent participation goal received a bonus (Touart, 2000). A discussion of the direct influence of goals and incentives on recycling behavior is included in Section 3.1.2.1 Incentives and 3.1.2.2 Goals.



### 3.3.2.3 Materials collected

Policies can dictate how many materials a service provider must include in the recycling program. Most programs can choose five and include additional materials optionally. Review papers and meta-analysis studies have found that with an increase in the number of materials collected there is also an increase in the material recovery rate (Skumatz, 2008; U.S. EPA, 2001; Metro, 2008). Certain materials can also be banned from entering the normal waste stream, such as, organics, electronics or hazardous waste. In a study of 500 North American communities, it was found that 16 percent of communities had banned landfilling of yard waste (Skumatz & EPA, 1996). Additionally, kitchen scraps have been banned from landfill in some cities, including San Francisco, Seattle, Fort Collins, Toronto, and Vancouver and Victoria, B.C. (Fish, 2015). In some of these cities, property managers are fined for high contamination rates. This generates incentive for the property managers to make composting and recycling as easy for the tenants as possible (Fish, 2015).

#### Commercial wasted food

★ In the 2017 Oregon DEQ Strategic Plan for Preventing the Wasting of Food, it was found that commercial and institutional kitchens, along with grocery stores, account for an estimated 40 percent of wasted food in the United States. Making commercial and institutional organics collection programs mandatory could have a big impact on waste recovery from landfills (Yepsen, 2015; Oregon DEQ, 2017). There is little research on commercial best practices for preventing the wasting of food, and Oregon DEQ is actively working to address that research gap. In November 2017, Oregon DEQ created a campaign to help commercial generators of food save money by reducing wasted food (Oregon DEQ, 2017). It has been recommended that traditional recyclables be prioritized for most multifamily recycling programs, since organics programs are more challenging. Buildings that have high levels of participation and recovery along with low levels of contamination of traditional recycling could be the focus for the addition of organics collection routes, as franchises permit (Stopwaste.org, 2008). The City of Seattle, for example, has already mandated wasted food collection for multifamily buildings (WAMRS, 2014).

Making commercial and institutional organics collection programs mandatory could have a big impact on waste diversion from landfills.

### 3.3.2.4 Material collection-area space ordinances

Communities can choose to adopt ordinances that ensure adequate allocation of space for materials collection areas. For example, California Integrated Waste Management Board developed a model ordinance for adoption by any local agency about areas for collection and loading of recyclable materials in development projects. The ordinance required local agencies to adopt the model, or an ordinance of their own. If a local agency had not adopted its own ordinance by the given deadline, the model ordinance would take effect. An alternative to a collection-area space ordinance is to adopt design guidelines for new construction and significant remodels (Stopwaste.org, 2017). Examples of space ordinances and design guidelines are included in Appendix B.

### 3.3.2.5 Tracking, reporting and enforcement

#### Tracking

★ As with most activities, measuring outcomes is also a key element to making progress. Tracking the performance of a program is clearly correlated with achieving high-recovery rate (U.S. EPA, 2001). Recordkeeping may even be a causal factor in the success of these programs, as programs that know how many receptacles are distributed and where, and how often they are serviced, will be better equipped to focus their program

Tracking performance is clearly correlated with a high-recovery rate.



## Multi-Tenant Recycling Literature Review

outreach efforts and maximize the use of program resources (U.S. EPA, 2001). It is rare that multi-tenant recycling program data is tracked separately. In the national EPA study examining multifamily recycling programs, 30 percent of the 40 communities were able to provide separate data. Additionally, the Washington State Recycling Association asserted that they experience a lack of reliable data regarding recycling rates and tonnages specific to multifamily recycling, and underscored that this prevents adequate measures of program success (WAMRS, 2014).

While many multi-tenant recycling programs are lacking good data to substantiate their performance, there are also examples of programs that are keeping detailed records of multi-tenant recycling trends, such as San Jose, California, Portland and Seattle (City of San Jose, 2011; WAMRS, 2014; Metro , 2017). These cities have multi-tenant recycling program recovery rates between 23-70 percent (City of San Jose, 2011; U.S. EPA, 1999; Metro , 2017).

### Reporting

In the 2001 EPA multifamily recycling report of 40 sample communities, the second most common problem cited with program operation was contractor cooperation with data sharing and reporting material quantities (U.S. EPA, 2001). It is important to include detailed specifications for reporting requirements in the collection service provider contract or franchise agreement. Examples of these specifications are included in model contracts in Appendix A.

### Enforcement

★ Good recordkeeping can also make enforcement easier. There are many different approaches and levels of enforcement of local multi-tenant recycling regulations. Overall, communities in the low-recovery category report fewer enforcement activities. Cities and collection service providers spot-check garbage and recycling receptacles and provide feedback to the customer, and sometimes issue warnings or fines for incorrect sorting. Communities in the high-recovery category report more frequent use of notices, fines or sanctions against complexes which violate the regulations (Stevens B. J., 1999).

Communities in the high-recovery category report more frequent use of notices, fines or sanctions against complexes which violate the regulations.

Enforcement can also take place at a higher level, such as enforcing the specifications in a contract or franchise agreement. For example, the City of Fremont, California, has institutionalized multifamily recycling through charters and franchises. Included in the terms of Fremont's exclusive franchise agreement with Allied Waste Services is a requirement that service be provided to multifamily dwellings, and a clause that the franchisee must complete three audits per year to estimate allocation between multifamily and commercial collections, for recordkeeping purposes (Stopwaste.org, 2008). Seattle, WA, and San Jose, California, are also cities with high-recovery multifamily programs that keep excellent records. They are able to keep these records because they require in their contracts with their service providers that data for tonnage collected and number of households served, for both single and multifamily households, be provided (U.S. EPA, 2001).

Examples of collection service provider contracts and franchise agreements, which contain specific requirements for tracking and reporting, are included in Appendix A.

### 3.3.2.6 Waste disposal fee structures

Businesses and individuals alike are driven by economic incentives. If recycling could be performed for the same or a lesser cost than disposing of waste, and it were convenient, customers would willingly adopt recycling programs (Stevens B. , 1994). If cost structures incentivize reducing the total waste generated by a customer and reward increases in recycling rates, the recycling behaviors of customers should begin to respond to these economic drivers (Stevens B. , 1994; Bilitewski, 2008).

## Multi-Tenant Recycling Literature Review

While there are many different available cost models associated with waste collection services and recycling programs, it must be underscored that customers of multi-tenant recycling programs do not pay for waste disposal directly. Instead, their services are contracted through the building owner or manager and tenants deposit their garbage and recycling into shared receptacles provided by the property. To understand the impact of cost models on multi-tenant recycling participation, it is important to acknowledge that the financial responsibility for waste and recycling services is usually not shouldered by the tenants themselves (Ando & Gosselin, 2005).

### 3.3.2.7 Flat fees

Historically, the most common waste disposal cost model is the flat fee, where customers pay a lump sum through general taxes or flat payments to local governments, or directly to private collectors (Carlson, 2001). In the case of tax financing, the amount of tax to be paid is determined along the same lines as property. The fee is also sometimes linked to the consumption of water or electricity or can also be deducted from a city tax, which is a flat-rate tax paid by every citizen (Bilitewski, 2008). The flat fee must be paid regardless of how much of the service is used by the customer. Usually the receptacles are sized to accommodate the average amount of waste generated by a household. The use of generously sized receptacles has dramatically reduced the occurrence of illegal dumping. For multifamily recycling programs it is common (more than 50 percent) to charge a separate fee for recycling, in addition to the garbage fees (U.S. EPA, 2001). Higher fees (two dollars per unit or more for recycling collection) have been associated with higher recovery rates, with 70 percent of high-recovery programs charging multifamily recycling fees. The most common fee is a monthly flat fee, generally on a households-per-complex basis (U.S. EPA, 2001; Skumatz & EPA, Nation Wide Diversion Rate Study: Quantitative Effects of Program Choices on Recycling and Green Waste Diversion; Beyond Case Studies, 1996; Stevens B. J., 1999).

Flat-fee structures are the simplest, and therefore also the least costly to implement. Most communities understand a flat-fee system, since garbage services have also historically been provided this way. One major drawback of the flat-rate system is that it fails to reward any efforts on the part of the customer to reduce or recover waste (Bilitewski, 2008; Reschovsky & Stone, 1994).

### 3.3.2.8 Variable-rate structures

Most modern fee systems are taking after the “pay-as-you-throw” approach. A successful PAYT methodology charges customers in a fair manner in accordance with the amount of waste they actually generate (Bilitewski, 2008). Variable-rate structures also have the added benefit of not only promoting recycling, but also encouraging waste-reduction behaviors, such as a shift in purchasing patterns toward products with less or recyclable packaging (Reschovsky & Stone, 1994). In curbside single-family recycling programs, variable pricing has been shown to be an effective policy tool for increasing recycling rates and reducing waste (Sidique, Joshi, & Lupi, 2010). This system allows building owners to reduce their fees as the volume of discards decrease or are diverted from garbage to recycling. Many single-family programs, in more than 7,000 jurisdictions in the United States, now use variable-fee structures based on volume or weight (Carlson, 2001; Skumatz, 2008). These communities have seen up to a 50 percent increase in recycling (Skumatz, 2008; Hector, 2008). However, within those 7,000 jurisdictions, there are very few examples of multi-tenant programs that have adopted variable-rate structures — the City of Aspen, Colorado, being one notable exception (Skumatz 2008; Carlson 2001). In order to implement variable-rate structures for multi-tenant programs, a monthly flat fee for recycling can be charged per unit in a building while variable fees for garbage are implemented. The reduction in garbage fees as more materials are diverted to recycling can work as an incentive and be communicated or passed on to tenants (U.S. EPA, 2001; Skumatz & EPA, 1996). Alternatively, modern technical solutions, with electronic identification and data transfer, could provide a solution to the challenge that shared material collection areas and receptacles present in multi-tenant complexes (Skumatz, 2008).

### 3.3.2.9 Weight-based programs

Weight-based programs are true PAYT systems, charging customers directly for each unit of waste generated. Truck-based scales can be used to weigh garbage and recycling receptacles and charge customers based only on the actual pounds of material set out for disposal. The required tracking of waste generated by individual

households can be a barrier to multi-tenant recycling program adoption (Skumatz, Pay as You Throw in the US: Implementation, Impacts, and Experience, 2008).

### 3.3.2.10 Volume-based programs

- **Variable-receptacle programs** are examples of PAYT systems using units of volume. Customers choose the number, size or both of receptacles appropriate for their household. Rates increase for larger number and size cans. A service where individual households use separate cans is not ideally suited to multi-tenant recycling programs (Skumatz, 2008).
- **Bag, tag or sticker programs** are volume-based programs where customers are required to purchase the appropriate bags, tags or stickers, and dispose of all waste in the special bags, or bags clearly marked with the tags or stickers. The most common size bags in these programs are 30 to 35 gallons. Like bags, tags and stickers are usually good for 30-gallon increments. Bags, tags or stickers might be sold at city hall or community centers, but are most commonly available at participating grocery stores or convenience chain stores (Skumatz, 2008).

### 3.3.2.11 Hybrid program

Hybrid programs are a combination of a monthly flat fee and one of the variable-fee models described above (Skumatz, 2008; Bilitewski, 2008). The flat-fee system does not take into consideration the variable cost factors, while the receptacle system ignores the proportionally-based fixed share of the costs (Bilitewski, 2008). These are some of the reasons why traditional fee systems have to be improved. Instead of receiving unlimited collection for payment of the monthly fee or tax bill, the customer only receives a limited volume of service for the fee. Limits for the flat fee service in communities across the country are typically one receptacle, two receptacles or two bags (Beck, 2008; Skumatz, 2008; Skumatz & EPA, 1996). For disposal beyond the base limit, customers are required to buy bags or stickers, as described above, for any extra garbage. As a rule of thumb, the amount representing fixed costs should make up 60-80 percent, and the variable costs should range from 20-40 percent of the total costs (Bilitewski, 2008). Under a hybrid system, the base service level can be tailored to best suit the community. No new billing system is needed, and bags only need to be purchased for service above the base. Existing collection and billing structures can be retained with minimal changes, and many customers see no change in their garbage fee. However, this often results in higher administrative overheads and generally leads to increased collection costs (Bilitewski, 2008). This system also provides a monetary disincentive for those who are putting out higher amounts of garbage (Michigan DEQ, 2016; Bilitewski, 2008).

★ With a graduated fee, by reducing, recovering or recycling waste, a resident can directly influence their own incurred costs (Bilitewski, 2008). This is a benefit to the community because it encourages residents to use the resources frugally. However, the direct costs of disposal are arguably high enough to tempt some residents to compact waste, to burn it or even to dump it illegally, thus defeating the purpose of the program and only seemingly reducing the quantity of waste produced (Bilitewski, 2008). Despite this potential abuse of the system, variable-rate communities have been associated with significantly higher recovery rates, holding all other program features and demographics constant (Skumatz & EPA, 1996). Variable-rate programs should ideally be based on a two or multi-component waste charge system. A fixed fee charged to each household and a variable fee component is then additionally chargeable for each individual unit of waste set out for collection. Fee differentiation clearly demonstrates to customers that an efficient waste management system comes at a price and it lends a certain amount of transparency into the complexity of waste handling and its staggered costs system (Bilitewski, 2008).

Communities with variable-rate structures have significantly higher diversion rates.

The most important element to putting a variable-rate structure in place is the political will. According to all available research, tenants resoundingly prefer PAYT to a flat fee, once it is in place (Skumatz, 2008). The benefits seen and measured in variable-rate communities indicate it is worth further consideration (PAYTNow.Org, 2017).

### 3.3.2.12 Materials tipping fees

★ A “tipping fee” is the cost of disposing a unit of materials at a landfill or an incinerator. Increasing garbage tipping fees improves the relative economics of recycling compared to disposal. This provides an incentive to reduce the amount of garbage disposed through improving recycling programs or encouraging source reduction (Barlaz, Loughlin, & Lee, 2003; U.S. EPA, 2009). Governments at all levels should work with industry and other stakeholders

Increasing garbage tipping fees incentivized recycling compared to disposal.

to use market signals, such as the cost of service, to promote better materials management. For example, in the state of New Hampshire, the average tipping fee climbed to \$52 per ton, higher than ever before in the previous 10 years, and continued to climb to \$72 per ton in 2009 (Huang, Halstead, & Saunders, 2011). From this experience, the state’s Solid Waste Task Force concluded that PAYT reduced garbage generation rates and increased recycling rates. Furthermore, it helped to alter the garbage generation and waste recovery amounts, which reduced the upward pressure on tipping fees (Huang, Halstead, & Saunders, 2011).

Commercial recycling in the United States is most often paid for by the generators and this creates a strong incentive to avoid disposal costs if recycling is less expensive. Increasing tipping fees is an approach that usually increases recycling in the commercial sector. Tipping fee increases have been most successful where local or state governments require waste collection service providers to use particular landfills or transfer stations. For example, in the 1990s landfill tipping fees in New Jersey increased to as much as \$120 per ton. New Jersey had a policy in place which allowed local governments to specify which landfills collection service providers could use. This combination of policies resulted in a considerable incentive for recycling (Barlaz, Loughlin, & Lee, 2003).

### 3.3.2.13 Extended producer responsibility laws

The laws on extended producer responsibility for consumer products intend to shift the responsibility for collection and recycling away from the local government to the producer of the products. The price for the recycling service is incorporated into the product’s selling price. Additionally, in various countries, non-recyclable convenience items are increasingly being sold with an advance disposal fee (ADF) incorporated into the price. When an ADF is included in the product’s cost, this ensures that the product is properly disposed of when no longer needed (Bilitewski, 2008).

## 4. Discussion

### 4.1 Limitations

The bulk of literature for multi-tenant recycling is about multifamily recycling. Multifamily and multi-commercial recycling have similarities but it should not be assumed that findings for multifamily recycling are applicative to businesses. Additionally, much of the foundation research was conducted between 10 and 20 years ago. The EPA study of multifamily communities was conducted in 2001, nearly 20 years ago. Some findings might not be as relevant now.

### 4.2 Recycling opportunities

Throughout the review, green stars have been used to highlight beneficial practices that have successfully increased recycling rates, or decreased contamination rates in communities over time. Table 3 presents a summary of these 19 highlighted practices. Ideally, all of these practices could be used in combination to improve multi-tenant recycling in Oregon.

## Multi-Tenant Recycling Literature Review

**Table 3:** A summary of the 19 beneficial multi-tenant recycling strategies

Beneficial strategy	Behavior	Collection	Policy	Example Sources
<b>Recycling behavior</b>				
1	Use outreach messages tailored to specific groups of people.	X		(Nixon & Saphores, 2009; Timlett & Williams, 2008)
2	Conduct sufficient commercial recycling program outreach and education.	X		(Environmental Services Department, 2008; Stopwaste.org, 2008; Metro , 2017)
3	Increase convenience of recycling.	X	X	(DiGiacomo, et al., 2017; Oom do Valle, Reis, Menezes, & Rebelo, 2004; U.S. EPA, 2001)
4	Provide feedback.	X	X	(Timlett & Williams, 2008; Osbaldiston & Schott, 2012; De Young, et al., 1995)
5	Use several types of media for recycling outreach and repeat quarterly.	X		(Oskamp, et al., 1994; Callan & Thomas, 1997; Schultz W. , 2002; Metro , 2017; Nixon & Saphores, 2009)
6	Conduct face-to-face outreach.	X		(Cotterill, John, Liu, & Nomura, 2009; Cascadia Consulting, 2012)
7	Use inclusive messaging.	X		(Oom do Valle, Reis, Menezes, & Rebelo, 2004; Burn & Oskamp, 1986; Mee & Clewes, 2004; Osbaldiston & Schott, 2012)
<b>Recycling collection system</b>				
8	Increase number of materials collected.		X	X (U.S. EPA, 2001; Metro, 2008; Skumatz & EPA, 1996)
9	All shared receptacles should be color coordinated, clearly labeled and have sufficient capacity for the building.		X	X (Smith, 2014; Lane & Wagner, 2013b; City of Portland, 2008; Fish, 2015; U.S. EPA, 2001)
10	Adopt ordinances or new building guidelines to set aside adequate space for shared material collection areas. Provide sufficient in-unit space for collection.		X	X (Skumatz & EPA, 1996; Smith, 2014; Rockwell, 2017; Beck, 2008; California EPA, 1993)
11	Adopt city code that requires signage to include instructional images as well as multiple languages.		X	X (Metro , 2017; Kennedy A. L., 2010; Olson, Powers, Rheineck, Sexton, & Yew, 2010; Fish, 2015)
12	Require diligent recordkeeping and separate tracking of multi-tenant recycling tonnage collected.		X	X (U.S. EPA, 2001; Skumatz & EPA, 1996; Stopwaste.org, 2008; Campbell Delong Resources, Inc., 2014)

## Multi-Tenant Recycling Literature Review

Beneficial strategy		Behavior	Collection	Policy	Example Sources
<b>Recycling policies</b>					
13	Use contracts (with private firms paid by the local government) to collect residential waste.			X	(Stevens B. J., 1999; Walls, Macauley, & Anderson, 2005)
14	Require mandatory provision of multi-tenant recycling programs. Include mandatory multi-tenant recycling in collection service provider contracts and franchise agreements.		X	X	(U.S. EPA, 2001; Carlson, 2001; Everson, 2009)
15	Mandate commercial wasted food recovery programs.			X	(Yepsen, 2015; Oregon DEQ, 2017; WAMRS, 2014)
16	Require diligent tracking of program performance. Track multifamily tonnage separately.		X	X	(U.S. EPA, 2001; WAMRS, 2014; City of San Jose, 2011; Re-TRAC Connect, 2017)
17	Enforce activities at the building level and at the collection service provider level.		X	X	(Stevens B. J., 1999; Stopwaste.org, 2008; U.S. EPA, 2001)
18	Use a variable-rate hybrid fee structure.		X	X	(Skumatz, 2008; Bilitewski, 2008; Beck, 2008; Skumatz & EPA, 1996)
19	Increase garbage tipping fees.			X	(Barlaz, Loughlin, & Lee, 2003; U.S. EPA, 2009; Huang, Halstead, & Saunders, 2011)

The beneficial strategies in section 3.1 Behavior, include identifying a focus audience and tailoring program messaging to specific groups. The importance of focused outreach to businesses, which make up the largest waste producing sector in the State of Oregon, is also underscored. Additionally, improving the convenience of recycling collection in multi-tenant buildings and providing feedback on recycling performance are highlighted. There is general agreement in the literature about the overall importance of strong outreach and education campaigns. Successful outreach strategies combine multiple types of media channels to communicate program messaging. The use of face-to-face outreach methods and inclusive messaging are also recommended.

In section 3.2 Collection system, the main beneficial strategies are related to the provision of adequate space and signage. It is recommended that multi-tenant programs attempt to increase the number of materials collected. Communal receptacles should be color-coded, clearly labeled and provide sufficient capacity. These strategies can be reinforced in material collection space ordinances, adopted at the city level. Space ordinances or city code that mandate the inclusion of multiple languages and images on signage could also be adopted. Finally, it is highlighted that detailed recordkeeping and reporting requirements are more common in high recovery recycling programs.

In section 3.3 Policy, the organizational arrangement of recycling services provisions are considered. Most commonly, contracts with private firms paid by the local government are the least-costly approach to collecting residential waste and are therefore recommended. Adopting policies that make the provision of multi-tenant recycling programs mandatory, at the building level, at the city level, and at the state level are also recommended. Using mandates to increase the adoption of commercial wasted food collection programs could dramatically improve statewide material recovery rates. The literature shows that programs that require diligent tracking of program performance and separate tracking of multifamily tonnage are usually high performing programs. High-recovery programs also perform more enforcement activities at the building level and at the collection service

## Multi-Tenant Recycling Literature Review

provider level, likely contributing to program success. Finally, it is recommended that collection service providers adopt a variable-rate hybrid fee structure. This, combined with increased tipping fees, incentivizes recycling over garbage disposal.

From the studies and experiences discussed in this literature review, it is clear that high-recovery communities have employed many of the above-mentioned strategies, and invested time and resources into the three main elements of successful recycling programs. Recycling programs that address recycling behavior, the recycling collection system and recycling policies, have been shown to have greater success than programs with less holistic approaches. The programs that have invested in these three main elements, and used a variety of the 19 beneficial strategies summarized here, are more likely to have recovery rates greater than 20 percent. The overarching shared recycling goal of communities around the country are to shift waste trends towards minimization and to use landfilling only as the last resort. This goal can be achieved when programs find the right combination of tools that provide residents and businesses with access to recycling, the understanding of how to participate, the realization of its environmental and monetary gains, and the importance of tracking and reporting progress.

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# Appendix A

## Contracts and franchise agreement templates

- U.S. EPA —
  - <https://www.epa.gov/transforming-waste-tool/contracts-and-franchise-agreements-waste-haulers-transforming-waste-streams>
  - [www.epa.gov/transforming-waste-tool/full-contracts-and-agreements](http://www.epa.gov/transforming-waste-tool/full-contracts-and-agreements)
- CalRecycle — [www.calrecycle.ca.gov/reducewaste/business/officepaper/Contracts.htm](http://www.calrecycle.ca.gov/reducewaste/business/officepaper/Contracts.htm)

# Appendix B

## Model recycling ordinances

- Calif.
  - CalRecycle — 1993 Space Allocation Guide — [www.calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=832](http://www.calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=832)
  - Stopwaste.org — Space Guidelines for Recycling, Organics and Refuse Services: for Designers of Multifamily and Commercial Buildings — [www.stopwaste.org/sites/default/files/Building-Guidelines-Final-Apr8.pdf](http://www.stopwaste.org/sites/default/files/Building-Guidelines-Final-Apr8.pdf)
  - The Institute for Local Government and CalRecycle — Sample Commercial Recycling Ordinance — [www.recyclenow.org/pdf/sample\\_commercial\\_recycling\\_ordinance.pdf](http://www.recyclenow.org/pdf/sample_commercial_recycling_ordinance.pdf)
- Des Moines, Iowa — Multifamily Recycling Guidelines — [www.dmgov.org/Departments/CommunityDevelopment/PDF/MultifamilyRecyclingGuidelines.pdf](http://www.dmgov.org/Departments/CommunityDevelopment/PDF/MultifamilyRecyclingGuidelines.pdf)
- Ga. — Building Multifamily Recycling Programs in Georgia — Ordinances and Enforcement, Pg. 15-17 — [www.dca.ga.gov/development/EnvironmentalManagement/programs/downloads/MultiFamRecycle2010.pdf](http://www.dca.ga.gov/development/EnvironmentalManagement/programs/downloads/MultiFamRecycle2010.pdf)
- N. J. — Model Municipal Source Separation and Recycling Ordinance — [www.nj.gov/dep/dshw/recycling/whatsnew/model\\_waste\\_ordinance.pdf](http://www.nj.gov/dep/dshw/recycling/whatsnew/model_waste_ordinance.pdf)
- Utah — Business and Multifamily Recycling Ordinance — [www.slcdocs.com/slcgreen/Business%20Recycling/SLC%20Business%20Recycling%20Toolkit%20May%202017.pdf](http://www.slcdocs.com/slcgreen/Business%20Recycling/SLC%20Business%20Recycling%20Toolkit%20May%202017.pdf)
- Texas — North Central Texas Council of Governments — Recycling Ordinances and Building Design Guidelines — [www.nctcog.org/envir/SEELT/documents/Final\\_Report-Ordinances\\_Guidelines\\_August\\_2009.pdf](http://www.nctcog.org/envir/SEELT/documents/Final_Report-Ordinances_Guidelines_August_2009.pdf)

# Appendix C

## Print media resources

- Calif. —
  - ReThink Waste — South Bayside Waste Management Authority — Property Owners and Managers/ Multifamily Dwelling Toolkit — <http://www.rethinkwaste.org/residents/multi-family-residences/property-owners-managers>
  - Stopwaste.org —
    - Multifamily Support Materials — [www.recyclingrulesac.org/multifamily-support-materials/](http://www.recyclingrulesac.org/multifamily-support-materials/)
    - Multifamily Recycling — [www.stopwaste.org/recycling/business/multifamily-recycling](http://www.stopwaste.org/recycling/business/multifamily-recycling)
- Ore. — Portland Planning and Sustainability — Resources for Recycling, Reuse and Waste Reduction — [www.portlandoregon.gov/bps/67463](http://www.portlandoregon.gov/bps/67463)
- Pa. — 2014-2017 Recycling In Multifamily Buildings Initiative, Pg.16-18 — <http://prc.org/app/uploads/2016/11/Multis-White-Paper-Draft-4.pdf>
- Saint Paul, Minn. — Eureka! Recycling —

## Multi-Tenant Recycling Literature Review

- 2017 All In Recycling Guide — [http://docs.wixstatic.com/ugd/8468e6\\_668aae31242f40848342c9c766eab77a.pdf](http://docs.wixstatic.com/ugd/8468e6_668aae31242f40848342c9c766eab77a.pdf)
- Saint Paul Apartment and Condo Recycling — [www.eurekarecycling.org/saint-paul-apartment-and-condo-recycling](http://www.eurekarecycling.org/saint-paul-apartment-and-condo-recycling)
- Vt. — Chittenden Solid Waste District – Brochures, Stickers, and Resources — <https://cswd.net/waste-reduction-resources/>
- Waste Management — Apartments and Condominiums — Mixed and Glass Recycling Guidelines — <http://wmnorthwest.com/portland/apartments.html>

# Appendix D

## Collection service provider and city multi-tenant recycling program tracking resources

- U.S. EPA — Re-TRAC Connect — EPA Sustainable Materials Management Data Management System User's Manual — [www.epa.gov/sustainable-management-food/sustainable-materials-management-smm-data-management-system-users-manual](http://www.epa.gov/sustainable-management-food/sustainable-materials-management-smm-data-management-system-users-manual)