CIF #762

"Review of CIF Funded Projects and Key Learnings"

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Prepared for:

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1.0 Executive Summary

At the request of the Continuous Improvement Fund, York University was retained to undertake a comprehensive review of CIF projects to date, evaluating the experiences, successes and challenges of CIF funded initiatives since program inception.

Study Objectives:

The objectives of the study were to:

- Assess the state of the data currently contained in the CIF reports
- Categorize CIF projects based on type of investments (Investments in promotion and education, multi-residential programs etc.)
- Evaluate the success of each project with respect their ability to achieve their intended objective (i.e. cost containment, improve diversion, improve accessibility etc.)
- Identify the enabling factors that contribute to a successfully funded project
- Gauge whether certain projects (or types of projects) yield a better return on investment relative to others
- Assess whether locality affects the types of projects that should be supported in a given area
- Provide recommendations regarding future funding priorities
- Provide recommendations regarding ongoing monitoring and assessment of funded projects

Study Deliverables:

- A report documenting the findings from the review, organized by project investment type

Structure of Report:

This report has 9 chapters:

1. Executive Summary
2. Investments in Rolling Stock
3. Investments in Recycling Promotion and Education (P&E)
4. Investments in Multi-Residential Projects

5. Investments in Public Space Recycling
6. Investments in Research Projects
7. Investments in Program Support Initiatives
8. Investments in MRF/Transfer/Depot Infrastructure
9. Conclusion

1.1 Key Learnings

Based on a review of CIF projects to date, there are a number of "key learnings" that have been summarized in the list below, as well as in greater detail at the end of each chapter. However, if we are to take a step back, and talk about the characteristics of (and enabling conditions for) a successful program, the following can be intuited:

There is a natural chronology to the "evolution" of a successful recycling program. While there is no one common recipe for success, there are pre-requisites that are common to all programs.

- The success of a municipal recycling program is a direct function of accessibility. The ability for households to have access to Blue Box recycling (either via curbside, or drop off points) is a pre-requisite to participation. Funded projects that supported the expansion of the Blue Box program (by providing service to additional households, or increasing the density of depots/transfer stations) were demonstrably effective at increasing the number of recovered tonnes.
- There needs to be sufficient capacity (both with respect to what households are able to generate and capacity within the processing system for recyclables). This will ultimately dictate the theoretical maximum of what a municipality is able to recover. Constraints on capacity are likely to occur during the initial stages of a program, or in areas (i.e. multi residential and public spaces) that have lower relative rates of recycling participation. CIF funded projects that supported the purchase of additional/larger Blue Bins, or investments at the MRF that allowed greater quantities of material to be processed, were successful at increasing the number of tonnes diverted.
- The "What, where, when and why" of a program needs to be effectively communicated to residents via promotion and education initiatives. However, P&E must be seen as an accompanying measure, and not a standalone initiative. Promotion and education is most effective when there is adequate access, sufficient capacity and recycling is made convenient for households. Consideration also needs to be given to what type of promotion and education is

most effective, the medium that should be used, and how best to communicate information to residents. This is discussed in greater detail in Chapter 4.

- Convenience is a significant predictor of household recycling, particularly within multi residential buildings and in public spaces. Generally speaking, households want and are willing to recycle, but are not willing to incur a significant "cost" to do so (expressed in either time or money). Funded projects that improved convenience (improved accessibility, larger recycling bins, optimized placement of public space bins in high traffic areas etc.) were successful in increasing the number of recovered tonnes.

  It should be noted that while convenience is generally tied to accessibility, increasing perceived convenience can also be achieved through promotion and education initiatives. Many of the barriers surrounding recycling participation are actually knowledge based, i.e. what constitutes appropriate recyclable material? Where should I put my recyclables and how often? P&E that effectively communicates this information to residents can assist in making recycling more "convenient" for households.
- The economic performance of a program is very much a function of the collection and processing system that is in place. The choice between Single vs. Multi Stream systems, bins vs. automated carts, depots vs. curbside collection etc. all significantly affect recycling system costs. As such, careful consideration needs to be given to what is most appropriate given the characteristics of the program. The above point speaks to the fact that there is no one formula for success – a small program in rural Ontario may find that depot programs are most appropriate, while large urban municipalities may opt for bi-weekly curbside collection using automated carts and a single stream MRF. Generally speaking, the larger the municipality, the more economically viable curbside and automated collection become.

  What becomes slightly less clear is whether single stream or multi stream recycling is preferable. Single stream recycling offers households more convenience, which has been shown to result in increased recovered tonnes. However, single stream recycling often results in higher rates of contamination, and requires a single stream equipped MRF that rely on automated sorting processes. Once again, larger municipalities who have a critical mass of material and the ability to invest in collection (automated carts) and processing infrastructure (mechanized sorts at the MRF), may find single stream collection a more suitable alternative. Conversely, smaller

municipalities will need to consider whether they are able to invest in processing infrastructure to overcome contamination issues faced by single stream systems.

- Municipalities benefit from being able to harmonize their program with sister municipalities in the surrounding area. As noted in Chapter 7, program harmonization should be seen as a better practice, as coordinating and pooling resources often results in a preferable outcome relative to "going it alone". The ability to negotiate better collection and processing contracts and deliver more effective service to households as a result of program harmonization, has been shown to improve both recycling and economic performance.

With the above in mind, the pre-requisites for a successful program can be summarized as:

1) A program should be accessible; 2) There needs to be sufficient capacity; 3) Recycling should be as convenient as possible for households; 4) Promotion and education should be used to communicate the essentials of the program to residents, but should be viewed as a complimentary tool as opposed to a standalone measure; 5) the choice for what type of system to implement (single vs. dual) is a function of program size and locality, and 6) Programs should seek to harmonize and pool resources with other municipalities where appropriate

However, all other things being equal, the above measures are only likely to get municipalities to a "baseline" level of performance. While there is no exact figure for what this baseline may be (as it is often dictated by locality) the provincial recycling rate average has historically been around 60%, and at a net cost per tonne of approximately $280. It seems reasonable to conclude that baseline performance resulting from having implemented the aforementioned pre-requisites is somewhere near the historical average (recognizing that locality significantly impacts recycling system performance).

However, what are the key learning's from the CIF report that can help municipalities achieve over and above this baseline? The concept of incremental performance increases, either in terms of diversion or cost containment, is becoming an increasingly difficult proposition for municipalities, particularly in light of the package light weighting issue. With that being said, some municipalities have found success by specifically addressing problem materials (i.e. other plastics) and problem areas (i.e. multi residential recycling), by adopting unique and innovative solutions with financial and technical support from the CIF. It should be noted that the decision to implement any of the following measures needs to take into account site and situation specific factors. As an example, RFID tracking and solar compactors were shown

to have extremely promising results in municipalities that piloted the technology, but that doesn't necessarily mean those successes could be replicated in all municipalities.

Some of the more salient findings from the CIF reports include:

Multi Residential Recycling

- Participation in recycling in multi residential households tended to face greater obstacles with respect to both accessibility and convenience. Municipalities have found success improving household participation and material recovery by working closely with building staff to ensure dissemination of promotional materials, and that recycling drop off points are clean, accessible and safe.
- Ensuring that there is sufficient capacity to accommodate for the generation of building recyclables is a mandatory first step in implementing a multi-residential recycling program.
- Convenience is a significant predictor of behaviour (measured in terms of accessibility), but it should not be seen as the only determinant of recycling participation
- Promotional and educational materials should be seen as a complimentary tool that accompanies adequate capacity and access

Promotion and Education

- Promotion and education should be seen as a complimentary effort that accompanies investments in infrastructure and convenience
- Promotion and education should be delivered using multiple mediums (print, online, billboards) to engage the greatest number of households
- P&E is a central element of virtually every municipal waste management plan, however, different municipalities have different needs and challenges, necessitating that programs be tailored to meet local conditions and characteristics. While there is a significant body of literature (both from the CIF and the academic discourse) supporting the efficacy of P&E, surprisingly little is understood about how to promote recycling among "new recyclers" such as immigrants. Promotion and education materials should be translated when possible. Additional research is recommended in terms of how best to engage ethnic minorities living in multi residential buildings.

Public Space Recycling

- The type of bin you choose in public space recycling matters – there are benefits and drawbacks to various opening designs and multi stream recycling containers. Restricting openings to match the recycling stream can reduce cross contamination discourage illegal dumping, rain and snow egress and vermin. It does, however, result in fewer (but higher quality) tonnes collected. Multi stream bins are significantly more costly which may be an issue for smaller municipalities. They can, however, facilitate twinning of services, aid in matching public space recycling to existing municipal collection services (e.g., two stream collection) and present a neater collection point.

- Density and placement of bins is the most critical factor in determining the efficacy of a public space recycling initiative. You need to be able to give people as many opportunities to recycle as possible, and ensure that those bins are placed in areas with the highest amounts of foot traffic

Market Development

- Developing markets and technologies to recover specific materials should be approached with caution. As a tangent to the previous point, all things being equal, increased diversion is a preferred outcome. However, how much money are stakeholders willing to spend behind developing markets and technologies to recover composite materials or other plastics? While this report does not specifically discourage CIF initiatives that promote material development, these investments should be made strategically. Municipalities should ask themselves "What materials give us the most bang for our buck, when recycled?"
- Projects that provide insights into the "economics" of recycling assist municipalities in managing the somewhat disparate objectives of increased diversion and cost containment. While the public consensus appears to be that increased diversion is better, not all materials are created equal, and municipalities may want to give preference to the recovery of specific materials that are a) more readily recyclable b) have developed end markets and c) have the ability to generate revenue for municipalities.

Collection Infrastructure

- Projects such as RFID tracking, mobile glass processing etc. are projects whose success/efficacy will largely be dictated by location and situation specific factors. RFID technology does show a lot

of promise, particularly with respect to improving collection efficiency for municipalities. However, there was not enough available data to see whether these positive experiences could be replicated in other municipalities.

- Investments that increase the capacity (purchase of larger/additional bins) and accessibility (providing recycling services to a greater % of households) of the Blue Box program are demonstrably effective in promoting increased diversion. These effects are most pronounced in rural and northern areas. The marginal cost of adding additional capacity, relative to its effect on diversion, lends support to financing these types of initiatives moving forward.

Processing Infrastructure

- Investments in the construction of depot facilities were demonstrably effective at increasing recovered tonnes. Depots provide increased service coverage and convenience for households who may not have access to curbside recycling pickup. Further to that point, upgrading existing sites through the purchase of larger capacity bins demonstrably increase the quantities of material recovered.
- Facility maintenance should be highlighted as a priority for facility operators, with financial support being provided by the CIF on an as needed basis to conduct annual audits.
- Investments to improve sorting efficiency and accuracy were demonstrably effective at improving both overall recovery, and the recovery of specific targeted materials. As such, these projects should continue to be supported, when economically feasible. However, a municipality is unlikely to address residue rates by simply investing in new technology alone.

Chapter 2: Investments in Rolling Stock

2.1What is rolling stock?

For the purposes of this project, rolling stock refers to CIF projects designed to improve the capacity, accessibility or convenience of the municipal Blue Box system through non MRF/Transfer station investments (which are considered separately in this report).

Based on a review of CIF initiatives financed to date, rolling stock projects have been further subdivided into specific sub types:

- Automated Carts: Projects to finance the switch from curbside bag to automated cart collection
- Compaction: Investments in compaction trailers

- Containers: Purchase of Large Curbside containers in lieu of the conventional Blue Bin
- Program Expansion: Increasing the collection capacity of the Blue Box program by increasing the service coverage to additional households
- RFID Tracking: Truck and weigh scale RFID technology to track the "flow of waste/recyclables"
- Truck Upgrades: Investments in collection vehicles (i.e. conversion to rear bin collection) and alternative fuel sources (i.e. natural gas vehicles)
- Other: Projects that could not be classified as they were considered to be "one off" initiatives, i.e. ("Mobile Glass processing")

2.2 Automated Cart Collection

There are presently two CIF projects listed that examine the effects of automated cart collection. It should be noted that the city of Torino's automated cart project was part of a larger initiative that also included the performance of compressed natural gas vehicles. While the sample size (2 projects) is not sufficiently large to draw any definitive conclusions, both municipalities reported an increase in overall diversion, and significant reductions in collection costs. A particularly interesting finding is that incidences of workplace injury for vehicle operators and waste collectors were reduced under an automated cart system. This makes sense intuitively, and lends support to the position that automated cart collection be explored as an alternative to conventional bag/bin collection.

However, attributing any increases in diversion specifically to automated cart collection needs to be cautioned – the increase (ranging in 2 – 4% across projects) was not sufficiently large that they can't be explained by unrelated factors.

It should also be noted that rates of contamination in the recycling stream are significantly higher using automated cart collection. The magnitude of this issue, and what means and methods can be used to ameliorate it, are currently being explored by a number of municipalities.

2.3 Containers/Carts

There are presently 14 CIF projects related to the purchase of additional Blue Bins and larger carts as a means to expand household recycling capacity at the curb. In all 14 projects for which summary reports were submitted, the purchase of additional/larger Blue Bins increased overall diversion. These effects were particularly pronounced in smaller/rural/northern communities – a statistically significant increase in overall diversion was observed across the entire data set. It is sometimes difficult to empirically substantiate a finding given that there are a number of other confluencing variables that can impact changes in diversion. However, in addition to the findings observed from an analysis of CIF initiatives to

date, the broader academic literature supports the position that adding additional capacity (either through increasing the number or size of recycling bins) results in an appreciable increase in recycling rates.

Additional recycling bin capacity for households through the provision of additional or larger bins would directly encourage increased household participation in recycling initiatives.

What remains slightly less clear is the impact of adding additional recycling capacity (through the provision of additional or larger recycling bins) has on program costs. By its very nature, investments in additional bins is a cost incurred by the municipality – however, the corresponding increase in diversion may be sufficient to offset that cost in one of two ways: 1) Through the sale of additional recyclables collected 2) Through financial incentives under the municipal pay out model (where, all other things being equal, an increase in diversion will result in a greater % of reported program costs being subsidized by Stewardship Ontario).

While there is not enough data to determine the exact nature of the relationship between the costs of additional blue bins vs. (potential) decrease in costs as a result of increased diversion, there is preliminary support that the return on investment from capacity building rationalizes initial expenditure outlay. Stated more simply, municipalities get a lot of "bang for their buck" by purchasing additional/larger recycling bins.

2.4 Program Expansion

There are presently 3 funded projects that explicitly state program expansion as their primary purpose. It should be noted that expanding the reach and capacity of the Blue Box program are listed as secondary objectives in several other listed projects, but the efficacy/experiences of those initiatives are considered separately.

Program expansion was demonstrably effective in increasing diversion – which is largely an expected outcome given that additional households are now participating in the Blue Box program. By expanding collection services to households (either in the form of curbside pickup or increased density of depot/drop off locations), recycling becomes more "convenient" for households, thereby incenting participation. However, the relationship between program expansion, diversion and costs remains less clear. Much like the provision of additional Blue Bins, expansion of a recycling program is a direct cost incurred by the municipality. However, this cost may be offset (in part), through the sale of additional recyclables or increased relative performance under the municipal pay out model. Given the relatively small sample size

and nature in which the data was reported in the 3 projects listed, no statistical relationship can be inferred between investments in program expansion and program costs.

With that being said, the following assertions can be made: In areas where recycling programs are relatively immature (newly implemented) or suffer from low rates of household participation, program expansion should be seen as a preferred method for increasing diversion. Accessibility and availability of recycling programs is one of the fundamental pre-requisites to a successful recycling program. Program performance cannot be expected to increase unless households have the opportunity to recycle. Previous research in this area has shown that households will not incur a significant "time cost" to recycle (driving a long distance to a drop off point or depot). Thus, increasing convenience via program expansion will directly encourage people to recycle by reducing the effort required to recycle. It should be noted that expanding a recycling program through curbside collection is more effective than increasing the density of depots/drop off points. The former is significantly more expensive to operate, and is sometimes not possible given the infrastructural characteristics of the municipality.

2.5 Compaction (Non MRF/Transfer Station)

There are presently five projects that address investments in compaction trucks/trailers (Non MRF/Transfer Station) – two of these projects are cross listed as public space recycling projects.

The underlying intuition behind investments in compaction technology is to increase the available capacity in trucks/collection bins, subsequently reducing collection costs by reducing the number of pickups required.

All five projects reported a decrease in overall operating costs as a result of investments in compaction technology (at either the bin or truck). Based on the available data, assuming that the observed savings were to be sustained over time, the "pay off" period would range between 2 and 4 years).

Beyond the savings observed in collection costs, the subsequent effect of increased compaction on commodity pricing is not reported. It seems plausible that increased compaction "may" decrease the value/quality of recyclables – however, the materiality of this potential decrease has not been evaluated or quantified. It is the recommendation of this study that follow up work be conducted in this area.

What's interesting to note is that 3 municipalities reported an increase in diversion that they specifically attributed to increased compaction. This is achievable in one of two ways 1) The limit on diversion prior to investments in compaction was "supply side", meaning that there wasn't sufficient capacity in the system to accommodate for the quantity of recyclables being generated, 2) As a result of increased

capacity, household behavior is indirectly incented to "fill the space" in adherence to the principle of cognitive compliance (admittedly, this scenario is a bit of a stretch). However, there was no specific mention in the reports that explained or hypothesized why this increase in diversion was observed, or if that increase could be sustained or attributed specifically to compaction technology.

2.6 RFID Tracking

There are presently only two projects listed on the CIF website that list RFID tracking as their primary purpose. Unfortunately, the region of Peel project did not provide a report, and only listed a brief synopsis of project objectives (but not outcomes).

The City of Timmins did report that RFID technology was able to provide them with a foundation to better control data on waste and recycling collection, and increase the accuracy of data collected with respect to household participation rates in recycling initiatives.

The city reported that RFID technology helped reduce the number of household complaints with respect to why waste was not collected (automated refuse collectors were equipped with "exemption buttons" which identified why the city did not pick up a certain set out. This information was then relayed to a server which would automatically archive this information to be reviewed by either households or city staff at a later date.

Routing data collected enabled the city to identify optimized collection routes and minimize delays among their collection fleet. While the potential savings realized from improved collection efficiency were not quantified, it seems plausible that operating costs would decrease in proportion to the decrease in the number of required truck hours.

Additional data collection is recommended to better understand the linkages between RFID tracking and operating costs in the future.

2.7 Truck Upgrades

There are presently three projects listed on the CIF website that specifically identify "Truck Upgrades" as their primary purpose. It should be noted that truck modifications to improve compaction are considered separately (under section 2.5).

2.7.1 Rear Bin

Two of the three projects listed described the (expected) experiences of converting collection trucks to rear bin packer systems. At this time, only the Township of Greater Madawaska has submitted a final report. From an operational perspective, the transition from roll off containers to ground level recycling

containers was well received by both city staff and residents. Feedback from households indicated that ground level containers increased convenience by reducing the effort expended in offloading material, and improved access during the winter. Conversely, city staff reported that it was easier to monitor the bins and its contents, while simultaneously improving safety conditions for attendants (as they were no longer required to walk up ramps etc.).

The project report noted that the decision to transition to a rear load system increased both the cost effectiveness and cost efficiency of the municipal Blue Box program.

Of note, the authors of the study recommended that other municipalities consider implementing rear load collection equipment to transport recyclables (assuming that they are currently using un-compacted roll off containers). There is not enough data (as yet) to support or refute this recommendation.

2.7.2 Natural Gas Truck Conversion

There is presently one project that examines the efficacy of alternative fuel collection vehicles (natural gas). The city of Torino also evaluated the performance of compressed natural gas vehicles as part of a joint project that explored the efficiency of automated cart collection. In both instances, the conversion of collection vehicles to alternative fuel sources (natural gas) were estimated to have significant cost savings. While there is a significant capital outlay to retrofit collection vehicles (or alternatively, purchase new ones), the pay back periods are relatively short given the lower relative pricing of compressed natural gas liquids. However, these savings are predicated on the proportional disparity in the spot price between natural gas liquids and gasoline. As we have observed over the past 18 months, the average price of gasoline has decreased by 33% per litre, while the price of natural gas liquids has remained unchanged. As such, the potential savings attributable to natural gas collection vehicles is a function of commodity pricing – this is a critical consideration for municipalities who are considering converting their collection fleet, particularly in light of the initial capital costs incurred.

2.8 “Other” Rolling stock projects

There are presently two projects that have been classified as rolling stocks, but could not be sorted into the aforementioned sub categories. This includes a project examining mobile glass processing and stationary box recycling collection.

2.8.1 Mobile Glass Processing

The report on glass recycling was to find a more cost effective solution for processing and marketing glass. The consulting team explored new technology that addresses some of the logistics and end markets concerns associated with glass collection and processing in rural markets. The concept for improved glass

processing in remote municipalities consists of stockpiling glass until a critical mass is reached, and then processing that material using mobile equipment. Mobile equipment can be scheduled in accordance with sufficient glass being stockpiled. It was the recommendation of the report that municipalities pool resources to purchase mobile glass processing equipment to be jointly service a given area.

2.8.2 Stationary Box Recycling Collection

The town of the Blue Mountains conducted a field test to investigate the benefits of a stationary waste box indicator system.

A field test was conducted where an indicator system was installed on participant waste collection boxes. Participants would then label the collection bins (using a sign for either recyclables or waste) on collection days to notify drivers for pickup. The rationale behind such a system was that a significant amount of vehicle operator time was wasted in collecting empty/partially filled bins. There was also evidence to suggest that some bins were going uncollected, as operators erroneously assumed that bins were empty (resulting in household dissatisfaction). The field test demonstrated that a waste box indicator program:

- Reduced missed collection events
- Improves participation in curbside recycling
- Reduces collection vehicle stops and starts
- Improves convenience for part time residents

Participant feedback (both from households and vehicle operators) was quite favorable, as the indicator system was a low cost, easy to use solution for indicating when waste/recyclables were to be picked up.

While an analysis of cost savings was not performed, it seems plausible that the improved collection efficiency (resulting from fewer stops, decreased travel time etc.) would translate into decreased operational costs for the municipality.

With this in mind, it is the recommendation of this study that an indicator system be explored in other municipalities (who face similar issues to the Town of The Blue Mountains). The relatively low capital cost to purchase signs, and ease of implementation make it a potentially low cost and effective solution for improving collection efficiency.

2.8.3 Comments from the broader academic literature

The following is an excerpt taken from Lakhan's 2015 study on Pay as you throw systems in Ontario –

> *"Overwhelmingly, respondents indicated that there was insufficient recycling bin capacity (61.7%) with majority of respondents indicating that they were forced to put*

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

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

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

Increasing the capacity of recycling bins increases the convenience of recycling for households (a behavioral antecedent measured by perceived behavioral control). Increasing the capacity of the bin (visually), also encourages "cognitive compliance" among households – while this is a theory that has not been historically applied to issues surrounding recycling, there is preliminary research that suggests when a household sees a larger space for recyclables, there is a compulsion to "fill the space". When an individual doesn't see their recycling bin as full, they will begin to question whether they have actually recycled everything they are able to. This is why pay as you throw policy shows a complimentary effect with increased recycling bin capacity – by simultaneously reducing the available space for garbage while increasing the space for recyclables, the intended behavior (increased recycling) is magnified.

As a tangent to this, there is also evidence to suggest that increasing the capacity of Blue Bins reduces rates of illegal dumping and littering.

2.9 Conclusions and General Observations

Based on a review of CIF projects classified as "Rolling stocks – Non MRF/Transfer Station", the following can be intuited:

- Investments that increase the capacity (purchase of larger/additional bins) and accessibility (providing recycling services to a greater % of households) of the Blue Box program are demonstrably effective in promoting increased diversion. These effects are most pronounced in

rural and northern areas. The marginal cost of adding additional capacity, relative to its effect on diversion, lends support to financing these types of initiatives moving forward.

- Automated cart collection and increased compaction show promising results, but additional data needed to be collected before they be recommended as a preferred approach. Particularly with respect to automated carts, issues surrounding increased contamination and household attitudes towards carts, needs to be carefully considered.
- Projects such as RFID tracking, mobile glass processing etc. are projects whose success/efficacy will largely be dictated by location and situation specific factors. RFID technology does show a lot of promise, particularly with respect to improving collection efficiency for municipalities. However, there was not enough available data to see whether these positive experiences could be replicated in other municipalities.

2.1 References

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

Chapter 3: Investments in Recycling Promotion and Education (P&E)

3.1 What is Recycling Promotion and Education?

For the purposes of this project, we define recycling P&E as projects designed to raise levels of household awareness regarding municipal Blue Box initiatives. While P&E campaigns vary depending on the intended message and the target audience involved, there is a consensus that communications should clearly specify: 1) why consumers should recycle, including the environmental, economic and community benefits, and 2) how consumers should recycle, including all of the relevant details (what, where, and how) of the program.

There are presently 42 funded initiatives that specifically focus on recycling P&E initiatives, with a total investment of approximately $1.183 million dollars. These initiatives have been broken down into the following sub categories to better differentiate project characteristics and types.

These include:

- Multi Residential Promotion and Education: These projects refer to initiatives that specifically focus on promoting recycling in Ontario's multi-residential buildings.

- Public Space Promotion and Education: Projects who emphasize promoting recycling in public spaces (parks, roadways, city squares etc.)
- Material Specific Promotion and Education: Projects that attempt to promote the recovery of specific materials within the Blue Box, i.e. plastics, fibres etc.
- Program Wide Promotion and Education: Projects that attempt to develop programmatic changes to a municipalities' promotion and education strategy. These projects tend to be "forward looking" describing what is being done and expected results.
- Online Promotion and Education: Projects that use online media to promote a municipalities recycling program (normally web pages)
- P&E Planning: Projects designed to enhance the effectiveness of existing P&E initiatives. These projects have normally been developed by the CIF to be used by other municipalities, and include templates, general recommendations etc.

3.2: Qualifier/Caveats to the analysis

Evaluating the efficacy of recycling promotion and education strategies is challenging, as it is often difficult to isolate the causal relationship between the initiative and the observed outcome, i.e. did project X achieve result Y.

Further to that point, P&E initiatives are often delivered in conjunction with the rollout of another initiative or programmatic change, i.e. (promotion and education for the Region of Peel's new Curbside Cart Program). This further obscures what relationship may exist between P&E, diversion and costs, as there is a collinearity between initiatives (i.e., did the carts cause the greatest change in diversion, or P&E? How do the presence of carts affect the effectiveness of other non-cart P&E?).

Lastly, there is an inter-temporal dimension to P&E initiatives. Behavioral change can be separated into two time periods short term (transient) change, or long term habitual change. A P&E campaign may result in an initial uptake in recycling behavior, but these results may not sustained over time. Alternatively, the effectiveness of a campaign may not be realized until a future time period, as the observed change in behavior takes time before it takes hold.

With these caveats out of the way, there are certainly a number of general observation based on the existing data that one could make. Caution should always be exercised by the reader when making declarative statements based on this analysis.

Direct impacts on program costs are not considered in this section, as P&E is almost by definition a "cost incurred" by the municipality. While increased diversion over time may result in decreases in program costs via the municipal funding model, there was not enough data to facilitate this type of analysis.

3.3: Multi-Residential Promotion and Education

There are presently 5 projects listed that specifically prioritize recycling promotion and education in multi residential buildings. Of these projects, three are cross listed with "Program Planning" initiatives, and are part of a larger P&E strategy being employed by the municipality, or strategies/tools developed by the CIF.

Of note, only 1 of the projects specifically focused on multi-residential buildings in the GTA (the area with the highest density of multi residential buildings). The city of Toronto, Region of Peel and York Region have specific multi residential P&E initiatives that are part of a larger city wide diversion strategy, but few projects under the CIF that are specifically funded for that purpose.

The overall effectiveness of P&E in multi residential buildings (based on CIF experiences and anecdotes gleaned from other research) is that it is mixed. Infrastructural impediments to access (the convenience of recycling) and the unique demography of multi residential families (skewed towards ethnic minorities and lower income groups – although not in all cases), makes recycling a "hard sell" in these areas. Both the Essex-Windsor Solid Waste Authority and the City of Peterborough reported positive preliminary results from their P&E campaign with respect to impact on diversion, but both projects were designed as "long term" studies. Whether these results could be sustained, or even attributed to the P&E initiative, remains unclear.

Multi Residential Planning support from the CIF (helping municipalities design their multi-res campaigns) seem to be useful in providing municipalities with the "ingredients" list of what needs to be considered in an effective multi residential recycling campaign.

There is also significant evidence of a complimentary effect between availability/access of recycling and the effectiveness of recycling P&E. The necessary pre-requisites to an effective multi-residential P&E campaign is that access to recycling is:

- Relatively easy
- Clean/Safe
- Clear with respect to what material goes where
- Supported by building management/superintendent

3.4: Online Promotion and Education

There are presently four projects listed on the CIF website that either support the development of, or describe the experiences of creating web resources to promote municipal recycling programs. Of note, all of the projects were conducted in medium to small municipalities outside of the Greater Toronto Area.

It was the recommendation of the reports that similar P&E web resources be developed and offered to small and northern municipalities. An additional recommendation was that an Ontario wide portal be constructed to rapidly guide Ontario residents to local municipal promotion and education materials. When developing web materials, it is recommended that municipalities engage a consultant or expert that exhibit core competencies in engagement, web development, supplier training and have a familiarity with local council politics and recycling staff.

Many of the reports listed were either "forward looking", i.e. what I will do, or describe initial successes with using online web resources. Participating municipalities tend to view web sites as a convenient and easy to access tool to communicate the what, where, when and why of recycling to residents. Results were positive, and intuitively, it seems like an easy win for municipalities in an era where the cost of implementation is relatively low, while the potential outreach is significant. Information can be readily changed to reflect programmatic changes or update residents with respect to the latest news on the Blue Box program.

3.5 Material Specific P&E

There are presently 8 projects listed on the CIF website that are designed to specifically promote the recovery of certain material types (namely plastics).

These initiatives tend to be collaborative projects between municipalities, the CIF and packaging producers to explore opportunities to increase the recovery of materials that have been characterized as "problematic". The increased recovery of these materials potentially represents a significant opportunity to increase diversion, as these materials are often recovered at a lower rate relative to other materials found within the Blue Box program.

Based on a qualitative assessment of the reports that actually reported results from the P&E campaign (some contained "forward looking" language about what they were going to do (#420), while others, i.e. #834.4, #238 did not include a monitoring component to the report), there was a measurable increase in diversion of targeted material types that are most likely attributable to the P&E campaign.

Unlike generalized P&E campaigns, it is somewhat easier to attribute increases in diversion to a particular initiative due to the specific nature of the campaign. It is generally a-typical for only one material to experience an increase in diversion rates unless that increase was explained by a specific initiative.

There also appears to be some tertiary benefits to material specific P&E campaigns, in that a "spill over" occurs with respect to other recyclable materials. Increasing awareness of plastics is also likely to increase the awareness of recycling in general, indirectly encouraging households to recycle more of everything.

What is less clear is the results from material specific initiatives could be sustained over time, and as a tangent to that, what the "opportunity cost of investment" is. By definition, spending resources to target a specific material reduces the amount available for other diversion initiatives. Does spending $50000 on increasing the recovery of PET thermoforms make sense, when that material comprises such a small share of the Blue Box program and is costly to manage? Would that money be better utilized elsewhere, i.e. investments in multi-res recycling infrastructure?

It is the recommendation of this study that investments in material specific P&E be made when a material is a) generated in sufficient quantities by households and b) can be managed economically within the existing recycling system.

3.6 Public Space P&E

There are currently 3 projects that specifically list public space recycling P&E as their primary objective. However, multiple projects are cross listed with other categories, as public space P&E is part of a larger program wide initiative/strategy/campaign. Some of these projects are jointly funded by both the CIF, municipalities and packaging producers (i.e. Nestle Waters) to tackle the issue of recycling in public spaces.

There are also a number of "project support" initiatives that include public space recycling, including a literature review of public space recycling in other jurisdictions. Evaluating the efficacy of public space recycling initiatives is often an inexact process – seasonality, special events, construction etc. can all adversely impact public space utilization, and subsequently, the quantities of waste being generated and recovered.

During waste audits, it is difficult, if not impossible to control for the multitude of variables that could potentially explain variations in diversion and contamination levels. Public space P&E, particularly through signage, seems to yield improved recycling results. However, these successes are contingent on the types of bin being used and density of bins in a given area.

While chapter 5 will provide a more comprehensive overview of P&E in public spaces, recommendations for promotion and education in public spaces is that it needs to be clear and easy to understand, and that high quality pictures are more effective than text.

Optimal placement of bins (to ensure they are situated in areas of maximal foot traffic), cleanliness of bins and accessibility are critical pre-requisites to a successful public space P&E campaign.

3.7 Program Wide P&E Initiatives

There are presently 20 projects currently listed that are designed to support the development and implementation of comprehensive municipal promotion and education plans for municipalities throughout Ontario.

The lion's share of these initiatives were "forward looking" in an attempt to reach a goal diversion rate in a future time period. However, many of these reports reported preliminary results – outlining experiences and successes during initial program implementation.

While the means and methods (some of which are outlined above) of P&E engagement employed by municipalities are varied, the following are the most common strategies:

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

Based on data gleaned from the reports, a P&E campaign exhibits its greatest impact in municipalities who are expanding their Blue Box program, or are undergoing significant programmatic changes. As an example, promotion and education initiatives that accompanied the introduction of new materials, rollout of new bins, new depot sites etc., all experienced increases in diversion after implementation of an accompanying P&E campaign. This is particularly true in smaller communities, where promotion and education is seen as an effective complimentary tool during a program's onset – it helps these developing (within the context of recycling) areas reach a new baseline level of performance (around 40-50% RR)

relatively rapidly. However, incremental increases in performance beyond a certain level (e.g. to go from 50% RR to 60% RR) becomes challenging, necessitating that multi-pronged, multi medium promotion and education strategies be developed. The Regional Municipality of Waterloo, The City of Ottawa and York Region (all mature recycling markets) engaged in multi-media P&E campaigns (including social media, print, online ads and bill boards) with preliminary evidence suggesting increased capture rates.

Based on both the data from the CIF reports and the wider body of research in the area, conventional methods of P&E engagement are an effective tool for going from point A to point B with respect to recycling performance. However, to get to points C and D, targeted and alternative P&E strategies need to be considered.

Of note, Essex Windsor's Solid Waste Authority "We Can Recycle More" campaign had the unintended consequence of increasing Blue Box contamination. Residents responded by recycling more of "everything", putting toasters, shovels, other non-printed paper and packaging materials in the Blue Box. This finding highlights the need to specifically tailor the message, as households may have difficulty making a distinction between recycling programs for different streams of material.

3.8 P&E Planning

There are presently 6 CIF initiatives that have specifically been classified as P&E Planning projects. These initiatives are generally conducted in tandem with the CIF to develop support and training for the optimal design and delivery of P&E programs. Support projects tend to address a specific issue, i.e. multi residential promotion and education, or P&E in small and northern communities. While it is somewhat difficult to evaluate the success of these types of projects (as it is contingent on the municipality appropriately adopting and implementing the support recommendations), there is significant utility in the "Tool Box" approach. This is especially the case for areas that may not have the internal capacity and resources to develop customized solutions. The CIF (or other agencies that are capable of providing guidance/support) play an instrumental role in providing supplemental P&E support for municipalities. P&E is not often top of mind for programs who already operate on shoe-string budgets. As such, having "pre-fab" solutions and decision tools allow these smaller programs to implement P&E to some degree (and as noted earlier, P&E is demonstrably successful during a program's early stages), without having to incur significant costs in creating solutions from scratch.

3.9 Is there a particular form of P&E that works better than others?

Having reviewed the full range of P&E initiatives listed on the CIF website, as well as overlaying these findings with what can be gleaned from the broader research in this area, can we rank P&E strategies?

(I.e. are newspaper ads better than online resources etc.?). The short answer to this is that it depends on site and situation specific factors.

Broadly speaking, direct engagement strategies (face to face interactions, community events etc.) yield the greatest immediate change in recycling behavior. However, these types of initiatives can only be implemented on a small scale, and are often resource and time intensive. Conversely, P&E advertisements communicated in local newspapers (a popular strategy employed in Ontario given the "in kind" contribution by newspaper stewards), is the least effective. However, given its extremely low cost and broad outreach, opting for newspaper campaigns is an easy fall back for municipalities who want to do "something". The most important take away from this review of P&E projects (and existing research) is that municipalities need to understand their audience, and recognize what works in one area or housing type cannot be readily transposed without adjusting for site and situation specific factors.

3.10 Findings from the Academic Literature

While online web resources have been highlighted as a potentially effective promotion and education strategy for municipalities, Lakhan's study on examining the effectiveness of various P&E mediums on first generation ethnic minorities provides additional insights. Websites are predicated on a basic level of computer literacy and English proficiency. However, a significant percentage of the GTA is comprised of households who are non-native English speakers, or have lower (relative) levels of computer literacy. The following is an excerpt taken from Lakhan's study

> ***"How easy was it for you to find the city's web site on waste management and recycling?"***
>
> This question had to be revised several times during pre-testing, as there was initially some confusion regarding what constitutes "easy" or "difficult" (the original phrasing of the question asked participants to comment on whether it was difficult to find the waste management web page). Other alternatives that had been tested include "did it take you a long time to find the web page?" – The inherently subjective assessment of difficulty and time made it difficult for pre-test participants to accurately answer the question. Also, pre-test participants expressed concerns over being judged if they answered that it was difficult for them to find the web page (tacitly implying that they were not technologically savvy). For this reason, the term "easy" was used (in lieu of difficult or time consuming), as it was a value positive statement. Though this did not overcome the issue of subjectivity, pre-test participants viewed this statement more favorably relative to alternative phrasing.
>
> 48 of 77 focus group participants expressed difficulty in navigating to and within municipal waste websites (commonly coded phrases included "It's hard to find the

information I'm looking for"). This result was consistent with the timed observations recorded by facilitators. The mean time for survey participants to navigate from the municipal home page to the waste management resource page was 4.4 minutes. In 26 instances, focus group participants were unable to successfully locate one or more of the waste management resource pages.

The second most frequently coded response for this question was that the municipality's web pages were often translated incorrectly (coded 33 times), making it difficult to locate the appropriate waste related resource. While the Google translate feature was available on each of the municipal web sites, the translation was often inaccurate (mistranslated words and phrases, grammar etc.). 24 study participants indicated that this was actually insulting to them - anecdotes recorded during the sessions include "If you're not going to do it properly, don't bother doing it at all" and "It shows how much they (the municipality) care about us". The notion of "us" and "them" was a recurring theme during the focus group sessions. There was a sentiment that municipalities catered to "white" households and ignored (or placed less emphasis on) the needs of ethnic minorities.

"Does the information presented in this advertisement raise your awareness about your municipalities recycling program?"

Focus group participants indicated that online resources were more informative relative to other mediums of P&E, and as a result, significantly increased recycling awareness (coded 45 times). Participants indicated that the accompanying visual examples on the website (e.g., pictures of various types of packaging, examples of how to properly wash jars and bottles before putting it in the Blue Box etc.) were useful in helping increase recycling awareness (the how and where to recycle). However, 16 respondents indicated that online resources did not increase recycling awareness in any meaningful way. Anecdotes noted during the sessions indicate that a language barrier was the primary impediment to increasing awareness among participants who responded "No" to this question. As noted previously, while the Google translate feature was available on the website, mistranslations resulted in confusion among some focus group participants. Municipalities also have a propensity to use sector specific terms in P&E messaging, i.e. describing juice boxes as Tetrapacks or Aseptic Cartons, or laundry detergent as high density polyethylene etc. These terms often confused study participants, which is perhaps why visual examples proved so successful in raising awareness. A person may not know what a spiral wound container is, but they recognize the product when shown a picture of it.

"Are you more likely to recycle because of the information contained in the sample advertisement?"

Perhaps the most interesting finding from this part of the focus group sessions is that despite increased recycling awareness, 64 of the 77 study participants said that they would not recycle more as a result of online P&E resources. Once again, the majority of respondents said that they were already recycling, and did not necessarily see the

> purpose of P&E initiatives. As shown in Figure 18, coded responses from the focus group sessions include "I am already recycling" (coded 59 times), "I'm not going to spend more time than I already am" (coded 43 times) and "It's all just going to end up in the dump anyways" (coded 27 times). The last comment was of particular interest, in that there was a perception among focus group participants that the city was not actually recycling the material that they collected. A number of respondents were under the impression that the municipality charged residents for recyclables collection (as a tax grab), but secretly sent the material to landfills. In 7 instances, respondents thought that garbage was being shipped overseas to developing countries. Once again, facilitators were instructed not to correct these misconceptions. One respondent indicated that "back home, I would see big shipments of garbage come from other countries and be dumped in open pits". This practice is expressly forbidden in Ontario, as municipal household waste cannot be shipped outside of the province. Why study participants feel this way, and whether these reflect the attitudes and opinions for ethnic minorities as a whole remains a curiosity and a topic worthy of additional investigation.

The above passage illustrates that online P&E have some successes in increasing recycling awareness among ethnic minorities, but are not effective in inducing behavioral change. These findings suggest that large urban municipalities have additional considerations when designing web based resources that extend beyond the "what, when, where and why" of recycling. These municipalities are charged with finding ways to effectively engage a diverse population base, and overcoming numerous misconceptions surrounding municipal recycling practices.

With the aforementioned in mind, depending on locality, online recycling promotion and education can be seen as an "easy win" that is fairly low cost, or a significant challenge that requires careful planning and consideration.

There may even be merit in having municipalities explore alternative means of P&E engagement and delivery, as current research has shown very promising results when municipalities partner with community organizations to delivery joint recycling P&E campaigns. The municipality is tasked with constructing the "ingredients" list with respect to the "what, when, where and why" of recycling, while the community organization creates the customized recipe to reach their membership.

As per Lakhan's study on alternative P&E mediums:

> *Using data collected from 12 religious institutions in 3 provincial communities, a promotion and education program was developed to: 1) Increase awareness about existing waste management programs in the region 2) Describe what materials should be recycled 3) Highlight the importance of recycling (to the individual, to the community and to the environment and 4) Make a direct appeal asking households to*

participate in their region's recycling programs. Post implementation of the P&E campaign, respondents indicated a statistically significant increase in positive attitudes towards recycling, moral norms, levels of perceived behavioral control and awareness of recycling consequences. Perceived behavioral control, situational factors, attitudes and moral norms were found to be the most significant predictors of recycling intention. Community leaders were demonstrably more successful in affecting positive change in stated recycling behavior among minorities relative to the municipality.

3.11 Key Findings

Based on experiences gleaned from CIF reports to date, the following "general" observations can be made:

- Recycling promotion and education advertising the what, when, where and why of the program is an effective initial strategy for municipalities who have recently implemented their Blue Box program, or have undergone substantive programmatic changes
- P&E is a central element of virtually every municipal waste management plan, however, different municipalities have different needs and challenges, necessitating that programs be tailored to meet local conditions and characteristics
- Promotion and education should be seen as a complimentary effort that accompanies investments in infrastructure and convenience
- Promotion and education should be delivered using multiple mediums (print, online, billboards) to engage the greatest number of households
- Promotion and education messaging should be clear and prescriptive with regards to what they want/expect households to recycle
- While there is a significant body of literature (both from the CIF and the academic discourse) supporting the efficacy of P&E, surprisingly little is understood about how to promote recycling among "new recyclers" such as immigrants
- Multi-residential promotion and education continues to be a significant challenge for municipalities, particularly those in large urban areas.

References

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Chapter 4: Investments in Multi-Residential Projects

4.1 What are multi residential projects?

For the purposes of this project, we define multi residential projects as initiatives that improve the performance of recycling programs in multi residential buildings, either through investments in

improved access, awareness, infrastructure or training. Of note, recycling promotion and education in multi residential buildings is also considered separately in chapter 3. The distinction between the P&E initiatives described in chapter 3, and the ones examined here, are that these projects are listed as a sub classification relative to the initial purpose of the project (i.e. A project specifically intended for recycling P&E in multi residential buildings, vs. P&E projects that are part of a larger initiative, i.e. implementation of best practices).

There are presently 35 projects listed on the CIF web page that have been classified as multi-residential initiatives by the study team. The total value of investments in these initiatives (jointly contributed by both municipalities and the CIF) is $4,665,740.

Unlike other chapters in this report, the discussion surrounding multi residential projects (and sub project types) is separated into three broad categories: Initiatives to improve awareness, initiatives to improve convenience, and initiatives to improve capacity. Sub classifying Multi Residential projects was challenging, as most projects were listed as “Best Practice”, which encompassed a number of strategies that touched upon both engagement and capacity building. As such, there is greater utility in examining what municipal experiences (to date) have been with respect to improving the design and delivery of the Blue Box program in multi residential buildings.

Initiatives to increase awareness: Increasing multi residential recycling awareness can largely be seen as promotion and education efforts undertaken by the municipality to increase multi-res household awareness regarding the Blue Box program. However, awareness can also refer to training of building staff and service providers to better understand the unique challenges facing multi residential buildings.

Initiatives to increase convenience: Increasing convenience of recycling activities in multi residential buildings is done either through the provision of in home recycling bags/mini bins, floor level recycling chutes, or improved access to recycling drop off points (ensuring that it is clean, safe and clearly labeled).

Initiatives to increase capacity: Increasing capacity of recycling in multi residential buildings includes the purchase of larger drop off bins for buildings, increasing the frequency of recyclable collection by the service operator, and ensuring that what is collected from the building (from households) can be readily collected and managed by the municipality (reduced contamination etc.)

4.2: Qualifier/Caveats to the analysis

Much like the issues surrounding evaluating the effectiveness of promotion and education campaigns, in multi residential projects, isolating a cause and effect relationship between an initiative and

an outcome poses challenges. Certain things can be readily empericized, i.e. the Town of Smith Falls purchased 98 recycling carts at a cost of $3200), but it is difficult to understand how that increase in capacity translated into an increase in diversion. Similarly, in projects classified as “best practices”, what part of a multi-pronged effort most contributed to a particular outcome?

Recognizing these limitations is important, as it helps provide some context to the results, and opens the doors for additional inquiry. However, as noted before, sometimes “good enough” is all we need. The same caution to the reader with respect to interpreting the results and implying causal relationships needs to be reiterated in this (and all other) sections.

4.3: Increasing Multi Residential Awareness

Increasing awareness in multi residential households, particularly using conventional promotion and education strategies, have yielded positive results, but there are still opportunities for improvement. Many municipalities attempt to increase awareness through CIF Best Practice Guidelines, which recommends strategies for distribution of print materials. Some of these recommendations include:

- Distributing print materials directly to residents
- Distributing and displaying posters and multi-residential properties, and
- Applying labels to recycling containers

Municipal staff ensure that these materials are distributed to residents (with a preference given to direct engagement of households), and that signage is clearly displayed. Municipalities have the discretion to customize this messaging (and subsequent delivery) to best suit their needs and the demographics of their target audience.

However, research from the City of Toronto’s Tower Renewal Feasibility study (#178) have identified that language barriers, transience, lack of ownership, inconvenience, material contamination, lack of financial incentives, lack of support by building management and existing infrastructure all conspire to undermine the success of recycling in multi-residential buildings.

While many of the major projects (Region of Peel #566.4, #895, Essex Windsor #513.4 etc.) contain forward looking statements (P&E materials have been delivered to residents, but any effects on stated or observed behaviour have yet to be recorded), preliminary results suggests promotion and education is effective when accompanied by adequate access and capacity. Anecdotes from municipalities during the initial roll out of P&E materials suggests that there is an initial increase in awareness, which may subsequently lead to an increase in diversion, but it unclear as to whether these results can be sustained

over time. By that token, there isn't any contradictory evidence to suggest that recycling rates return to baseline after the P&E campaign ceases. However, it is difficult to determine whether individual successes experienced by municipalities can be attributed to any specific P&E strategy (i.e. pamphlets were particularly effective), and as such, no recommendations for "what works best" can really be made.

This ultimately begs the question as to what changes can be made to promotional efforts to yield the greatest results in multi residential buildings? As noted in the City of Toronto tower study, there is a need to effectively communicate promotion and education materials in multiple languages, and in a way that is culturally relevant to the target audience. There is an increasing body of literature that suggests different ethnic groups have different behavioural triggers with respect to participation in recycling programs. As such, an appeal to environmental conscience may not resonate with a significant percentage of households in multi residential buildings (and minorities in general).

What does seem effective in increasing recycling awareness is direct "door to door" intervention by municipal or building staff that personally communicates the specifics of the program. Retention of the "What, where, when and why" of recycling is significantly higher when using direct engagement strategies, but the drawback is the resource cost (expressed in both time and money) in employing this method. Increasing awareness and training of building staff has also been shown to be critically important in ensuring that recycling programs are actually supported for residents. There were numerous incidences reported in CIF reports of building staff failing to distribute P&E materials, or not providing clean and accessible recycling drop off areas. Getting building staff to "buy in" to the importance of recycling programs not only promotes diversion efforts among residents, but helps service providers performing pickups (ensuring all bins/carts are accessible, in the right area, not overloaded etc.).

4.4 Multi Residential Accessibility (Convenience)

Convenience (or lack there-of) is often seen as the primary driver of recycling participation in multi-residential buildings. Intuitively, this makes sense – given that residents are often required to bring recyclables down to a building basement (which may be unclean, unsafe or not clearly labeled), there is an incentive to forgo participation and simply dispose of all materials in the waste stream. This assumption has been supported by previous investigations in the literature, however convenience may not be the only determinant of participation. Awareness (that the program even exists) was is seen as an equally critical behavioural antecedent, highlighting that promotion end education efforts must be delivered in conjunction with initiatives designed to increase convenience. With that being said, convenience (both

with respect to households, building management and service operators) is seen as an almost necessary pre-requisite to the success of any multi-residential recycling program.

Based on a review of completed CIF projects to date, increasing convenience for households (through the provision of in home recycling bags, more accessible and organized drop off points, and cleanliness of drop off points), contribute materially to observed increases in diversion noted in reports. A degree of caution needs to be taken when assuming this observed increase in diversion will persist – improved accessibility is contingent on continued efforts on both the part of households and building management to ensure that the desired behaviour continues. While households may initially be amenable to using an in home bag during the initial phase of the study, they may grow tired of having to find a separate storage space, or the time expended in doing so. Tangent to this, cleanliness and organization of drop off points requires both households and building managers to work collaboratively to ensure that accessibility is not impeded. The conditionality of this outcome highlights the necessity of prioritizing accessibility as the most critical factor for success of multi residential recycling initiatives. It requires not only ongoing participation of households with respect to source separation behaviour, but a coordinated effort to ensure that the drop off and collection of recyclables is easy to do (something that is not traditionally required of curbside single family households). Accessibility is also of equal importance to service providers, who often incur significant time costs in the event that access to recycling bins and carts is impeded in some way. Assuming that collection is provided by the municipality (or sub contracted), the additional time in collecting from multi residential households resulting from impeded access can materially contribute to elevated collection costs.

4.5 Increased Capacity

Ensuring that there is sufficient capacity to accommodate for the generation of recyclables is a fundamental component of a successful multi residential recycling program. Many of the CIF funded projects were either specifically designed, or part of a larger initiative, to expand the capacity and outreach of recycling services in multi residential buildings. Increasing capacity (generally speaking) can take two forms: 1) Increasing capacity within the home, through the provision of recycling bags or mini recycling bins or 2) Increasing capacity at the drop off point, to ensure that the bins are large enough to accommodate for the recyclables generated during one pickup period. Unlike investments in improved accessibility and awareness, an increase in capacity results in tangible, enduring and measured increases in diversion (Projects #864, #545.3, #359, #631.5 etc.) (assuming there was a previous constraint on capacity) for municipalities. The purchase of additional recycling carts resulted in a 5% increase in the

average quantities of recyclables collected, with an increase in building recycling rates ranging from 4% to 15%. While a comment was made earlier regarding the importance of accessibility in ensuring a successful multi res recycling program, that is predicated on there being sufficient baseline capacity in the building. However, adding capacity over and above what households generate is unlikely to encourage recycling behaviour, but any purchase of bins/carts in buildings where either none or few exist is likely to result in a significant increase in diversion.

The impact of adding in home capacity in multi residential dwellings is slightly less clear. Intuitively (and also based on anecdotes provided by municipalities), adding in home capacity allows a convenient spot for households to put recyclables until they are ready to take the bin/bag to the designated drop off point. However, given that residents are being asked to store recyclables "in home" requires space, and low levels of food contamination (while generally not a huge issue with packaging waste, some food jars and tubs can pose spoilage issues if not properly cleaned). Households where space is already a premium may be unable or unwilling to accommodate for in home storage of both recyclables and garbage. The academic literature shows no real consensus on this issue – there is evidence to suggest that while multi residential households would like the opportunity to recycle, their participation was a function of finding an appropriate storage solution (is there a "sweet spot" for the size of bind put in multi-residential units?)

4.6 CIF Investments in Multi Residential Projects

A significant investment has been made in multi residential projects since the CIF's inception, primarily through project #723, which contributed 2.8 million dollars in an effort to improve the efficiency and effectiveness of MR programs. The creation of MR Best practices, which assist municipalities in the optimization of their program operations, has resulted in significant improvements to access (in terms of buildings that receive coverage), accessibility, capacity, and engagement. While many of the projects listed on the CIF website are still underway, posted reports site preliminary successes, namely increased diversion resulting from increased capacity. Monitoring was also seen as a key feature of multi residential best practices – the ability to for a municipality to assess and track building performance is integral in ensuring the long term success of MR recycling programs. Unfortunately, there is not enough evidence from the reports to clearly say that a particular promotion and education strategy or training initiative results in improved multi residential recycling performance. A key learning is that promotion and education should be seen as a tool that compliments initiatives that improve capacity and convenience. Any effort is unlikely to be successful unless all the enabling conditions are in place.

A recurring theme throughout this report is that there is an inter-temporal dimension to most projects. An investment in period one may not result in the desired outcome until years later. Affecting changes in behavior takes time, and even longer before any meaningful changes are noticed. As noted throughout the multi-residential "best practice" reports, municipalities are putting in the pieces to ensure a successful program once (or if) changes come into effect. Investments in capacity and convenience are fundamental to the success of multi residential recycling programs. Investments in these types of projects are almost nonnegotiable, as no amount of promotion and education will ever be able to overcome constraints on capacity or impediments to convenience. Municipalities should be encouraged to continue place focus on these areas, as densification (expressed in the form of increased development of multi-residential properties) is only likely to increase with time. What is obvious is that doing nothing is not a viable option in the multi residential sector. Multi residential represents a significant opportunity for municipalities to improve recycling rates (given their performance relative to single family households), but the exact recipe for success has yet to be found. Continuing to invest in multi-res projects, but allowing for an iterative process that allows both municipalities and the CIF to adapt and respond to issues unique to multi-residential buildings, is going to be what allows for improved operational efficiency and diversion performance. This further highlights the need to monitor programs such that municipalities can be adaptive in how they respond to the challenges facing the MR sector. There are a confluence of factors at play that can affect the success of multi residential recycling (many of which are beyond the control of the CIF or the municipality). As an example, multi residential buildings that are classified as community or public housing have infrastructural and safety issues that go well beyond issues with a buildings' waste management program. Encouraging recycling in these buildings will be an uphill battle in light of exogenous factors surrounding decaying infrastructure and public safety.

While the following point will be addressed in Chapter 9 on recommendations, there needs to be a mechanism in place that allows for a "follow up" to CIF projects several years after a policy/program has been implemented. As an example, the Toronto towers project now has several years' worth of data and anecdotal experiences that can provide significant insights into the success/failure of the initial project, but there are very few municipalities that provide a "post script" report that discusses a project years after it has gone live and has had an opportunity to mature and for staff to reflect.

4.7 General Findings from CIF reports:

- Ensuring that there is sufficient capacity to accommodate for the generation of building recyclables is a mandatory first step in implementing a multi-residential recycling program.

- Convenience is a significant predictor of behaviour (measured in terms of accessibility), but it should not be seen as the only determinant of recycling participation
- Promotional and educational materials should be seen as a complimentary tool that accompanies adequate capacity and access
- Promotion and education materials should be translated when possible. Additional research is recommended in terms of how best to engage ethnic minorities living in multi residential buildings.
- Municipalities should work closely with building managers to ensure that recycling programs are promoted. "Buy in" from building management was seen as a significant predictor of MR program success.
- Areas where recyclables are dropped off by households should be kept clean, safe, well lit, and accessible (both to households and collectors)

4.8 Learnings from the broader academic literature

Much of the existing literature on recycling in multi residential buildings has tended to focus on how access to recycling services (expressed in terms of convenience) affects households recycling behavior (EPA (1999); Ando and Gosselin (2005) and Stevens (1999)). These studies have found that multi residential households tend to recycle less than single family households due to the time it takes to sort, store and transport recyclables to building recycling bins. Ando and Gosselin (2005) describe this as the "transaction cost of recycling" – where in recycling participation is a direct function of the time and effort it takes to participate in source separation programs. The current literature suggests that multi residential households face higher transaction costs to recycle (McQuaid and Murdoch, 1996; Schwebel, 2012; Stevens, 2005). There is less space to store recyclables in the home, too few recycling containers/carts in the building and in some instances, the designated space to bring recyclables are located in building basements (which often face issues surrounding access, cleanliness and safety) (CIF, 2010).

Studies by the USEPA (2001) and Ontario's Continuous Improvement Fund (CIF) lends support to these findings (2010). In an analysis of "successful" multi residential diversion programs – wherein success was defined as buildings achieving a recycling rate that exceeded 20%, the characteristics of the units achieving the highest recycling rates were:

- Access: Recycling was rated as "accessible" or "very accessible" for residents

- Recycling area: well maintained, inviting, clean, tidy and well lit
- P&E: provided to residents regularly
- Building staff: Were informed, supportive of recycling and actively involved in maintaining the program
- Ownership: People who owned their units recycled more than those who rented (by a rate of almost ten to one).

Individual municipalities/cities have also found success in driving multi residential diversion through alternative recycling service and outreach initiatives (Schwebal, 2012; Ando and Gosselin, 2005)).

In a pilot program conducted in the city of Baltimore, multi residential buildings that offered doorstep collection of recyclables noted significant increases in diversion (Schwebal, 2012). The study's authors concluded that residents were willing to participate in recycling initiatives when it was made convenient for them to do so. Similar programs that increased recycling convenience, i.e. allowing mixed waste and recyclables to be placed in the same chute (that would be sorted at a later point at a specially equipped "dirty" material recycling facility (MRF)) and placing recycling containers near existing waste chutes were also observed to increase building recycling rates. It should be noted that while both of the aforementioned initiatives increased diversion, they require significant time and infrastructural investments on the part of the building owner and waste operator. For example, there are presently no MRFs in Ontario that are capable of sorting commingled waste (recyclables + organics), and as such, initiatives that allow multi-residential households to put waste and recyclables in the same chute would not be possible.

Two additional areas of research in multi residential recycling include: 1) How do socioeconomic/demographic factors affect multi residential recycling behaviour? and 2) How does normative/peer influence affect recycling behavior in a multi residential setting?

Lebersorger (2005) found that attitudes towards waste and recycling were largely a function of "situational context", wherein factors such as income levels, marital status, number of children etc. were likely predictors of recycling behavior. Given that the demography of families living in multi residential households tended to be quite different than those in single family households, Lebersorger posited that discrepancies in recycling participation between the two dwelling types were largely explained by demographic differences (2005). Of note, Lebersorger's findings have generally not been supported by other researchers in this area, as research by Sidique et al. (2009), Lakhan (2014, 2015) and Callan and Thomas (2006) do not find statistical support for the relationship between age, income, education and

recycling participation. Lebersorger concedes that additional work is needed to better understand how these factors may influence recycling in a multi residential setting (2005).

Increasing household recycling awareness in multi-residential buildings poses unique challenges that are over and above those faced in single family homes. As noted in section 2.3, families in multi residential homes face less communal pressures to participate in recycling initiatives, as they are unable to see if their neighbors are participating or not. Essentially, recycling is based on an honor system where people are expected to participate, but there is no mechanism to track participation. The relationship between normative pressures and peer influence with respect to recycling behavior in a multi residential setting is an area that remains in its conceptual infancy. Though there exists a rich scholarship that examines how normative influence modulates recycling behavior (see Azjen's seminal work on The Theory of Planned Behavior (1985), and subsequent studies by Callan and Thomas, 2006; Lansana, 1992; and McCarty and Shrum (2001) that apply this framework to recycling behavior), what has been conspicuously absent from this line of inquiry is how, if at all, normative influence changes in a multi residential setting. DeYoung et al. (1995) has done some preliminary work in this area, namely, examining how a focus on peer influence may influence a person to recycle, but the emphasis of the research was on the effects of a "volunteer coordinator" in promoting recycling initiatives. However, as far as can be ascertained, no study to date has specifically examined how a lack of "noticing your neighbor" recycling, affects household recycling behavior. Unlike conventional curbside single family recycling collection, multi residential units do not have a specific day to put out recyclables. Building residents have no way of noticing whether their neighbors are recycling, nor do they fear judgement from others if they chose not to participate in the buildings recycling program (a phenomenon that has been observed to directly influence recycling participation in single family households). Thus, there may be a situation wherein recycling is "out of sight, and out of mind" – unless building residents can see and be seen as participating in a recycling program, they will be less likely to do so.

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Chapter 5: Public Space Recycling

This section is devoted specifically to projects designed to support and develop public space recycling initiatives. It is important to note that public space recycling is also addressed in Chapter 3 on recycling promotion and education, however, those projects specifically had a P&E focus or were the subset of a larger program initiative.

Evaluating the efficacy of public space recycling initiatives is often an inexact process – seasonality, special events, construction etc. can all adversely impact public space utilization, and subsequently, the quantities of waste being generated and recovered.

There also appears to be a lack of consensus regarding what constitutes a public space (at least in the academic literature). Broadly speaking, a public space is considered a space that is open and accessible to the public. Road ways, public squares, parks, beaches, town squares etc. are generally considered to be public spaces. To a lesser extent, municipally operated buildings which are open to the public (i.e. libraries, recreational facilities) can also be considered public spaces. As a term and concept, public space is largely fluid (i.e. social gathering places are sometimes construed as public spaces). There remains considerable debate regarding what constitutes public space, the role it plays and how to design cities and spaces to encourage common areas.

Further complicating issues surrounding recycling in public spaces, is that the quantities of waste generated and diverted in these areas is something that remains poorly understood in Ontario, as it generally falls outside the regulatory requirements of existing residential waste management programs. While the responsibility for public space recycling largely rests with the municipality (with some exceptions), there is little prescriptive guidance surrounding what types of waste should be collected/diverted. Additionally, there is no official mechanism in place to monitor the number of recycling bins in public spaces, which makes ensuring equitable access to services difficult.

While many municipalities undertake initiatives to quantify and estimate public space waste generation through audits (some of which are discussed in this section), it is difficult, if not impossible to control for the multitude of variables that could potentially explain variations in diversion and contamination levels. Seasonality, special events, and even something like construction can all affect utilization of a public space.

Though a degree of caution should be exercised when implying causality, investments in public space recycling projects had more concrete linkages between a particular initiative (i.e. bin twinning) and outcome (increased diversion). As such, this section will be structured in a way that ordinally ranks initiatives based on municipal experiences. This is done to provide insights as to where there are "easy wins" for municipalities looking to improve recycling performance in public space areas.

5.1 The "Easy Wins"

5.11Increase bin density and placement of public space bins

The initial impediment to public space recycling is simply a lack of opportunity for the public. In the absence of having sufficient bins in a public commons area, people will either have to hold onto recyclable material until they get home (which rarely happens), or they are going to throw it in the garbage (the most likely outcome)

Ease of access to recycling significantly influences diversion rates – convenience is the primarily motivator for recycling in public spaces based on findings gleaned from these reports.

In every funded project in which additional recycling bins were purchased, diversion increased. The City of London (#558.7), the City of Markham (#643.13), the Municipality of Killarney (#639.13) and Essex Windsor (#340) all experienced an uptick in total recovered tonnes as a result of bin purchases (sometimes in excess of 50%). It should be noted that this increase in diversion is not solely attributed to the purchase of additional bins – promotion and education efforts, choice of bin, and bin placement all contributed to observed changes in recovered tonnes.

However, there doesn't appear to be an "ideal" figure for the number of bins required in a given area. This is often dependent on site and situation specific factors, so it is difficult to provide exact guidance on how many recycling bins a municipality should install. A more critical consideration for the success of a public space recycling initiative appears to be bin placement. Bins should ideally be placed in areas with the highest foot traffic, or in areas where disposable items (food stuff, newspapers etc.) are likely to be consumed (i.e. concessions stands, transit shelters, densely populated road ways etc.) In both the City of London (#558.7) and the City of Peterborough (#565.7), the placement of bins along busy, pre-established collection routes (in downtown streets and park trails respectively), were successful in increasing the number of recycled tonnes collected. Placement of bins along existing collection routes (either where the collection contractor is passing by, or municipal staff are already collecting garbage), is seen as a way to realize cost savings. Extraneous trips and special routes that are specifically meant to collect recycling bins should be avoided, where possible.

5.12 Increased Capacity

Tangent to bin availability, is the consideration that needs to be given to bin capacity. Many of the funded projects included the purchase of larger recycling bins, which could accommodate for greater quantities of generated material. This achieves multiple purposes:

1) The greater the capacity of the bin, the less likely it is to reach capacity and overflow before a scheduled pickup. One of the greatest concerns expressed by both households and city staff is that littering and cleanliness were an impediment to public space recycling. When a recycling bin is "overflowing", residents are more likely to dispose of material in the garbage, or to "pile" on to the overflow by discarding materials around the bin.
2) As noted above, increasing capacity reduces the number of scheduled pickups required by the municipality or service provider. This can result in significant cost savings – the City of Kenora (#637.13), the City of Markham (#643.13) and Essex Windsor (#340) observed significant decreases in labor and vehicle costs – in the City of Markham's case, the expected reduction in public space collection costs was estimated to be between 50% and 80%. It should be noted that increased capacity is not necessarily achieved by simply providing larger bins – In both the City of Markham and the City of Kenora projects, solar powered compactors were used to compact materials to increase available bin capacity. These cities also implemented monitoring software that would provide feedback to the municipality on when bins were reaching capacity, such that pickups were performed on an "as needed" basis. While this is a 'nice to have' feature, there is

not enough evidence to suggest that monitoring software should be a recommended feature for public space bins. Though it does contribute to increased diversion and result in a decrease in collection costs, there is a much higher capital cost incurred at the onset of the project.

5.13 Twinning Bins/Bin Choice

Twinning bins, which refers to placing recycling bins and garbage bins together, was observed to have a significant (positive) effect on diversion rates. Once again, this seems like a fairly obvious solution given that it increases the public's opportunity to recycle, with the barrier to doing so largely being one of cost and available space.

The City of Toronto, the City of Peterborough, Essex Windsor, the Municipality of Killarney etc. observed an increase in capture and diversion rates when twinning both recycling and garbage bins together. Twinning bins may also help reduce contamination by making the public aware that there are specifically designated spaces for refuse and recyclables. Municipalities have attempted to differentiate between the two container types using different colors (blue vs. black, multi stream vs. open mouth). While no reports specifically commented on the effects of twinning on contamination rates, it stands to reason that contamination in recycling bins will decrease, as the public will have an opportunity to dispose of food stuff and liquids in the garbage bin.

5.14 Monitoring and Assessment

As noted above, overall quantities (and composition) of waste being generated in public space areas remains poorly understood. However, most of the public space projects that have been funded to date include some monitoring and assessment dimension – whether this be tracking overall quantities of waste being diverted, establishing baseline values prior to a new initiative, levels of contamination or composition of waste, understanding the "scope and scale" of an issue is critical for planning as well as evaluating the success of a given initiative. The general consensus from the reports posted to the CIF website is that the recycling stream in public spaces suffers from high degrees of contamination (most often organics waste). This, in part, is explained by the nature of consumption in public spaces. A half full pop can is normally disposed in the recycling bin, subsequently contaminating the rest of the material. This can (and does) have adverse effects on the quality of material that can be recycled, necessitating that particular attention be paid to measures that combat contamination (i.e. better signage, more restrictive bin openings etc.). It is recommended that future CIF projects that involve public spaces continue to include a monitoring and assessment component (that goes beyond qualitative visual evaluations), such that future investments can be targeted to specific areas that need improvement (or where there are easy wins)

5.2 The "Maybe" Works:

5.21 Implementing Multi Stream Bins

What type of bin should be implemented in a public space is largely a function of economics, available space, and existing collection infrastructure. Municipalities with single stream systems may not care how recyclables are collected in public spaces, but based on the reports posted to the CIF website, there appears to be a preference for multi-stream public space bins as a means to reduce contamination. Essex Windsor, the City of Killarney and the Municipality of Meaford all observed significant reduction in contamination post implementation of tri-stream recycling containers. The City of Killarney's report on public spaces (#639.13) indicated that items most commonly consumed by the public walking on city streets naturally fell into two categories (paper products vs. beverage bottles/cans), which contributed to the decision to choose multi stream bins.

However, multi stream bins, on average, tend to be more expensive and physically larger than open mouth containers. Municipalities may want to take this into consideration when selecting bins for public spaces. In areas where the types of material being disposed is relatively homogenous (i.e. primarily newsprint), single stream containers may be a suitable and more cost effective solution.

Numerous reports highlighted the need for recycling bins to have lids to prevent illegal dumping. This is particularly true of bins located in parks, which had higher observed instances of illegal dumping due to their relatively remote locations. Closed lids also help prevent weather related contamination and interference from vermin.

The size of the bin opening is also an important consideration for municipalities when making bin choices in public spaces. This issue is discussed in greater detail in section X.

5.22 Automated Carts

While there were relatively few projects that attempted to implement automated recycling carts in public spaces, there may be utility in exploring this system in large urban municipalities (largely based on the City of Toronto's successes, project #396). The City of Toronto's diversion rate increased from 14% to 22%, while capture rates increased from 51% to 68%. Contamination decreased by 41% over the same period.

Automated carts were also observed to improve collection efficiency (both with respect to time and total quantities of material collected in a single set out). The ability to collect carts using auto-load systems also significantly reduces the chance of municipal employees (or contracted collectors) from incurring injuries. Toronto observed a material decrease in the number of work related injuries as a result of waste/recyclable collection post implementation of auto-carts.

However, despite these results, the ability for a municipality to transition to an auto-cart system is largely contingent on the whether the existing collection system is already configured for carts.

5.3 What needs work:

5.31 Recycling Promotion and Education in Public Spaces

Like with most promotion and education efforts, it is difficult to ascertain the direct relationship between changes in diversion and a campaign initiated by the municipality. While projects in the City of Markham, the City of St. Thomas, Essex Windsor and the City of Sarnia all noted the success of P&E in increasing diversion, it is difficult to determine how much of the observed change in diversion were attributable to P&E efforts (vs. increased bin density, bin placement or bin choice).

The general consensus from the reports is that promotion and education materials should be:

- Clear and consistent
- Closely align with the CIF Public Space Best Practice recommendations
- Attempt to maximize recycling program participation
- Reduce contamination in recycling receptacles, and
- Encourage/reinforce at home recycling behaviour

Visuals (often in the form of Bin stickers or signs) were seen as being more effective than text when it came to communicating information to the public. What text was used, should ideally communicate simple, global messages “Please Recycle”, “Remember to Recycle!” “We can Recycle More!” etc. Labeling bins with the recycling Mobius loop was also seen as a way to effectively communicate to the public that these bins were specifically designated for recyclables, not garbage.

When it comes to promoting recycling in public spaces, simplicity seems to be key. In most of the aforementioned reports that specifically commented on the effectiveness of promotion and education initiatives, signs and labels that visually captured what materials were accepted (and where to put them) complimented the effectiveness of other public space initiatives. Of note, the City of Toronto had conducted a small control study that measured the diversion rate of recycling bins with P&E signage, and without. Bins with signage diverted 37.5% more material than those without signs. However, a somewhat unexpected result is that bins with signs experienced an almost 50% increase in contamination rates. In this particular instance, the signs appeared to “remind” the public to recycle, but did not effectively communicate what constituted recyclable material.

The public space project in the regional Municipality of Niagara (#564.7) actually recommended that direct engagement strategies be employed by municipalities to encourage participation in public space initiatives. The report identified focus groups, public outreach that involved person to person meetings, and follow up surveys with the public as means to promote public space initiatives. While these were seen as being successful strategies (and there is demonstrable evidence in the broader academic literature that supports this position), direct engagement is often seen as being too resource and time intensive.

Public space recycling is likely to continue to pose an issue for municipalities, as there is less personal incentive for the public to recycle. The logical first step to public space recycling P&E appears to be providing the "essentials" of the program (what can be recycled, where does it go etc.). These messages should be communicated as simply and clearly as possible, to support other initiatives such as bin twinning, increased bin density etc. However, as evidenced in these reports, conventional methods of promotion and education are unlikely to result in significant increases in diversion (or reduced contamination etc.).

5.4 Findings from the academic literature and research recommendations

Findings from the literature on bin contamination and littering

Beyond the concerns surrounding sanitation, there is evidence in the academic literature to suggest that "bin overflow" results in a negative association with recycling among members of the public. When people see a bin that is overflowing or heavily contaminated, there is an assumption that the municipality (or service provider) does not care, and neither should they. There is a principle referred to as "shared responsibility in stewardship" where the public will participate in a given environmental initiative premised on an equal or greater effort on the part of the expectant party (a city, a company etc.). If there is evidence to suggest that the expectant party (in this case the municipality) does not care about public space recycling, neither will the public.

Findings from the literature on public space recycling promotion and education

In the Public Space better practices report (Project #202) clear and consistent signage was one of the recommendations. While I agree with the former point, new research suggests message "consistency" may not produce the desired results. As noted in Chapter 3, whatever behavioral change that public space P&E results in is likely achieved at the project onset – as soon as the signage becomes part of the built environment, its efficacy diminishes. It simply blends into the landscape for regular patrons, and visitors are unlikely to feel a perceived moral obligation to recycle in a given space as they are not part of the

community (not to say that they don't recycle, but they are less likely to do so out of perceived normative pressures).

As such, developing "new" promotion and education signage on a regular basis (monthly, quarterly etc.) or alternatively, implement something that is a-typical to the space (visually jarring, clearly doesn't belong) may produce desired results. While the latter may contravene the expected aesthetic, there is demonstrable evidence in the academic literature to indicate that the public respond to this type of signage.

Findings from the literature on multi stream bins with restricted openings:

Restricted openings on public space bins may reduce the risk of contamination, but more recent research seems to suggest that people make recycling decisions (in public spaces) in split seconds. During an observational study conducted in 2015, it was noted that the public generally does not pay attention to the labels on recycling bins. There is a propensity to group "like with like", i.e. "If I see a bin has a lot of newspaper in it, that's where I'm going to put my newspaper". In instances where there are opaque bins (where you cannot see its contents), it runs the risk of becoming a catch all for all recyclable materials and garbage.

However, given that public space disposal decisions post consumption are made in fractions of a second, there is a natural inclination to put their garbage/recyclables in the spot that has the biggest opening – which happens to be the waste bin. In most instances in which bin twinning is implemented, multi stream recycling bins have designated openings with different sizes, while the waste container is normally a "wide mouth" bin, encouraging people to put both recyclables and garbage in the larger container opening. This "bad behavior" is reinforced via the cognitive compliance principle, where people will see that the garbage bin is full of recyclables. As such, they will think to themselves "If other people are doing it, it is ok if I do it as well".

5.5 Key Learnings from CIF reports

1) Density and placement of bins is the most critical factor in determining the efficacy of a public space recycling initiative. You need to be able to give people as many opportunities to recycle as possible, and ensure that those bins are placed in areas with the highest amounts of foot traffic
2) As a tangent to the above point, every garbage should ideally be accompanied by a recycling bin (and vice versa). Providing only one or the other either limits the opportunity to recycle, or results in significant contamination of collected recyclables (in recycling bin only scenarios)

3) Public space bins need to be kept clean and tidy. While any receptacle in a public area is going to be at a higher risk for illegal dumping and vermin, a failure to ensure cleanliness (either by allowing the bins to reach capacity before pick up, or other exogenous factors), will discourage the public from recycling (and may even lead to a negative attitude towards the behaviour over time)
4) Municipalities that have the requisite collection infrastructure in place may find automated cart collection for recyclables effective. However, these initiatives generally require a significant capital expense during initial implementation, which may restrict such investments to larger municipalities. However, the potential savings in labor/vehicle time, reduced incidences of workplace injury and other collection efficiencies may help rationalize the investment.
5) The type of bin you choose matters – there are benefits and drawbacks to various opening designs and multi stream recycling containers. Restricting openings to match the recycling stream can reduce cross contamination discourage illegal dumping, rain and snow egress and vermin. It does, however, result in fewer (but higher quality) tonnes collected. Multi stream bins are significantly more costly which may be an issue for smaller municipalities. They can, however, facilitate twinning of services, aid in matching public space recycling to existing municipal collection services (e.g., two stream collection) and present a neater collection point.
6) Contamination is always going to be an issue in public spaces – primarily food and animal waste (poop and scoop). It is difficult to address the former, as items consumed in public spaces (i.e. a pop) may have leftovers that a person cannot reasonably discard of. This further highlights that twinning of bins be a logical "first step" when implementing a public space recycling program. Providing the public the opportunity to dispose of unconsumed organic waste can potentially reduce the risk of contamination in the recycling stream. Signage (or Bin Labels) that clearly communicate what is/is not an acceptable material may also discourage contamination.
7) Promotion and education in public spaces needs to be clear and easy to understand. High quality pictures are more effective than text. While no reports were able to establish what type of signs were most effective, "something is better than nothing". Recycling bins that were not accompanied by signage diverted fewer tonnes than those that did. Given the high rates of contamination in public spaces, it is the recommendation of this report that P&E materials emphasis what "does/doesn't" belong in the bin.
8) Monitoring and assessment is fundamental to the success of any public space program. Being able to establish baseline measures of how an area is being used, what types of waste/recyclables is

being generated, can all aid municipalities in decided how to roll out their public space recycling programs. Ongoing monitoring of program performance is also necessary to ensure that adjustments can be made when needed, and to identify what specific initiatives are driving the greatest results.

Chapter 6: Research Projects Summary

This chapter summarizes and evaluates CIF funded research initiatives intended to improve municipal recycling performance, or enhance understanding of a particular subject area. There are presently 32 projects that have been classified as "Research Projects", with CIF contributions totalling $1,059,475. This information is often used to help guide policy and planning decisions for municipalities when designing and managing their recycling programs.

6.1 Evaluating Research Projects

Evaluating the effectiveness of research projects is somewhat difficult, as the benefits of such initiatives are not directly quantified in terms of increased diversion, or a direct decrease in costs (although projects designed to identify optimizations or improvements will subsequently achieve both if learnings are implemented). Research support projects are generally intended to enhance understanding, model and compare various policy or infrastructural scenarios, or establish clearly defined methodologies for undertaking a task (i.e. cost allocation). What information that can be gleaned from these types of projects is then designed to be shared with other municipalities in the hopes of developing better and best practices in programs across the province.

Research Projects can largely be subdivided into the following categories:

- *Infrastructure Optimization*
- *System Optimization*
- *Economic Analysis*
- *Policy Analysis*
- *Activity Based Costing*
- *Material Specific Development*
- *Jurisdictional Scan*

6.2 Infrastructure Optimization

There are presently three project listed under the research projects parent category which are designed to undertake an analysis of Blue Box Infrastructure (namely processing capacity and design) in Ontario. Project #254 examined individual MRF Capacity and Capability of public sector material recycling facilities

in Ontario. A key finding from the report is that of the 25 public sector MRFs in Ontario, the majority were classified as having only minor wear/defects of MRF equipment. The report also found that there was significant available capacity (49%) remaining within the system to accommodate for additional material, and that IC&I materials made up a relatively small % of total MRF tonnage processed. As such, it is unlikely that additional system capacity is required in the near term, however, refurbishment and maintenance of existing facilities is recommended. The insights gained through the study indicated that there are benefits associated economies of scale associated when processing Blue Box materials.

Study #428 engaged in modeling of the transfer of Blue Box materials within the province to help optimize the transfer-processing system. This was done as a means to reduce costs and improve operational efficiency. Study findings include: 1) Reducing the number of MRFs reduces the overall processing and transfer system costs province wide 2) Regional dynamics will dictate how much savings can actually be achieved by reducing the number of MRFs 3) A "hub and spoke" processing system is highly efficient in medium and large MRFs running 2 shifts per day 4) Materials can be transferred economically over long distances 5) Collection costs need to be studied to fully understand savings potential. Recommended next steps were to convene consultation sessions with municipalities to discuss the prospect and viability of a proposed "hub and spoke" system for MRFs/transfer stations.

Study #716 examined the relative system performance of single and multi-stream recycling systems, in an attempt to identify whether one system was demonstrably more effective than the other. The study found that there is no evidence that clearly demonstrate that either multi or single stream recycling is a specific best practice. Rather, current information indicates that the benefits and issues associated with each respective system must be individually considered by the municipality. Site and situation specific factors may result in municipalities wanting to prioritize a specific element of their program (i.e. diversion vs. cost, contamination vs. convenience), which will dictate whether a single or multi stream system is more appropriate.

6.3 System Optimization

There are presently 7 projects listed under the research projects parent category that have been sub categorized as a system optimization project. System optimization, used within the context of the reports, can refer to potential changes to a municipality's processing or collection system to improve the operational performance of municipal diversion programs.

While the findings from each of these reports is highly specific to the municipality in question, i.e. Converting a MRF to a Transfer Station in Haldimand County, these reports highlight the need to evaluate and identify potential opportunities for savings and increased efficiency. The recommendations and potential cost implications (from implementing any sort of programmatic or infrastructural change) are largely rooted in the MIPC study examining the optimization of the Blue Box Material Processing system. While this report is discussed in greater detail in section 6.2 above, several of the projects that have been sub categorized as system optimization attempt to quantify the economic and diversion impacts of implementing the recommendations of the MPIC study. Based on preliminary modeling exercises, there is a significant opportunity for cost savings should municipalities implement the recommendations outlined in the report.

Project #917 and #820 outlined recommendations for system optimization that were independent of the MIPC study, that were specific to the municipality. The Township of Iroquois falls (#917) explored the potential cost savings of harmonizing their Blue Box program with other sister municipalities. The ability to pool resources and leverage inter-municipal relationships was seen as a means to not only significantly increase diversion, but reduce operating costs. This finding is not only applicable to the Township of Iroquois Falls, but any municipal program that share a common waste shed or catchment area with other programs. Sharing trucks, harmonizing P&E materials, and synchronizing collection programs across sister municipalities can yield cost savings that cannot otherwise be achieved when operating in isolation.

6.4 Policy Analysis

There is presently one project listed under the research projects parent category which have been sub categorized as policy analysis. Project #725 undertook an analysis of the proposed Bill 91 legislation, and the potential impact to municipalities. While Bill 91 was ultimately tabled (and succeeded by the Waste Free Ontario Act), the project helped municipalities understand the implications of the proposed legislation on their diversion programs.

While this specific project did not lead to a specific outcome or recommendation, these types of initiatives are of significant utility to municipalities. Often times, municipalities lack the internal resources and expertise to navigate and understand potential legislative changes. By ensuring everybody is “on the same page” and understand how any changes to provincial regulation are likely to affect the system, municipalities are better equipped to make informed decisions and plan for the future.

6.5 Jurisdictional Scans

There are presently two projects that have been sub classified as "Jurisdictional Scans" under the Research Projects category.

Project #195 involved in an analysis of international technologies that could potentially be used in Ontario for recycling and reuse of post-consumer plastics. A total of 14 countries in two geographic regions were identified as possessing potential technologies that could sort, densify, transport or recycle used plastics.

Each country's international trade organization was contacted, and solicited for a response. Five countries were highlighted as possessing technologies or techniques that could potentially prove applicable to post consumer management of plastics in Ontario. The final recommendation of the report was to further explore potential relationships between the CIF and target countries to further research how such technologies can be leveraged in Ontario.

What remains unclear at this time is whether any of the proposed technologies highlighted in the report were implemented locally. While the benefit of such research initiatives helps in identifying new and innovative methods for recycling, there needs to be mechanism in place that ensures follow up (by either the CIF or its stakeholders) to ensure that the full benefits of this research can be realized.

Project #470 undertook a comprehensive review of extended producer responsibility schemes for packaging and printed paper across Canada. This report outlines program information, fee structures, financing arrangements, and the range of obligated materials. The overall findings of the report suggest that while provincial EPR programs are conceptually similar, there is significant variability with respect to design, levels of funding and level of transparency with respect to program operations. This project was intended to aggregate and compare EPR programs across provinces, and did not necessarily have an objective beyond information gathering and knowledge mobilization. These type of "snap shot" studies are important, in that it helps stakeholders better understand what is happening in jurisdictions outside of Ontario (and potentially highlight what is/is not working under alternative EPR schemes). However, the legislative and policy landscape in EPR is rapidly changing, necessitating that follow up studies be conducted, or alternatively, a "living document" be maintained that updates information on Canadian EPR systems on an as needed basis.

6.6 Activity Based Costing

The projects currently classified as "Activity Based Costing" under the Research Projects category did not have a summary report attached. The intent of the project was to determine the useful life remaining in

the transfer system, and its current value. While there isn't much additional information to glean from this, activity based costing is a useful exercise for municipalities who want to understand where costs are incurred within the system. Activity based costing can be used to estimate the amount of resources and activities required to collect, transfer, sort and process a material collected within the Blue Box system. These types of initiatives are important with respect to understanding cost drivers and allocating costs to specific activities and materials used in fee setting calculations.

6.7 Economic Analysis

There is presently one project listed under the funded projects parent category, which undertook a comparison of collection and processing costs for the full range of Blue Box materials. This was done in an attempt to provide guidance to municipalities regarding what materials should be included as part of their Blue Box program, and model a series of scenarios that attempted to optimize the mix of Blue Box materials.

The study found that certain materials (namely composite papers and plastics) were extremely expensive to manage within the existing system, and as such, municipalities may want to prioritize accepting materials that the public readily recognizes as recyclable (newsprint, cardboard, metals etc.). Based on a cost model developed for the study, it was possible for Ontario to achieve a 60% recycling rate at a lower cost (when compared to the existing system), if municipalities targeted certain materials for recovery.

It should be noted that these findings are consistent with what has been reported in the broader academic literature. Lakhan's (2015) study examining the economic impacts of Blue Box recycling arrived at a similar conclusion to the CIF report, suggesting that municipalities target "core" materials and consider restricting the number of items accepted in the Blue Box as a means to minimize costs.

6.8 Request for Proposal/Quotations (RFP/RFQ)

There are presently 11 projects under the program support category that are intended to assist municipalities in recycling services development support. These include projects that support the development of tenders for collection and processing services (both by individual municipalities, and under cooperative multi municipality agreements). These reports outline detailed tender requirements when issuing a request for quotation/proposals. Broadly speaking, this includes information on the tender schedule, proposed period or duration of the contract, submission instructions, submission requirements, terms of reference, bidder requirements and terms and conditions. This is only some of the information contained in the project support documents posted to the CIF website - RFP/Contract documents are

highly prescriptive, clearly articulating expectations and responsibilities of all involved parties, including potential bidders.

As noted in section 6.1 above, there isn't really a clear way to evaluate these types of initiatives - however, their utility is self-evident. Many of the support service documents, particularly those surrounding tenders for recycling services, provide a step by step guide for what needs to be considered with issuing an RFP/RFP. It adds transparency and clarity to an otherwise complex process, to ensure that both municipalities and potential service providers are on the same page.

6.9 Material Specific Development

There are presently three projects listed under the funded projects parent category, which are designed to support the development and recovery of specific materials (namely plastic film, flexible packaging and fibers).

With respect to paper fibers, the report examined possible future trends that could potentially affect the value chain. Three different "Future scenarios" are considered, where in the report attempts to gauge how the composition of Blue Box fibres will change with time, and corresponding changes to both the collection and processing system that are likely to occur.

While neither of the studies on plastic film and flexible plastic packaging included a summary report, the synopsis is that flexible film is making up a growing portion of the waste stream, for which there are limited markets. The economic viability of including plastic film as part of the Blue Box program is also considered as part of the project scope.

Material specific research is an important undertaking in that it helps municipalities better understand how changes to the packaging mix are likely to affect them. Understanding how things have changed, or may change in the future, is a critical component when designing policy and infrastructure that has the reflexive capacity to adapt to changes to the Blue Box program.

6.10 Key Learnings

- Municipalities should frequently evaluate and monitor their programs, identifying opportunities for increased processing and collection efficiency. This can be achieved through strategies such as program harmonization, resource pooling across multiple municipalities, and implementing the recommendations outlined in the MIPC Blue Box System optimization study. System optimization projects provides municipalities with a useful reference for what might be considered a better or best practice when attempting to optimize a diversion program

- It is important that future research projects help municipalities understand potential legislative changes, and how those changes may affect their diversion programs. Navigating the regulatory and legislative landscape can be challenging – any projects that help provide insights into the implications of regulatory changes should be welcomed by both municipal and private sector partners. Legislative changes affect all parties, and in order to facilitate meaningful dialogue, stakeholders should be operating on the same page.
- While Ontario's recycling situation is unique, undertaking periodic legislative scans to understand the strategies and experiences of other jurisdictions is important. Of critical importance is that we ask ourselves what can we glean from the experiences of others, and can those learnings be readily transposed to Ontario? What transpires at the national and international level can also provide Ontario with an indication of tail/head winds that may potentially impact diversion programs in the province.
- Projects that provide insights into the "economics" of recycling assist municipalities in managing the somewhat disparate objectives of increased diversion and cost containment. While the public consensus appears to be that increased diversion is better, not all materials are created equal, and municipalities may want to give preference to the recovery of specific materials that are a) more readily recyclable b) have developed end markets and c) have the ability to generate revenue for municipalities.
- Developing markets and technologies to recover specific materials should be approached with caution. As a tangent to the previous point, all things being equal, increased diversion is a preferred outcome. However, how much money are stakeholders willing to spend behind developing markets and technologies to recover composite materials or other plastics? While this report does not specifically discourage CIF initiatives that promote material development, these investments should be made strategically. Municipalities should ask themselves "What materials give us the most bang for our buck, when recycled?"
- Research projects that assist municipalities and other stakeholders in better understanding where costs are incurred within the system should continue to be supported by the CIF. This not only helps municipalities identify what areas should/can be optimized, but it is a necessary step when calculating steward fee obligations. These projects should be conducted at regular intervals to ensure that estimated costs are reflective of what is actually being incurred by municipalities.

Chapter 7: Program Support Initiatives

This chapter summarizes and evaluates initiatives designed to support municipalities in various program planning and operational initiatives. The Continuous Improvement Fund has created a series of documentation, templates and guides for municipalities that include support for the development of: Request for Proposals, Training Initiatives, Online Resources, Promotion and Education Templates and Recycling Plants.

There are presently 23 projects listed on the CIF website that have been classified as Program Support – with total investments made by CIF totalling $359,300 (It should be noted that this may not be the total amount that has been allocated by the CIF towards program support initiatives – several projects did not have dollar figures attached).

7.1 Evaluating Program Support Initiatives

Program support initiatives are difficult to evaluate in that the benefits of such initiatives are not quantified in terms of increased diversion, or a direct decrease in costs (although the latter does occur due to operational efficiencies). Program support initiatives are generally intended to give municipalities a template or toolbox to use as a reference when designing their recycling program. The utility of such initiatives are in the standardization of how to request a tender submission, what is required, terms of reference etc. These initiatives are designed to reduce the administrative burden faced by municipalities-particularly smaller ones who may not have the internal resources to develop their own procedures). Consistency in procedures and protocols across municipalities can also be beneficial when negotiating contracts with service providers.

7.3 Collaborative Initiatives

There are presently 3 projects under the program support category that have been sub classified as “collaborative initiatives” – projects designed to leverage new partnerships, sources of funding and improve stakeholder relations.

With respect to the two projects intended to identify and explore new funding opportunities, the CIF determined that few organizations provided direct funding support in the form of grants, bursaries or partnerships. While many of these organizations did not fund work that were directly applicable to the scope of work that the CIF engages in, they were identified as potential strategic partners. These types of initiatives are important, as leveraging organizations both within and outside the waste sector has benefits in creating awareness about the CIF and its functions. Cultivating relationships (even non remunerative ones) is a practice that should be continued moving forward, as funding bodies are

increasingly looking to foster relationships between academia, industry and government. Both the Social Sciences and Humanities Research Council and Natural Sciences and Engineering Research Council have specifically ear marked funds (Insight Development and Strategic Partnership Grants) to promote inter-sector collaborations. It is the recommendation of this report that this topic be revisited, as the landscape of project funding has changed significantly since the initial projects were conducted.

Project #169, involved a stakeholder review, interviewing CIF partners and clients to provide potential insights to the development of CIF activities and strategies moving forward. Key findings include: awareness regarding the CIF is almost universal among both municipal and other stakeholders, with high levels of awareness regarding the goals and objectives of the CIF, b) stakeholders appreciated the proactive outreach and engagement by the CIF in promoting the program, but there were some concerns regarding the application process. Some stakeholders wanted additional clarity with respect to eligibility criteria, and how funds were to be disseminated. Other findings suggest that there is stakeholder disagreement regarding what the "goals and objectives" of the CIF should be, with some wanting to prioritize ROI, while others preferring equitability in terms of fund distribution. There was also divided support, particularly among municipal partners, regarding the CIF's role in developing markets for problematic materials.

It is the recommendation of this report that a new stakeholder interview project be conducted (and scheduled bi-annually) to re-calibrate the CIF's goals to meet the evolving needs and challenges facing the sector. This type of contextual information (stakeholder interviews) is extremely useful, as it is typically not captured in individual reports submitted by municipalities for specific projects.

7.4 Online Resources

There are presently 2 projects listed as providing online resource tools for municipalities - #122 (Municipal Contracts Data Base) and #236 (Multi Res Access Database Template)

While project #122 did not provide a final report, the final deliverable was an online resource to municipalities to improve the quality of recycling contracts, establish and transfer best practices in tenders and agreements, reduce administrative externalities, and harmonize the tender process and documentation for service providers.

The final output (which can be found on the CIF website) is the processing RFP for both public and merchant MRFs, as well as a collection RFP for recyclable materials. The benefits of these types of resources are communicated in section 6.8, namely, standardization, consistency and transparency in

recycling contracts and tenders. Such initiatives should continue to be funded in the future, as it can help municipalities (particularly smaller ones with fewer internal resources) to adhere to better and best practices.

Project #236 is part of a larger multi residential initiative undertaken by the CIF that provides municipalities with an 8 step program to help guide and shape their multi residential recycling programs. This includes an overview of relevant literature, guidelines for best practices in multi residential recycling, how best to manage data collected during program operation (contact name, program information etc.), suggestions for how to build capacity and promote the program (with the latter including a tool kit of materials), training suggestions for stakeholders, and how best to report program results to both the CIF and the sector.

While many municipalities face specific multi residential challenges that are endemic to their locality (as noted in Chapter 4), this "Pre fab" solution provides municipalities with the basics for implementing and managing a functional multi residential program. In many ways, it is analogous to providing municipalities with the "framing" of a successful program, and leaves it up to them to build the specifics (which they can work with the CIF in accomplishing). However, there is a risk of municipalities doing "just enough", and following the CIF guidelines prescriptively as opposed to going above and beyond (although there is no evidence to suggest that this is happening, it something that should be flagged)

7.5 Recycling Plans

There are presently three projects under the program support category that have been sub classified as "Recycling Plans Support". Broadly speaking, these initiatives are intended to provide municipalities with guidelines, tools and resources to ensure that their Blue Box recycling plans align with provincial goals and best practices. In the case of project #158, municipalities were given the opportunity to participate in an assessment process, wherein individual programs were evaluated as a part of the Blue Box Program Enhancement and Best Practices Assessment project. These findings were then used to create assessment "Blue Prints". Findings from the report highlighted the importance of: a) multi municipality partnerships as a means to exploit economies of scale in collections and processing operations b) standardize and optimize collection within service areas c) enhance training for staff in core competency areas d) develop a promotion and education plan and e) Issue new RFPs to optimize collection/processing operations. The overall takeaway is that every municipality should create and implement an up to date plan for recycling as part of an overall integrated waste management strategy. The CIF has funded a number of projects to assist municipalities implementing Blue Box "Master Plans" in their region.

The effectiveness of this (and other like initiatives) is that most municipalities in Ontario have developed recycling plans with clear vision, purpose and direction that ties into broader recycling and environmental objectives of the province. These plans provide municipalities with an "Ingredients list" of considerations for a successful program, but allow them to realize operational and infrastructural efficiencies that improve program performance over time. A recommendation of this report is that an "adaptive" dimension be included in recycling plan guidelines. To the point made earlier in section X, recycling plans need to have the adaptive capacity to react to changes in the recycling system (be it legislative, demographics, or types of material being collected). The ability to iteratively re-evaluate a program and adjust as needed is integral for continued success.

7.6 Key Findings

Standardization and Harmonization is Key

The enduring theme of project support initiatives is that the CIF has provided municipalities (and other stakeholders) with templates, tools and the basic building materials for developing and improving their recycling program. While every program is fundamentally unique and will face their own challenges and resource needs, initiatives such as standardizing contracts/tenders, creating recycling "master plans" etc. helps reduce the administrative burden that is commonly associated with developing these materials from scratch. These types of initiatives are particularly useful for smaller municipalities who must rely on the CIF for external expertise and guidance when managing their recycling programs.

Continue to seek out partnerships and foster relationships

While the initial review of potential funding partners wasn't particularly fruitful, it did establish numerous relationships between the CIF and other stakeholders (both within and outside the waste space). Given the increasing emphasis being placed on inter-sector and inter-agency collaboration, particularly under the new liberal government, it would be worthwhile for the CIF to revisit this topic, particularly with SSHRC and NSERC.

Tangent to this, the CIF should continue to solicit feedback from their own partners to ensure that CIF priorities align with stakeholder needs and interests. Stakeholder consultation is particularly critical during times of major programmatic changes, i.e. the new "Waste Free Ontario" legislation.

Develop adaptive capacity

When developing templates, program plans and other resources, it is critical that there is an iterative dimension that allows periodic review of what is/is not working, and the ability to adjust as needed. This

is particularly true of the waste management "Blue Prints" that originated from the KPPG best practices and best practice assessment report – are the recommendations made in 2009 still applicable today? If they aren't, what needs to be changed, and how should this be reflected in municipal planning decisions moving forward?

Chapter 8: Investments in MRF/Transfer/Depot Infrastructure

This chapter summarizes and evaluates CIF investments in material recycling facility, transfer station and depot infrastructure and equipment. There are presently 96 projects listed on the CIF website that have been classified as a "MRF/Transfer/Depot Infrastructure Investment". To date, investments totalling more than $22 million dollars have been made by the CIF in MRF/Transfer/Depot Infrastructure investments. For the purposes of this report, funded projects have been further subdivided into investments related to:

Energy: Projects designed to assess and implement energy savings opportunities at processing and storage facilities

Material Specific Technology/Equipment Investments: Projects normally pertaining to investments in material specific technologies (e.g., eddie currents, paper screens) to improve the recovery of materials sorted at a processing center

Balers: Equipment Purchases of new, or upgrades to existing, balers which are used to compact and prepare recycled material for shipment

Compactor: Investments in compacting equipment designed to reduce transportation and haulage costs.

Residue: Projects normally pertaining to investments in sorting technology designed to reduce the residue rates of processing facilities.

Stream Conversion: Projects pertaining to the conversion of recycling facilities to accommodate different collection systems.

Transfer Station Upgrades: Projects pertaining to infrastructure investments specific to the construction or upgrade of transfer stations.

Depot Upgrades: Projects pertaining to infrastructure investments specific to the construction or upgrade of depot sites.

Optimization Projects: Projects pertaining to investments designed to increase the operational efficiency of a material recycling facility. These projects may include investments in material specific technology, or energy savings opportunities (as described above)

Weigh Scales: T Projects pertaining to the purchase of new weigh scales to weigh the quantities of material entering a processing site

Maintenance: Projects pertaining to the maintenance or refurbishment of a material recycling facility or transfer station.

8.1 Evaluating Investments in MRF/Transfer/Depot Infrastructure

Evaluating the effectiveness of infrastructure investments is largely based on a quantitative assessment of the investments ability to increase diversion, decrease costs, reduce contamination etc. However, given the forward looking statements of some of the projects (the full impact of a particular investment would not be realized until a future time period), it was not possible to establish a causal relationship between a specific investment and particular outcome in all instances (i.e., Investing in compactors reduces costs by X%, and increases diversion by Y%). However, there is sufficient evidence and data in the reports to draw generalized conclusions, which can be used to help guide priorities and investment decisions for municipalities.

8.2 Compactor

There are presently 12 projects that have been sub classified as "Compactor investments" under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was $104,000, ranging from approximately $5000 to $210,000. Compactor investments normally involved the purchase of compaction systems designed to reduce transportation costs by reducing the number of loads hauled from the selected sites. Eleven of the 12 projects found that the purchase of compaction equipment dramatically increased the efficiency of recycling operations, resulting in a significant cost savings. Anticipated savings ranged from $833/month to $3,374/month, with the average pay back period being less than two years. While there is demonstrable evidence to suggest that investments in compactors reduce operational costs for municipalities, what remains less clear is why some municipalities were able to realize greater savings when implementing compactors relative to others. While there are a confluence of factors that ultimately affect program costs, it is the

recommendation of this report that research be conducted into whether specific compactors yield more beneficial results, or are more suitable to specific situations/local conditions.

8.3 Energy Efficiency

There are presently 9 projects that have been sub classified as "Energy Investments" under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was $36,000, ranging from approximately $6,600 to $120,000. Investments in energy efficiency involved an assessment of energy savings opportunities and the implementation of energy retrofits and assessment recommendations – these include the implementation of renewable energy sources, energy efficient lighting, roof top solar voltaic system and the replacement of low efficiency equipment. Tangentially related to energy efficiency, recommendations included guidelines on workplace lighting to improve worker comfort, and placement of light fixtures. Depending on the size and scale of the recommendations, investments in energy efficiency reduced operating costs from between $600/month to $900/month, with the average pay back period ranging from 2 to 3.5 years. It is the recommendation of this report that energy efficiency studies continue to be undertaken, particularly in light of rising utility costs in the province, and the sensitivity of processing costs to utility rates.

8.4 MRF/Transfer Station Maintenance

There are presently 3 projects that have been sub classified as "MRF/Transfer Maintenance" under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was $3,750, ranging from $2,500 to $5,000. Based on observations by field staff, it was determined that process equipment is generally in good working order, with facility operators making necessary repairs and maintenance of equipment when required. Active monitoring and assessment regarding the quality and functionality of processing equipment is critical in ensuring an efficient processing system and a safe working environment for workers. It is the recommendation of this study that facility maintenance continue to be highlighted as a priority for facility operators, with financial support being provided by the CIF on an as needed basis to conduct annual audits (to supplement the work already being done by on site staff).

8.5 Converting Facilities from Multi to Single Stream

There are presently two projects listed that discuss the conversion of a multi stream processing and collection system to a single stream system (Note: These projects have been listed under the MRF/Transfer/Depot infrastructure investment parent category, as it involves significant retrofits to the processing system). Costs ranged from $35,505 to $2,000,000, with project #135 (City of St. Mary's) being

the only one to have completed a report (project #947 was still ongoing as of this date). Based on the results of project #135, the conversion from multi stream to automated single stream collection resulted in significant decreases in collection time, and greater quantities of material being recovered per pickup. Household attitudes towards automated single stream collection indicated that they found the chart/wheelie system preferable to conventional Blue Box collection.

8.6 Depots Construction/upgrades

There are presently 7 projects that have been sub classified as "Depot Investments" under the parent category of MRF Depot infrastructure investments. The average CIF contribution for each project was $36,171, ranging from approximately $10,000 to $73,224. Most depot investments involved the construction or expansion of depot facilities for the collection of recyclable material from households. The underlying intuition is the construction of depot sites will increase recycling convenience for households, allowing the capture of materials that would otherwise be disposed of in a landfill. The purchase of larger capacity bins at depot sites were shown to decrease the number of collections required, thus reducing haulage costs. The purchase of larger bins also managed to increase the overall quantities of recyclables collected by the municipality. Estimated savings from the purchase of larger capacity containers ranged from $18,500 to $74,240 (With the size of the savings being a function of the size of the municipality and number of bins purchased (average net savings per tonne of material collected was approximately $150). Upgrading depots with service ramps were also designed to improve the transfer of recyclables to the processing facility. Service ramps were also observed to yield operational savings, expressed in the time needed to load trailers for transport to processing facilities. It is the recommendation of this report that investments in the construction of depot facilities continue to be supported by the CIF. Depots provide increased service coverage and convenience for households who may not have access to curbside recycling pickup. Further to that point, upgrading existing sites through the purchase of larger capacity bins demonstrably increase the quantities of material recovered.

8.7 Balers

There are presently 2 projects that have been sub classified as "Baler Investments" under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution ranged from approximately $12,000 to $94,304. The purchase of new balers were shown to increase operational performance in both projects. New balers achieved higher bale speed, lower energy use per bale, increased bale density, and reduced operating time. These efficiencies subsequently resulted in both direct and indirect operational savings, while increasing overall processing capacity at sorting facilities. Of

note, new balers had the ability to scale baler speed and capacity to react to peak and off peak demand scenarios, providing great flexibility to facility operators. Project #511 (Township of Armour) noted that the installation of new balers would have an initial operating cost of $1000/tonne initially, but subsequently begin to decline after a two year period. While there is insufficient data to provide definitive guidance regarding whether the CIF should continue to support investments in new balers, new balers provide an opportunity for municipalities to increase processing efficiency at their material recycling facilities. However, these increased efficiencies must be weighed against budgetary constraints, and compared against other potential MRF investments.

8.8 Residue

There are presently 3 projects that have been sub classified as “Investments to reduce residue” under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was approximately $76,000, ranging from $10,000 to $127,833. While many of the material specific projects discussed in this chapter also identify technologies/methods for reducing residue, these projects are specifically intended to address residue rates at processing facilities. Project #376 involved the purchase of a residue compactor upgrade for the Regional Municipality of Niagara. The installation of 11 cubic yard compactors resulted in a net savings of $177,321 ($16.63/tonne) during its first year of operation. Additionally, the Regional Municipality of Niagara was successfully able to divert an additional 6,400 tonnes of residue from the landfill through a residue management process that allowed residue to be processed at a secondary MRF. This “second sort” was only made possible as a result of the savings accrued as a result of the compactor upgrades.

Project #933 involved an analysis of Quinte Waste Solution’s MRF to determine primary sources and the overall value of residue. The findings from the initial phase of this project will then be used to help inform additional capital investments to reduce residue level (where cost effective).

While the range of projects that were specifically classified as “Residue investments” were relatively limited, when taken into consideration with findings from other material specific projects, there are several opportunities for facility operators to help combat the issue. Investments to improve sorting efficiency and accuracy should continue to be supported by the CIF, when economically feasible. However, as noted in project #382, a municipality is unlikely to address residue rates by simply investing in new technology alone. Supporting conditions must be in place (in the case of project #382, adequate capacity at the curb for mixed plastics), for the full results of any investment in processing infrastructure/technology to be realized.

8.9 Investments to improve the capture of specific materials

Glass Cleanup

There are presently 5 projects that have been sub classified as “glass clean up” under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was approximately $224,861, ranging from $4,820 to $830,050. Given the problems broken glass poses to a processing facility, glass clean up systems are seen as an effective method for separating glass from the rest of the container stream. As noted in the reports, glass clean up systems capture in excess of 95% of all glass entering the facility, with only nominal amounts of non-glass material ending up in the glass bunker. Glass clean up systems are able to significantly improve the quality of the container stream, but often come at a considerable expense to municipalities. As noted by Regional Municipality of Niagara (project #821.3.2), factors that influence the economic feasibility of a glass clean up system are largely contingent on the existing processing and disposal costs for other materials, and the added revenue from the recycled glass marketplace as a result of a cleaner mixed broken glass product. While glass clean up systems are demonstrably effective, it is the recommendation of this report that municipalities continue to work with the CIF in exploring whether a glass clean up system is appropriate for their facility.

Transfer Station Construction/Upgrades

There are presently 11 projects that have been sub classified as “glass clean up” under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was approximately $200,276, ranging from $1,159 to $2.15 million dollars (the latter being part of larger project involving both the construction of a new transfer station and MRF regionalization). Most projects listed under this section involve the construction of a new transfer station, or upgrading existing facilities through the purchase of compaction trailers and weigh scales. Transfer station upgrades were observed to decrease loader/operator time, as well as fuel and haulage savings (as a result of compaction reducing transport costs and number of pickups required).

Several of the projects also undertook an examination of whether transfer stations or MRFs were more appropriate to service a given area. Stemming from the findings of the MRF Optimization Study, some municipalities may find it more appropriate to transfer their material to larger regional MRFs in lieu of operating smaller, less efficient facilities. While the optimization study posits that decreasing the number of MRFs (while increasing the number of transfer stations) can result in a cost savings for municipalities, there was not enough evidence from the CIF reports to either support or refute this recommendation.

Much like investments in Depot construction/upgrades, it is the recommendation of this report that the CIF continue to support and work with municipalities to:

1) Identify where transfer stations are most appropriate
2) Identify what upgrades offer the most "bang for the buck", and
3) Identify when to decide between an existing MRF, or new transfer station construction.

Fibre

There are presently 6 projects that have been sub classified as "Fibre investments" under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was approximately $499,754, ranging from $19,589 to $1.09 million dollars. The objective of fibre investments is to improve the recovery and quality of materials found in the fibre stream (i.e., paper and paper based packaging). Such investments include: Mixed paper cleanup systems, optical sorters, paper shredders, and dedicated fibre lines at the MRF. While the results of these projects, both with respect to cost and effect on recovery rates, vary, the following observations have been gleaned from the reports:

Mixed Paper Clean Up Systems: It is important to have sort staff downstream of mixed paper clean up systems to manage misdirected fibre. Mixed paper clean up systems cannot be expected to recovery exclusively containers. Specific thought needs to be given as to what equipment should be available downstream of a mixed paper clean up system to prevent contamination in other areas of the plant.

Fibre Optical Sorters: 3 projects involved the installation of a fibre optical sorter to improve the processing of fibre based packaging. This was done to improve the quality of the baled product to premium levels and increase the overall recovery rates of fibres. While none of the three projects offered finalized reports, there was preliminary data to demonstrate the effectiveness of Fibre Optical Sorters with respect to both recovery and realized revenue. However, given the cost of such projects, it is recommended that facility operators carefully evaluate whether an investment in optical sorters makes sense for them given commodity pricing environments and the mix of materials entering their facility.

Paper Shredder: Guelph implemented a pilot project to install a paper shredder at their depot facility to encourage residents to source separated shredded paper, subsequently reducing glass cross contamination and increase the revenue from the sale of OFP. The expected payback period for the project is estimated to be 5 years.

Upgrades to the Fiber Line: Project #142 explored to how increase the quality of ONP by increasing the number disks used in the OCC screen. Project findings suggest that the success of this approach is contingent on finding the appropriate balance between the number of OCC screen disks, and its corresponding impact on screen performance with respect to minimizing the amounts of OCC/OBB following through the screen. Facility operators carefully monitored and adjusted the number of screens on an "as needed" basis in an attempt to achieve the optimal balance.

Project #227 installed a back scraping drum on the fibre line as a means to increase the fibre processing capability by providing a consistent feed to sorters, while minimizing black belt time. As a result, fibre processing capability increased from 3.1T/hour to 3.3T/hour, while reducing labor costs by $ 7,635 in the first six months of operation.

Metals

There are presently 3 projects that have been sub classified as "Metals investments" under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was approximately $43,323, ranging from $26,370 to $53,750. The objective of metal investments is to improve the recovery of aluminum and metals, two materials that traditionally have much higher revenues relative to other packaging. CIF funded projects include: Eddy current installation and Aluminum Blower Replacements

Eddy Currents: Investments in eddy currents were shown to be demonstrably successful in increasing both recovery rates and revenues in both projects #821.3.3 and #138. Eddy currents were able to achieve "primary grade" UBCs (resulting in higher revenues), while reducing contamination to manageable levels. The speed of processing recyclable material also increased. However, as noted by one of the reports, the location of the Eddy Current system is an important consideration for facility operators. Niagara region found success in placing the eddy current at the end of the container line, and recommended that manual sortation be used to compliment automated technology to maximize recovery.

Aluminum Blower Replacement: The primary objective of a new aluminum blower was to decrease labor costs on the sorting line by replacing a small UBC blower with a larger system. The new blower system decreased labor costs, while increasing the container line processing capacity from 1.3T to 1.5T per hour. The total savings for the project during the first seven months was $16,575. The estimated payback period for the project is 1.9 years, while total annual savings were projected to be approximately $30,000.

Plastics

There are presently 13 projects that have been sub classified as “Plastics investments” under the parent category of MRF/Transfer/Depot infrastructure investments. The average CIF contribution for each project was approximately $294,467, ranging from $23,400 to $705,000 million dollars. The objective of plastics investments is to improve the recovery of plastics (including the recovery of other plastics), or reducing the contamination of unwanted plastics in other material streams. CIF funded projects include: Optical Sorters, bunkers, and sorting line upgrades

Optical Sorters: The installation of optical sorting technology was largely successful with respect to increasing diversion and realizing higher revenues. The technology is useful in capturing and targeting specific plastics. However, labor savings may not be as high as initially anticipated, as it was a recommendation that manual sorters be placed downstream of the optical sorter to ensure quality control. Placement of the optical sorter (with respect to the flow of materials through a facility) is also a key consideration to ensure maximum recovery. Despite the success of optical sorters, it is recommended that municipalities ensure that it is appropriate for the size of their program and the quantities of plastics being processed by their system. The typical payback period for optical sorters ranged from 4-5 years.

Bunkers: Project #855 involved the installation of a new bunker at the London MRF designed to capture additional oversized plastics. It is expected that this project will recover an additional 200 tonnes of plastics that are presently being sent to residue. This material will then be marketed for additional revenue.

Sorting Line Upgrades/Retrofits: Installation of container specific sorting lines (or retrofitting existing container lines) resulted in a significant increase in the quantities of plastics recovered. In project #649.8 (North Bay), installation of a container sorting line increased mixed plastics recovery from 375kg/ bi weekly to 18,75kg/biweekly. Project #515.11 container line retrofit resulted in a 66% increase in the diversion rate of PET, and resulted in an annual savings of $360,000 annually. Overall, container line retrofits resulted in an increase in the total tonnes marketed, decreased labor costs, decreased residue and eliminating WSIB injury claims. The payback period is estimated to be 2.5 years.

8.9 Key Learnings and Recommendations

- Investments in the construction of depot facilities should continue to be supported by the CIF. Depots provide increased service coverage and convenience for households who may not have

access to curbside recycling pickup. Further to that point, upgrading existing sites through the purchase of larger capacity bins demonstrably increase the quantities of material recovered.

- There is demonstrable evidence to suggest that investments in compactors reduce operational costs for municipalities
- It is the recommendation of this report that energy efficiency studies continue to be undertaken, particularly in light of rising utility costs in the province, and the sensitivity of processing costs to utility rates.
- It is the recommendation of this study that facility maintenance continue to be highlighted as a priority for facility operators, with financial support being provided by the CIF on an as needed basis to conduct annual audits.
- New balers provide an opportunity for municipalities to increase processing efficiency at their material recycling facilities. However, these increased efficiencies must be weighed against budgetary constraints.
- Investments to improve sorting efficiency and accuracy should continue to be supported by the CIF, when economically feasible. However, a municipality is unlikely to address residue rates by simply investing in new technology alone.
- While glass clean up systems show are demonstrably effective, it is the recommendation of this report that municipalities continue to work with the CIF in exploring whether a glass clean up system is appropriate for their facility.
- It is the recommendation of this report that the CIF continue to support and work with municipalities to:
    - Identify where transfer stations are most appropriate
    - Identify what upgrades offer the most “bang for the buck”, and
    - Identify when to decide between an existing MRF, or new transfer station construction.
- Investments in material specific technology (i.e. optical sorters, eddy currents.) were shown to significantly increase the recovery of materials as well as the revenue received from the sale of materials (as a result of a higher quality bale). However, the decision as to whether to invest in material specific technologies is contingent on the amount of material entering the facility, current commodity markets, and other local conditions that can affect the economic viability of projects.

Chapter 9: Conclusion and Recommendations

The CIF (or similar funding organizations) plays a critical role in providing municipalities with the resources (both financial and knowledge based) to undertake initiatives that have had demonstrable success in both improving recovery and containing costs. In some instances, particularly for smaller municipalities who tend to face resource constraints, CIF funding allows municipalities to undertake initiatives that may not have been considered otherwise. While it is difficult to specifically quantity the impact that CIF projects have had on overall Blue Box performance, it is reasonable to assert that the return on investment for every dollar spent rationalizes both what the organization has achieved to date, and the necessity of a similar organization moving forward. Furthermore, the CIF has assisted municipalities in being able to "plan for the future" and adjust to an ever changing political/legislative and packaging landscape.

However, there remains a need for municipalities and the CIF to fund strategically, recognizing that every municipality faces their own unique issues and challenges. Depending on site and situation specific factors, different projects may want to be emphasized/prioritized. As noted earlier in the report, municipalities with relatively new or immature recycling infrastructure should emphasize accessibility, capacity and convenience. Conversely, more mature markets (assuming they have the above in place) should explore alternative promotion and education strategies, or improvements to processing and collection infrastructure (through increased mechanization at the MRF, automated carts etc.)

9.1 Recommendations moving forward

9.11 Region specific recommendations

The CIF has funded a range of projects across the province – based on the total number of projects, the CIF actually emphasizes funding in smaller communities in municipal groups 4-9. While the majority of Blue Box tonnes are generated and recovered in larger urban municipalities, the financial support and development of recycling programs outside of major urban areas is critical to the success of the Blue Box program as a whole.

Household recycling in Ontario is largely characterized by two extremes: On a relative scale, municipalities in the province's densely populated urban south enjoy regular and convenient curbside service, high levels of household participation and lower costs of material management. Conversely, for many of the municipalities located in the province's rural and northern areas, recycling faces numerous infrastructural impediments (i.e. limited staffing resources, remote depots and transfer stations etc.), that negatively affect cost and diversion performance. Given this lack of resources, the CIF plays a critical role in providing both financial and program delivery expertise to ensure that households have access to the

Blue Box program. Investments that specifically prioritize increased access to recycling (construction of new depot/transfer station sites), bin purchase programs for households etc. should continue to be supported in rural and northern Ontario. There may also be efficiencies realized by having smaller municipalities coordinate resources and service delivery with one another, particularly surrounding how material is collected and processed. The CIF should continue identifying opportunities where consolidated processing points, placement of transfer stations etc. can reduce operational costs for smaller municipal programs. Program support initiatives (such as providing staff with training, or "pre-packaged" promotion and education solutions) should also be seen as a funding priority, as it is often a more cost effective solution relative to municipalities "going it alone". It should be noted that while projects that support P&E in rural and northern Ontario are important, funding emphasis should be placed on removing barriers to access in order to maximize return on investment. The success of promotion and education initiatives is often predicated on there being few impediments to household recycling participation.

Investments in larger urban municipalities should also prioritize access/infrastructure, but there is perhaps less of an imperative to do so relative to smaller municipalities (given the maturity of the Blue Box program in many of these areas). As such, future funded projects should place a particular emphasis on processing efficiencies (which, as noted in Chapter 7, is a demonstrably effective way to improve revenues and recovery) or going after the "marginal tonne". The multi residential sector in particular should be an area where additional investments are encouraged, as there is a significant opportunity to increase recycling participation among households that historically recycle at a much lower rate relative to single family dwellings. Existing CIF projects (particularly the multi residential best practice guideline) is an important first step in improving recycling in this area, but continued efforts need to be supported. Promotion and education initiatives will be a critical tool in engaging households in large urban areas, as there is a need to target households that are not presently participating in their recycling programs (primarily new immigrants). However, the means and methods of engagement will need to be revisited, or at the very least, tailored, to meet the specific needs of an area, as conventional campaigns that appeal to environmental altruism may not appeal to these groups.

9.12 Are some investments more effective than others?

It is perhaps erroneous to think that initiatives can be ranked and directly compared as site and situation specific factors may necessitate a specific approach/technology etc. Furthermore, there is a utility in undertaking projects as a knowledge building exercise, even if the results cannot be readily translated into increased diversion or cost containment. However, based on the data available to date, encouraging either diversion or cost containment can be separated into a demand (inducing behavioral change) and

supply side (developing capacity and infrastructure) projects. Successful and enduring changes in Blue Box program performance often requires a multi-pronged effort that addresses both infrastructural and behavioral issues.

The results (both with respect to diversion and cost containment) attributed to CIF supported investments in processing infrastructure have significantly improved Blue Box program performance. While it is difficult to specifically quantify the magnitude of these impacts, reported savings by municipalities have totalled in the millions of dollars since CIF's inception. Improvements in recovery and capture rates have also been observed, even in spite of the increased generation of volumous, light weight packaging.

A recurring theme throughout this report is that there is no single solution to improving program performance. What solutions work best, and when and where to apply them, are largely a function of conditions specific to each municipality. Broadly speaking, the maturity of a recycling program is most likely to influence what projects should be considered a funding priority by the CIF. In areas with newly implemented or relatively immature recycling programs (rural and northern communities), the "easy wins" can be seen in projects designed to improve accessibility and capacity. Households need to have the ability to participate in the program, and a place to put their recyclables. However, once a program matures, promotion and education efforts, material specific strategies, and processing investments (to maximize recovery/minimize contamination) should be prioritized in order to ensure continued performance over time.

Anecdotally, there appears to be a "baseline" level of performance for the Blue Box program. While this level may vary from area to area, on aggregate, provincial recycling performance tends towards 60% on the whole. Barring any significant disruptions to the market (economic shocks, radical shifts in packaging design), it is unlikely that performance will fall below this level. However, the converse of this is also true – to achieve recycling rates over and above the 60% level, requires active intervention and investment on behalf of stakeholders (CIF, municipalities, stewards etc.) While this study is not designed to provide recommendations regarding the appropriateness of increased diversion as a policy objective, there is enough evidence to suggest that future increases in diversion are unlikely to occur without funding and resource support by the CIF (or a similar organization). Beyond the direct financial support that is provided by the organization, there is a benefit in information sharing, standardization of protocols, resource and program harmonization etc. However, quantifying these benefits remains an inexact process, as the full

benefits of many CIF investments are not realized until a future time period (outside of the reporting window), or are non-remunerative in nature (difficult to assign a dollar value).

9.13 Accessibility and Convenience (Demand side)

Accessibility is the most significant predictor of household recycling behavior – This may seem like a fairly obvious observation, but projects designed to increase access to the Blue Box program yield significant increases in the number of recovered tonnes. Households need to be able to have the opportunity to recycle, either through curbside collection, or being in close enough proximity to a drop off site.

As a tangent to accessibility, convenience is shown to be a significant predictor of recycling behavior. Households are unlikely to incur a significant time cost to participate in source separation programs, and as such, efforts that make recycling more convenient are likely to have a positive impact on diversion performance. It should be noted that convenience is not strictly a function of accessibility – initiatives that increase program awareness (the what and where of the program) can also make recycling more convenient for households. Behavioral barriers to participation (a lack of awareness) may be sufficient to impede household participation, even if no infrastructural barriers exist.

Ensuring that there is sufficient capacity within the system is also critical in ensuring program performance. Whether it be in single family homes or in public spaces, a program is ultimately constrained by its ability to manage material being generated. Ensuring that there are sufficient bins, selecting appropriate bin size, and regularly servicing an area are pre-requisites to a successful diversion program. Constraints on capacity are a particularly salient issue for the multi residential sector, or during the early stages of a recycling program. The CIF has found numerous successes in working with municipalities to improve system capacity through bin purchases, compaction and processing investments etc.

9.14 Processing and Sorting (Supply Side)

While encouraging household participation in recycling is, broadly speaking, the primary objective of the Blue Box program, municipalities have the ability to invest in equipment, technology and infrastructure that maximizes the operational efficiency of the program. As noted throughout the CIF reports, investments in sorting and processing infrastructure yield significant benefits with respect to capture rates and realized revenue, and in many ways, should be seen as a funding priority for the CIF moving forward. Continued investments in processing and sorting infrastructure will ensure that municipalities are

equipped to address changes in the composition, quantity and quality of the material being collected from households. Investments in sorting technology that reduce processing costs are particularly salient in light of the "evolving tonne, where a greater percentage of material is being comprised of light-weight materials. However, given the capital costs associated with many of these projects, municipalities are encouraged to work with the CIF to identify what technologies/investments may be the most appropriate given the types of material being generated by households. Certain investments may only become economically viable assuming there is a critical mass of material being collected and managed within the system.

9.15 Closing Comments

Despite the numerous successes achieved to date, rising system costs and stalled recycling rates for the Blue Box program as a whole point to the opportunity for improvement moving forward. While much of the factors contributing to system cost increases and stagnating recycling rates are beyond the control of municipalities, there are opportunities for programs to implement some of the "better practices" as highlighted by this report. Program harmonization, resource sharing, standardized contracts, clear and consistent promotion and education etc. can all be used to improve recycling performance. While municipalities may choose to undertake these initiatives independently, resource constraints may prohibit them from doing so, and as such, are more likely to do so with technical input and funding from organizations such as the CIF. These investments have and will continue to result in a more efficient Blue Box program, allowing municipalities to achieve environmentally beneficial outcomes (increased diversion) in a cost conscious manner.