

A Comparative Analysis Of Applied Recycling Collection Methods in Saint Paul

Executive Summary



Presented by Eureka Recycling
May 2002
for the Saint Paul Neighborhood Energy Consortium

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Executive Summary

Overview

Eureka Recycling, in partnership with the city of Saint Paul and the Minnesota Office of Environmental Assistance (MOEA), completed a study of curbside recycling collection methods in order to identify ways to improve the city of Saint Paul's curbside recycling program. According to the MOEA's 2000 Solid Waste Policy Report, *Waste Management in Minnesota: A Transition to the 21st Century*, our waste generation will triple from the amount generated in 1995 to 2020 if Minnesotans stay on their current path. Even those that disagree with these projections do not disagree that waste generation is increasing each year - even with our recycling efforts. Ramsey County's SCORE reports state that its citizens have achieved a recycling rate of about 40% of the waste generated but that increased waste reduction and curbside recycling is going to have to dramatically improve in order to keep up with the ever-increasing amounts of garbage.

The recommended changes that Eureka Recycling proposes, as a result of the 14-month study just completed, aim to go beyond keeping up with the waste generated to further a recycling program that is more cost effective, more convenient and better protects the environment.

Recommended Changes

The results from data collected over the 14-month study have been evaluated to assess the environmental impacts, cost and convenience of each method. Our recommendation is made using these three indicators:

- **Environmental Impacts:** Consider which collection method allows residents to recycle the most materials while having the least amount of materials that have to be thrown out? (Contaminated and damaged materials have to be thrown out.) Consider the recycling collection method that gets the most recycled with the least pollution.
- **Cost:** Consider how much the different methods cost and how the cost of each impacts the residents' choice.
- **Convenience/Satisfaction:** Consider why, how and what do people want to recycle and what would make them recycling more.

After measuring and analyzing the costs (combined collections and processing, less material revenues), convenience (measured through customer surveys and actual household participation levels) and environmental impacts (net recovery of materials that get to markets versus residuals) of the various collections the study concludes that:

In order to provide the greatest environmental benefits at a greater convenience and affordable costs to residents, Saint Paul's recycling program should:

- Move to a two-stream recycling sorting system: papers (including newspaper, cardboard, paper and mail) and rigid containers (a mix of cans, glass and plastic bottles).
- Add PET (#1) & HDPE (#2) plastic bottles to curbside collection.
- Provide 18-gallon recycling bins with weekly collection. Although recycling carts net a greater diversion, the cost of the carts is a barrier to this method. Residents ranked this as a low funding priority. Blue bins that are collected weekly provide the same storage capacity as carts that are collected every other week.
- The study results clearly indicate that the greatest potential for diversion can be achieved through organics collection. Therefore, Saint Paul should aggressively work toward adding organics collection to its curbside program to significantly reduce Saint Paul's waste generation

Organics collection should be further evaluated for transportation cost and residential acceptance issues. There is no doubt that big environmental savings are still being left in the trash. Eureka Recycling needs more information about the possibility of using transfer stations to reduce the cost of having to transport multiple loads to the nearest organics processor in Dakota County. Permits, regulations and other structures that inhibit this type of collection need to be analyzed by state, county and city regulators and changes should be made to streamline this collection alternative.

Methodology

The purpose of this project was to field test several different strategies for expanding the effectiveness of the existing program and for increasing the quantity of material diverted for recycling or composting. In order to provide objective and quantified data upon which to make sound decisions, rigorous study design procedures were implemented.

First, a test area was designated in which to field test each of the strategies of approximately 200-400 households that, based upon prior experience, would produce statistically meaningful results (defined to be within +/-20% at the 90% significance level).

Second, a nearby control area was designated that was demographically similar to the associated test area. The purpose of the control area was to be able to sift out any changes exogenous to the field test that affected the recycling characteristics of all of the residents of Saint Paul. That is to say, if the residents in the study area exhibited an increase in participation after the study started, but so did residents of the control area, then it was not assumed that the improvement in the study area was due to the study, but rather was caused by something else going on in the city. Only the difference between the test and control areas could be used in calculating the impacts of the test method.

Third, the parameters were compared under examination in the test and control areas before and then after the change in collection strategy. This methodology is called a before and after test with controls, and is well recognized as a way to develop solid field data.

Study Groups

Four neighborhoods (approximately 400 households each) tested new ways to sort and collect recyclable materials. Each household received a brochure that included a detailed description of the temporary recycling collection method and the collection dates. A fifth neighborhood, the control group, also received a brochure. This brochure explained the current program with their collection dates. The control group was monitored prior to the application of the education elements. The monitoring included the collection of set-out rates, participation rates and amounts of materials recycled. Staff canvassed all five neighborhoods and spoke to 83% of the residents in person. Shortly after the canvassing, appropriate recycling containers were delivered to their homes.

This study was designed to measure the convenience, environmental impact and cost of five different recycling collection scenarios. Each scenario tested different parts of a recycling collection system, including education, the way materials are sorted, the types of containers (bins or carts) used by residents, frequency of pickup and the addition of new materials, like plastic bottles or household organics. Nearly 2000 households tested one of these scenarios for four months.

Here is a snapshot of the five collection methods that were developed and tested:

1. **Scenario A: Source-separated** collection system. Residents sorted the materials at the curb into separate categories. Collection occurred bi-weekly.
2. **Scenario B: Two-stream** collection system using two **18-gallon blue bins**. Residents sorted materials into two categories or streams: papers (including newspaper, cardboard, paper and mail) and containers (a mix of cans, glass and plastic bottles.) Collection occurred bi-weekly.
3. **Scenario C: Two-stream collection**, same as above, but using **35-gallon rolling carts** to collect and set out their materials. Collection occurred bi-weekly.
4. **Scenario D: Two-stream collection** with 18-gallon blue bins and the collection of household **organics** (including food scraps and non-recyclable papers like pizza boxes and paper plates) in a 35-gallon rolling cart. In this neighborhood, recycling and household organics were collected every week.
5. **Scenario E: Single-stream** collection system using one large 60-gallon rolling cart to collect recyclables. Residents did not sort by stream. Materials were mixed together-cans, glass, plastic bottles and papers-and the entire separation took place at a recycling facility. Collection occurred bi-weekly.

Each study and control route had several data points that were established for tracking. They were as follows:

1. Each individual household, in each study and control route, was tracked each collection week as to whether or not they placed materials out for collection. Eureka Recycling staff drove through the study area just ahead of the collection vehicle and recorded the information. This information was entered into a database to establish set-out rates for each collection week, as well as overall participation rates for each collection method.
2. Each truckload was weighed from each study and control route. The truckloads were measured for percentages of paper and containers as well as overall weights. This information was entered into the database to determine average weight per set-out and for average weight per household.
3. Stratified load samples were sorted to determine material compositions. These were compared between collection methods to determine impacts of collection methods on resident behavior.

Compiled Results for Tested Collection Methods

The following table provides a view of the measured impacts of the tested collection methods when compared to their control routes. Included are the baseline numbers for the control route used for comparative purposes.

Table 1: Changes in Recycling Behavior - Tested Methods vs. Baseline Data

Study Results	Projected Set-Out Rate	Projected Participation Rate	% Increase in Materials Collected	% of Load Paper	% of Load Containers
Baseline Route Data	46%	71%	402 lbs./hh/yr.	85.16%	14.86%
A. Source-Separated	52%	75%	6.2%	84.72%	15.28%
B. Two-Stream Bins (Bi-Weekly)	52%	75%	7.3%	82.25%	17.75%
C. Two-Stream Carts (Bi-Weekly)	58%	78%	32.8%	79.64%	20.36%
D. Two-Stream Bins (Weekly)	53%	78%	26.1%	82.55%	17.45%
E. Single-Stream Carts (Bi-Weekly)	59%	76%	20.8%	76.50%	23.50%

This combination of field data collection, national information gathering and program participant surveys has provided a comprehensive evaluation and comparison of the costs of each tested collection method, the convenience of each method to the residents and the impact of that convenience on their participation, and the overall environmental impacts, or increase/decrease in materials getting to markets. Table 2 provides a comprehensive comparison of the various collection methods overall performance, combining the collection route performance measures with the cost and processing performance data that is provided in Appendix A.

Table 2: Comparison of Program Elements of Tested Scenarios

	A. Source-Separated w/ Education		B. Two-Stream Commingled		C. Two-Stream Commingled		D. Two-Stream Commingled		D. Two-Stream Commingled & Organics		E. Single-Stream	
Collection Schedule	Bi-Weekly		Bi-Weekly		Bi-Weekly		Weekly		Weekly		Bi-Weekly	
Recycling Containers	18-Gallon Bins		18-Gallon Bins		2 - 35 gallon Carts		18-Gallon Bins		18-Gallon Bins 35-Gallon Cart		64-Gallon Cart	
% Increase in Tons Collected	6.2%		7.3%		32.8%		26.1%		91.6%		20.8%	
City-Wide Materials Collected *	16,300 Ton/Yr		16,453		20,394		19,361		29,410		18,519	
% Material Loss During Processing **	A 1%	B 1.6%	A 6.4%	B 10.9%	A 6.4%	B 11.6%	A 6.4%	B 10.8%	A 7.5%	B 11%	A 14.2%	B 27.2%
Net Program Material Recycled **	16,137	16,039	15,400	14,660	19,089	18,028	18,122	17,270	27,204	26,175	15,889	13,482
Net overall % Increase in Tons Recycled	5.1%	4.5%	0%	-4.5%	24.4%	17.5%	18.1%	12.5%	77.2%	70.5%	3.5%	-12.2%
Collection Costs / Ton	\$60		\$50		\$65		\$59		\$80		\$51	
Processing Costs / Ton	\$35		\$50		\$50		\$50		\$50 (Rec)	\$30 (Org)	\$60	
Processing Revenue / Ton	\$50		\$43		\$44		\$43		\$43	\$20	\$33	
Net Costs / Ton	\$45		\$57		\$71		\$66		\$88		\$78	
Customer Satisfaction***	N/A		80%		83%		76%		75%		87%	
Willing to Pay for Change	N/A		73%		63%		61%		54%		65%	

* Excludes District 14 and Multifamily Program tonnages.

** Column "A" under "Material Loss During Processing" is the residual rate calculated without including mixed glass. Column "B" is the residual rate when including mixed glass as not being recycled. Eureka Recycling does not consider the use of mixed glass as an aggregate material or daily landfill cover as a recycled material. These residual rates are then applied to the total materials collected to calculate "Net Program Material Recycled"

***Percentage preference of the study method that group tested to the current source-separated program.

Information Supporting Recommendations

PET & HDPE Plastic Bottles - Using the container composition sorts done for each method, it can be concluded that any curbside system greatly increases diversion of plastic bottles over the current drop-off system. Providing residents with two 35-gallon carts, one for all of the recyclable papers and another for their plastic bottles, glass bottles and aluminum and steel cans, provided the greatest recovery of plastic bottles - a 560 ton increase.

Collection System	Annual Tons	% Plastic Bottles Curbside	Projected Annual Plastic Tons
Current Drop-off	154	N/A	154 drop-off
Two-Stream/Bins	16,453	2.6	427.78
Two-Stream Carts	20,394	3.5	713.79
Two-Stream Bins Wkly	19,361	2.8	542.11
Single-Stream	18,519	3.0	555.57

Residential Mixed Paper (RMP) - The current residential recovery of RMP is 1,719 tons per year from 76,524 households, or 45 pounds per household per year. A survey of RMP programs with more aggressive education campaigns indicates that 100 to 150 pounds per household per year are feasible. Eureka Recycling found that an aggressive education program yielded a 6% increase in all recyclables. The highest percentage of recovery of fiber 85.16% was the source-separated program. This was true even before the addition of an aggressive paper recycling education campaign (the RAM RMP Project also funded by the MOEA.) The net highest recovery of fiber by weight occurred in the two-stream, bi-weekly 35-gallon cart study area, which resulted in over 425 lbs./hh/yr. of recycled fiber, a gain of over 82 lbs./hh/yr.

In the survey that was done at the end of the study, residents were asked why they threw away paper and could select more than one reason. A very strong majority (75%) replied that it was contaminated so that it could not be recycled. Twenty-five percent said they did not recycle the paper due to confidentiality concerns, only 8% said they were unsure of what to recycle and 9% said that it was too difficult.

- *The data shows a projected increase of 712.27 tons per year of additional RMP through education in the current source-separated program with NO other program changes.*

Kitchen Organic Material - Over 25% of the waste stream is made up of kitchen (or household) organics that are currently thrown away but could be separated for composting. This element of the study netted the highest potential for additional diversion. Eureka Recycling will continue to study this option in order to identify how this option could be implemented citywide.

- *The data shows a 254 lbs/hh/yr collection rate. Citywide this would increase diversion by 10,160 tons/yr, which is a 68% increase in tons diverted over the current curbside program.*

Seventy-five percent of the residents who tested the method said that it was very valuable. Fifty-two percent said that they would pay for this service. Four percent preferred backyard composting and 12% used their sink disposal while 13% said they preferred to throw it in the trash. Forty-six percent of residents that tested this method noted that they preferred composting their organics because they had less trash - but only 20% said they did or could have reduced their garbage bill.

NRG Processing Solutions reported no (negligible) contamination in the organic materials collected in the study. NRG Processing Solutions operators visually inspected all loads and all materials were accepted for composting. Because the volume of material was not sufficient for separate processing, it is not feasible to determine the specifications of those specific materials in the final product. NRG Processing Solutions maintains that the material met all of their specifications at the point of entry into the composting system.

Carts & Bins – Ninety-three percent of the residents either loved (29%), liked (41%) or thought the blue bins were okay (23%.) Over 80% of the residents that tested the carts preferred them and were willing to pay for them. Bins or carts - residents liked them. When asked specifically what they disliked about the carts less than half (47%) thought the carts were too big.

- *The data shows that the two-stream, bi-weekly 35-gallon cart recycling method netted the highest diversion rates of all the tested methods-over a 32.8% increase from the baseline recycling program.*

Weekly – Sixty-eight percent of the residents that tested weekly felt that it was just the right amount of service and 61% were willing to pay for this additional service.

- *The data shows that two-stream weekly collection in blue bins netted the second highest diversion rate of all tested methods-over a 26% increase from the baseline recycling program.*

Education - Residents liked all of the educational materials, but most preferred the information that was sent in the mail, followed by the information delivered to the door, the discussions with the staff and finally the hotline. With no other changes the control group recycled an additional 6% just due to increased awareness of the study and the educational materials.

Residuals - What Really Gets Recycled - While all the methods showed promise as far as increasing what residents recycled, the way Eureka Recycling collects and then later processes (sorts) material effects what actually gets recycled. Eureka Recycling contacted the Government Advisory Associates, a consulting firm that specializes in recycling

industry research, to determine residuals rates at two-stream and single-stream facilities. Residuals consist of materials that are not accepted by the program but are picked up during collection, also known as out-throws (i.e. toys, #3-7 plastics, refuse), and recyclables that are too damaged or contaminated to be shipped to market and must be thrown away.

- *Source Separated Collection - Currently Saint Paul’s program does not exceed a 1.6% residual rate.*
- *Two-Stream Collection – GAA research showed that two-stream programs average a 6.4% residual rate (based on a survey of 215 facilities nationwide).**
- *Single-Stream programs average a 27.2% residual rate (based on a survey of 16 facilities nationwide).***

**This average was reported based upon the assumption that all glass collected was recycled back into glass.*

*** This average was reported based upon the assumption that no glass collected was recycled back into glass.*

Glass is a significant part of the residual rate in both two-stream and single-stream programs. As stated earlier, residents were asked about their preference for managing glass. Overwhelmingly residents want the glass bottles and jars recycled back into bottles and jars. Eureka Recycling calls this the “highest and best use” and “closed loop recycling” where these materials can be recycled and remanufactured over and over again. Less than 1% of residents were willing to allow their glass to be used as a landfill cover.

Table 3 below provides a comparison of the various methods of collection in two ways. Column A shows the average residual rates when the mixed-colored glass component of the recycling stream, after processing, is recognized as being recycled when used as an aggregate substitute or as daily landfill cover. This material is not made into glass bottles. Column B indicates the percentage of the glass in each collection method that, on average, ends up as mixed-colored glass. Column C shows the average percentage of glass of the total recyclable materials collected in each collection method. Column D provides the calculated residual rate if the mixed glass is not recognized as being recycled when used as landfill cover or aggregate.

TABLE 3 Impact of Strategy on Quality of Recyclables				
	A. Average Residual Rates (excluding Mixed Glass)	B. Mixed Glass (% of all glass)*	C. Glass % of Total Recyclable Stream	D. Total Residuals (%)[†]
Truck Sort	1%	1%	12.2%	1.6%
Two-Stream Bin	6.4%	41%	11.1%	10.9%
Two-Stream Carts	6.4%	41%	12.6%	11.6%
Two-Stream Weekly	6.4%	41%	10.7%	10.8%
Single-Stream	14.2%	100%	13.0%	27.2%

* Broken glass for truck sort is from Saint Paul experience; two-stream data is from WMI Saint Louis Park, MN facility; single-stream data is from Allied Wastes facility in Plano, TX.
[†] Residual data for truck sort is from Saint Paul experience; single-stream data is from GAA (see Appendix C).

Summary

By carefully implementing important changes in what and how Saint Paul recycles, Eureka Recycling can control costs, improve convenience and divert, through composting and recycling, 74% of the discards that households generate.

Organics collection needs to be analyzed in more detail since this is where the next greatest diversion can occur. There are still unanswered questions regarding the cost and method of collection but there is no doubt that residents are willing to sort the materials because of their commitment to the environment.

The data that was gathered in this grant can and should be used by other communities in the metro area to ascertain the relative value of changing their current collection method. Although this project began with our baseline data, other communities should be able to begin with their baseline data and input the variables developed to create some projections for participation, diversion and net diversion after residuals.

In particular, since communities are struggling with ways to maintain or increase their recycling rates, single-stream recycling has taken on significant interest and has resulted in many unanswered questions. Many communities move to this system without thorough analysis of its challenges and benefits in hopes of increasing residents' convenience and thereby increasing recycling rates. It is important to note that in this study the single-stream method did not prove to be cost effective when compared to the other methods. Although single-stream, along with the bi-weekly two-stream bins scenario, resulted in the most inexpensive collection costs, the increased processing costs and decrease in revenues due to material loss made it the most expensive method when looking at the overall system. In addition, the net overall recovery (environmental benefit) in the single-stream method (i.e. materials reaching end markets) was less than every other tested method when subtracting the residuals from the collected amount. There is no single answer or one-size-fits-all solution to the leveling of recycling rates. Rather, it takes a recycling program tailored to meet each community's values and needs to accomplish our recycling goals.

Each community values different elements of their recycling program. In Saint Paul it is clear that the residents value the environment over convenience and then cost. Each community will interpret their data with an eye to their community's overriding goals in resource management.