Using Normative Feedback to Increase Recycling Participation in the Town of Dedham

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The Massachusetts Department of Environmental Protection

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Introduction

The recycling rate in the Town of Dedham, Massachusetts was 24% in 2002, below the statewide average of 33%. The Department of Environmental Protection funded a pilot project in Dedham in FY03 to test the potential of a community-based social marketing (CBSM) strategy for increasing recycling participation. CBSM uses social science knowledge regarding behavior change to encourage environmentally sustainable practices. CBSM involves 1) identifying the barriers and motivations associated with participation in the activity of interest; 2) designing a strategy to overcome the barriers and strengthen the motivations using proven behavior change tools; 3) piloting the strategy on a small scale to assess its effectiveness.[1]

The Motivation: Social Pressure

Social scientists have been studying recycling behavior since the 1970's. In order to identify the barriers and motivations that are related to people's recycling habits, social scientists ask recyclers and non-recyclers questions about a wide variety of factors that might influence their recycling behavior. They then use statistical methods to determine which of these factors are linked to recycling participation and which are not.[2] Reviewing the social science literature reveals that "social pressure" shows up in numerous studies as being linked to recycling habits. People are motivated to recycle by actual pressure they receive from family and friends to do so. Furthermore, simply knowing that family, friends and neighbors recycle increases our likelihood of recycling.[3]

The LaVerne Strategy

In 1993, researchers tested a strategy for strengthening the motivation due to social pressure by providing residents in LaVerne, California with feedback on neighborhood recycling rates. One hundred twenty households in LaVerne were provided with four weeks of weekly feedback on the quantity of recyclables collected in their neighborhood and on the percentage of households setting material out. This let residents know what the prevailing recycling habits were -- that is, what the "norm" was -- in their neighborhood with regards to recycling.[4]

The week prior to beginning the feedback, residents received a message stating that, "Volunteers will be conducting a study on recycling. Your household has been selected as part of a larger sample of La Verne residents……. In order for La Verne to achieve the benefits of recycling, please try to recycle as much as possible." This information was printed on one side of a green door hanger, and placed on the front doorknob of each household. This door hanger served the purpose of alerting residents that they would be part of a new outreach effort to increase recycling.

For four subsequent weeks, the researchers observed the volume of recyclables set out by each household in the study area. Later on the same collection day, the researchers returned to each household and left a preprinted door hanger on which they had written the total quantity of material set out in the neighborhood for the current week, the previous week and since the

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[1] McKenzie-Mohr, D. & Smith, W. (1999). Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing. British Columbia: New Society Publishers.
[2] Aceti, J. (2002) The Curbside Door Hanger Feedback Strategy. [Fact sheet prepared for the Massachusetts Department of Environmental Protection] Boston, MA.
[3] Aceti, J. (2002) The Curbside Door Hanger Feedback Strategy. [Fact sheet prepared for the Massachusetts Department of Environmental Protection] Boston, MA.
[4] Schultz, P.W. (1998). Changing Behavior With Normative Feedback Interventions: A Field Experiment on Curbside Recycling. *Basic and Applied Social Psychology*, 21(1), 25-36.

beginning of the study. The researchers also provided feedback on the number of residents setting recyclables out that week. A sample of the weekly feedback is displayed in Figure 1.

Figure 1. LaVerne Door Hanger Text

Neighborhood Recycling Results

Below is printed recycling participation of LaVerne residents in your neighborhood.

This week: July 15 – 19
Participation 54 out of 120 households
Amount newspaper (# crates) 42
Amount glass (# crates) 18
Amount plastic (# crates) 25
Amount metal (# crates) 15
TOTAL (# crates) 100

Last week: July 6 – 12
Participation 48 out of 120 households
Amount newspaper (# crates) 38
Amount glass (# crates) 16
Amount plastic (# crates) 22
Amount metal (# crates) 14
TOTAL (# crates) 90

Cumulative Total
Weekly Participation 41%
Amount newspaper (# crates) 110
Amount glass (# crates) 49
Amount plastic (# crates) 67
Amount metal (# crates) 39
TOTAL (# crates) 265

The residents who received the feedback increased the volume of material they recycled by 19% compared to a control group that received no outreach at all. This increase was observed during the period in which feedback was provided, and also for four weeks after the feedback ended.

With some differences, this strategy was piloted in the Town of Dedham in 2003 to determine if the success of the LaVerne pilot could be replicated.

The Town of Dedham

The Town of Dedham is a suburban community located just south of Boston. The town contracts with Waste Management (WM) to provide residents with every-other-week curbside recyclables pick up service. One recycling truck is sufficient to provide this service. Table 1 shows that the town is homogeneous in terms of housing stock, housing tenure and racial composition.

Table 1. Town of Dedham Demographics

Demographic	
Population	23,500
# Households	8,700
% Single Family Homes	86%
% Owner Occ. Housing	79%
Race	94.5% White
Median Household Income	$62,591
% with College Degree	32%

The town is also quite homogeneous in terms of median household income and education level, with six of Dedham's ten recycling routes having median household incomes between $60,000 and $70,000. The percentage of residents with a college degree is between 28% and 37% on seven of the ten routes. A more detailed breakdown of the demographic characteristics by recycling route can be found in Appendix A.

The Dedham Strategy

The strategy piloted in Dedham differed in several ways from the strategy piloted in LaVerne, CA.

Scale

In LaVerne, the strategy was tested on a scale of about 120 households. There is some evidence that individuals are more influenced by the behavior of people who are closer to them and whom they may know, such as people on their street or in their immediate neighborhood. So, providing feedback about recycling habits city-wide, for example, may be less likely to change behavior than more local feedback.[5] Indeed, when a strategy similar to LaVerne's was tested in Vista, CA on a city-wide basis, it was not effective.[6] In Dedham the strategy was tested for effectiveness on an entire recycling truck route of about 800 households; intermediate between the 120 household scale used in LaVerne and the city-wide scale used in Vista, CA. Implementing the strategy at the truck route scale cuts costs by eliminating the need to do time consuming observations of the quantity of recyclables set out at each household. Instead, truck load weights can be converted to volume for the purpose of providing feedback on the bins and bagsful of material recycled in the neighborhood. Further, the hope was that the truck route scale was small enough so that neighborhood connections would still have an impact.

Feedback

There were several differences between the feedback provided in LaVerne and the feedback provided in Dedham.

Number of Door Hangers

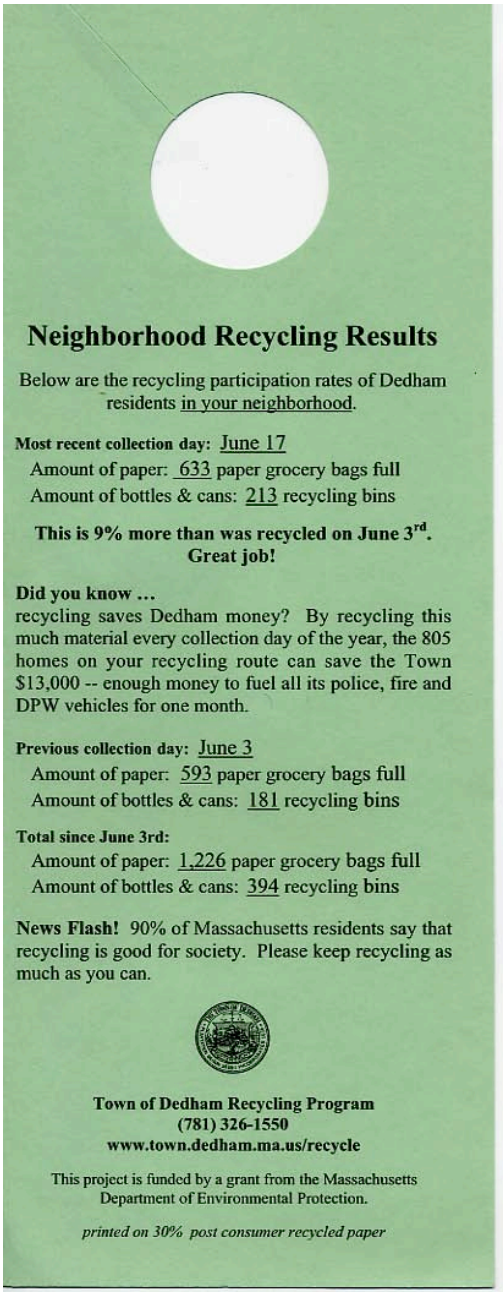
The LaVerne researchers distributed five door hangers. In Dedham, seven were distributed. The Dedham project staff increased the number of door hangers because tonnage on the test route began to show a positive change compared to the control route only after several door hangers had been delivered. Given this lag time in response, it was thought that increasing the number of door hangers would enhance the behavior change among residents. .

[5] Schultz, P.W. (2002, November). California State University San Marcos. Email Communication.
[6] Schultz, P.W. (2002, November). California State University San Marcos. Email Communication.

Door Hanger Format, Timing and Content

With the exception of an initial introductory door hanger, the door hangers used in Dedham used the format displayed in Figure 2. All seven of the door hangers distributed in Dedham are displayed in Appendix B.

Figure 2. Dedham Door Hanger



Neighborhood Recycling Results

Below are the recycling participation rates of Dedham residents in your neighborhood.

Most recent collection day: June 17
Amount of paper: 633 paper grocery bags full
Amount of bottles & cans: 213 recycling bins

This is 9% more than was recycled on June 3rd. Great job!

Did you know …
recycling saves Dedham money? By recycling this much material every collection day of the year, the 805 homes on your recycling route can save the Town $13,000 -- enough money to fuel all its police, fire and DPW vehicles for one month.

Previous collection day: June 3
Amount of paper: 593 paper grocery bags full
Amount of bottles & cans: 181 recycling bins

Total since June 3rd:
Amount of paper: 1,226 paper grocery bags full
Amount of bottles & cans: 394 recycling bins

News Flash! 90% of Massachusetts residents say that recycling is good for society. Please keep recycling as much as you can.

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post consumer recycled paper

On each collection day in LaVerne, the researchers observed the number of crates of recyclables set out in front of each of the 120 households, added the numbers up and hand wrote the totals on pre-printed door hangers. They then distributed a door hanger to each household on the same collection day to which the feedback pertained. In Dedham, six customized feedback door hangers were produced (in addition to the introductory door hanger), one for each collection day for which residents received feedback. Due to the greater number of households in the pilot, the feedback was not handwritten, but Lucida Handwriting font was used to approximate a handwritten look. Because of the time needed for production, and to arrange for distribution staff, there was generally a two week delay between the collection day and distribution of the feedback pertaining to that day. The formulas used for calculating the number of bags and bins of recyclables can be found in Appendix C.

In Dedham, when the quantity of recyclables increased compared to the quantity collected the previous collection day, the magnitude of the increase was explicitly noted just below the feedback for the day, as displayed in the example in Figure 2.

The Dedham door hangers each included a "Did you know…..?" section, which was intended to make the feedback more vivid, personally relevant and concrete for residents. Information that is vivid, personally relevant and concrete is more likely to catch people's attention.[7] Further, the information was intended to enhance residents' perception of the effectiveness of recycling. Research shows that the more people see recycling as making a difference, the more likely they are to participate, or participate fully.[8] Describing what the benefits of residents' recycling efforts would be over a year's time emphasized the difference that the neighborhood could make. Each door hanger highlighted a different benefit of recycling or described end products that are manufactured from household recyclables. The facts and figures used to calculate the quantity of each end product manufactured and the financial and environmental benefits that accrue from recycling can be found in Appendix D.

Although the feedback used in the LaVerne study included the number of households participating, the feedback in Dedham did not. Before launching the Dedham pilot, project staff spoke by phone with 40 householders on the recycling route where the door hangers were to be distributed, and asked them what percentage of the households on their street typically recycled. On average, residents believed that about 85% of their neighbors recycled. Project staff then did a count of the number of households actually setting out recyclables on one collection day. These observations indicated that the set out rate was in fact around 50%.

It was somewhat surprising that residents' perception of the set out rate would be so different than the actual rate. Are there alternative explanations for the discrepency? One possibility is that respondents wished to portray their neighborhood as socially responsible. Respondents know that recycling is the "right thing to do," and that the survey was being conducted on behalf of the town. Another possibility is that people are not able to distinguish well between different levels of participation. Perhaps any set out rate above 50% is perceived by people as "very high," – corresponding to an estimate in the range of 85%. Finally, it is possible that the phone survey respondents were not representative of the neighborhood. Project staff used the town census listings to identify households located on the test route. The census listings provided information about the age and occupation of each household member. There seemed to be a greater tendency for households consisting of middle-aged, higher earning couples with children to pick up the phone and be willing to respond to the survey. These families may live on streets with higher set out rates than younger, single person households with less earning power.

[7] McKenzie-Mohr, D. & Smith, W. (1999). Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing. British Columbia: New Society Publishers.
[8] Aceti, J. (2002). Recycling: Why People Participate; Why They Don't. [Fact sheet prepared for the Massachusetts Department of Environmental Protection] Boston, MA.

Research shows that people consider others' recycling behavior when deciding on appropriate behavior for themselves. If the actual percentage of people participating is lower than what people believe it to be, providing feedback on the actual participation rate may cause people to feel less motivated to participate. On the other hand, providing participation rate feedback will be most effective in areas where the participation rate is actually higher than people think it is.[9] Because the actual set out rate was lower than what people perceived it to be on the test route in Dedham, project staff chose not to provide feedback on the number of people participating. Instead, positive statements about the beliefs and actions of Massachusetts residents were included in the "News Flash!" section on the door hangers. These statements were derived from the results of a phone statewide phone survey on recycling participation conducted by DEP in 2000.

Pilot Implementation

Choosing Test and Control Routes

It was important to monitor changes in the tonnage collected not only on the test route where the door hangers were distributed, but also on a comparison, or "control" route, on which no outreach was done. Monitoring the tonnage on a control route provided information about changes in recycling tonnage that occurred due to factors other than the strategy being piloted. These factors might include seasonal fluctuations in recyclables tonnage, or fluctuations due to changes in the economy. In evaluating the effectiveness of the feedback strategy, it was important to subtract out any change observed on the control route, since it would be due to factors other than the strategy.

Of the ten recycling routes in Dedham, the Tuesday A and Wednesday A routes best met the criteria needed to ensure a smooth implementation and valid evaluation of the pilot.

Table 2. Test and Control Route Characteristics

Criteria	Test Route Tuesday A	Control Route Wednesday A
Collected in Same Week	Yes	Yes
Ease of Door Hanging	Good	Not Applicable
Excess Truck Capacity	Yes	Not Applicable
Level of Participation	Medium	Medium
Median Household Income	$65,323.22	$61,022.87
Avg. Household Size	2.67	2.65
% Owner Occupied	81.10%	80.15%
% with College Degree	32.02%	28.15%

If the test and control routes were picked up in opposite weeks, collection delays due to holidays would affect the amount set out on one route but not the other. Therefore, it was important that the test and control routes be picked up in the same week. It was also important that door hanger distribution on the test route be straightforward. Project staff wanted to avoid a situation in which undue challenges might lead to difficulties implementing the strategy properly. In this case, if little or no tonnage change were observed on the test route, it might be impossible to tell if the weak pilot results were due to implementation problems or to an ineffective strategy.

The project staff also wanted to avoid a situation in which an increase in tonnage led to the need for driver overtime. Such a situation might lead to operational or contractual difficulties that could

[9] Schultz, P.W. (2002). Knowledge, Education and Household Recycling: Examining the Knowledge-Deficit Model of Behavior Change. In T. Dietz & P. Stern (Eds.), *New Tools for Environmental Protection: Education, Information and Voluntary Measures in Environmental Protection.* Washington, DC: National Academy Press.

jeopardize the success or even the completion of the pilot. Therefore, the project staff chose a test route that was routinely completed by the driver in less than eight hours, without completely filling the truck. Finally, if factors other than the strategy affected the tonnage on the test and control routes, choosing routes with similar demographics and similar levels of pre-pilot participation would increase the likelihood that the two routes would be affected similarly.

Monitoring the Tonnage

Initially, the Waste Management supervisor for Dedham emailed the truck load weights for the Tuesday A and Wednesday A routes to the project staff. However, due to long hours on the road and relatively few in the office, the supervisor was not always able to email the tonnage figures in a timely manner. Further, there was no way to double check the accuracy of the figures or to confirm that the driver had emptied his truck before starting each route. As a result of the drawbacks of receiving emailed tonnages, it was agreed early on in the pilot that the office-based WM dispatcher would fax the Dedham weight slips to the project staff each day during A weeks. Reviewing the weight slips allowed the project staff to confirm that the weights were for the right day and community. For routes on which the driver picked up more than one truck load, the time of day that the second load was dumped indicated whether the driver started his next route with an empty truck.

The weights for the test and control routes were monitored for five collection days before the door hangers were distributed. Because Dedham has every other week collection, this “pre-test” or “baseline” period extended from April 7 – June 3, 2003. The weights for the test and control routes were monitored for eight collection days during the “feedback” period while the door hangers were being distributed. This period extended from June 17 – September 23, 2003.

Door Hanger Production and Distribution

The artwork for each door hanger was prepared by project staff using MS Word. The door hangers were produced by a local copy/printing firm. Dedham high school students and Boston-area adults were hired to work with the project staff in distributing the door hangers. While most of the door hangers were simply left at residences, the distributors greeted residents who were outside their homes or visible through screen doors and handed them a door hanger. As the weeks went on, it was clear that residents were becoming accustomed to having the door hangers delivered door-to-door, and occasionally had a question or a comment for the distributors. Comments from several residents revealed that they thought they were receiving the same door hanger that they had gotten on the previous collection day. The first three door hangers were all produced on green paper, as had been done in LaVerne. However, each subsequent door hanger was produced on a different color paper, in order to help residents differentiate between them. More details regarding the door hanger production and distribution can be found in Appendix E.

Budget

The monetary costs of implementing the door hanger feedback strategy on a recycling route of 800 households are displayed in Table 3.

Table 3. Budget

Budget Item	Cost
Door Hanger Production [1]	$ 795.00
Rubber Bands	$ 6.00
Door Hanger Distribution [2]	$ 1,680.00
TOTAL	$ 2,481.00

[1] 1,000 copies of each of 7 door hangers @ $110/1000. The final door hanger cost an additional $25 because it was double-sided.
[2] 4 people earning $60 each for each of 7 distributions. In retrospect, a payment of $45 per person per distribution would have been sufficient. This would have brought the door hanger distribution cost down to $1,260, and the total monetary cost for the pilot down to $2,061.

Results

The changes that occurred in the test and control route tonnages during the pilot are displayed in Table 4.

Table 4. Pilot Results

Route	Avg. Weekly Tonnage		% Change in Avg. Tonnage
	5 Wk. Baseline Period	8 Wk. FeedbackPeriod	
Control Route	6.71	6.06	-9.7%
Test Route	5.71	5.35	-6.3%
% Change Due to Strategy			3.4%

The average weekly tonnage for the control route declined from the baseline period to the feedback period. This is not surprising. The baseline period occurred during the spring and early summer, before the ending of the school year. The feedback period occurred primarily during the summer vacation season, when more residents were away. The average weekly tonnage for the test route declined also, but not as much. The difference, 3.4%, may be attributable to the strategy, or may have occurred by chance. A two tailed, independent *t* test indicates that the 3.4% difference approaches statistical significance ($p < 0.146$). This result would have come about by chance alone only 15 times out of 100.

However, when the number of data points is less than 12 to 15, the *t* test for statistical significance is strongly influenced by the number of data points. Specifically, a small data set may decrease the likelihood of statistical significance. Only 8 truck load weights were obtained during the feedback period. It is possible, however, to do a “back-of-the-envelope” test to determine whether the pilot results would have been statistically significant if the number of data points had been greater. The test is done by duplicating the data set of 8 truck load weights, thus making the data set twice as big. When the *t* test is done using this “larger” data, set, the pilot results are statistically significant ($p < 0.032$). This result would have come about by chance

alone only 3 times out of 100. The results of the "back-of-the-envelope" test suggest that with more measurements, the pilot results would have been statistically significant.
It is very likely that the feedback strategy employed in the pilot motivated residents on the test route to recycle more than they otherwise would have. But, what is the "real world" significance of the pilot results? Would it be worthwhile for Dedham to implement this strategy townwide? If Dedham were to implement this strategy on its remaining 9 recycling routes, with a resulting 3.4% increase in recycling tonnage town wide, Dedham's recycling rate would increase less than 0.5 percentage points. The net cost of diverting each new ton from the waste stream would be $346.[10] This cost is substantially more than the $78 trash tip fee savings that Dedham would realize for each new ton recycled. In short, the pilot results were not good enough to justify town wide implementation of the door hanger feedback strategy.

Given the strong results observed in the LaVerne study, what might explain the much weaker results observed in Dedham? After the completion of the pilot, project staff conducted a small phone survey of households on the test route to better understand residents' reaction to the door hangers. Did they read them? Did they understand and absorb the information on them? Survey respondents were asked to be as frank as possible in their answers.

When asked if they had read the door hangers, 64% of survey respondents said yes, 26% said they had read some or had taken a quick look at them and 10% said they had not read the door hangers. Except for those who had not read the door hangers, all respondents were asked: 1) what they thought about the door hangers and 2) what information on the door hangers they found most interesting. Responses to these two questions overlapped somewhat. The most common answers by far were variations on the following comments:

"What was most interesting to me was knowing
- how much we recycled each week; or
- the change in how much we recycled each week, or
- that recycling increased; or
- that people are taking the time to recycle."

With the exception of one respondent, who mentioned that it was most interesting to know where the recyclables go, no one mentioned the information in the "Did you know?" or "News Flash!" section of any door hanger. Interestingly, although the information in the "Did you know?" section was designed to make a vivid impression upon people, they either didn't read it, or didn't recall it. A likely scenario is that even those who read the door hangers devoted only a few seconds to doing so; taking in the number of bags and bins set out that week, and the percentage increase over the prior week, if there was any. It is also possible that the higher text density of the "Did you know?" section discouraged people from reading through it. The impact of the door hangers may have been lessened because people did not read them in their entirety.

Other possible reasons for the weak pilot results include:

- Normative feedback may be less meaningful to people on a scale of 800 households than on the 120 household scale used in LaVerne.
- The less personal nature of printed feedback rather than handwritten feedback may have decreased its impact.
- The two week delay between each collection day and the distribution of the feedback pertaining to it may have affected the outcome.
- Feedback in LaVerne was distributed weekly, based on observations made on weekly recyclables pick up days. It is possible that the less frequent door hanger distribution schedule in Dedham (every other week) meant that the feedback did not reinforce changes in residents' recycling habits as continuously between collection days.

[10] This figure assumes that door hanger distribution workers would be paid $45 per distribution rather than the $60 paid during the pilot.

- Feedback in LaVerne consisted of both quantity and participation rate information. The absence of participation rate feedback may have decreased the effectiveness of the Dedham door hangers.
- The majority of the feedback was delivered during the summer vacation season, due to the timing of the grant, and the ten weeks needed to collect the baseline data. Out of town trips reduced people's exposure to the feedback, which may have decreased its effectiveness.
- When the LaVerne study was carried out in 1993, LaVerne's curbside recycling program had been in place for just three years. It is possible that the potential for tonnage increases was greater than in a more mature program such as Dedham's which is over ten years old. It is also possible that residents were more motivated to make behavior changes in the early days of recycling, when curbside programs were novel and imperatives to reduce waste were receiving more media attention.
- A number of barriers and motivations influence people's recycling habits. It is possible that social pressure is not (or is no longer) among the most important factors influencing recycling participation.

Lessons Learned

Presenting the Feedback

- Steps need to be taken to help residents distinguish one door hanger from the next. Changing the color of the paper used and employing noticeably different text and graphics on each door hanger may be beneficial.
- The follow up survey showed that the most memorable information on the door hangers was in the section at the top, perhaps because it was less text heavy and therefore simplest to read. In the future, presenting feedback graphically with bar graphs or thermometers would eliminate the textual density and may make the information more eye-catching.

Producing and Distributing Door Hangers

- Copying produced a door hanger of sufficiently good quality, meaning that a more expensive printing process was not needed. (See Appendix E for more details.)
- Using a door-to-door distribution company to distribute the door hangers was not a viable option. Only one such Boston-area firm could be identified and this firm was unable to meet the desired specifications. Hiring Dedham high schools students and Boston-area adults to work with the project staff was an effective alternative for distributing the door hangers. Pre-screening young people for a conscientious approach to work is important, as is teaming each young person with an adult.
- Lessons learned about efficient door hanger distribution can be found in Appendix E.

Eliminating Confounding Factors

Piloting a strategy to test its effectiveness in increasing recycling participation involves not only implementing the strategy on a small scale, but also establishing conditions that allow a conclusive evaluation to be carried out. The Dedham project provides some valuable guidance for eliminating confounding factors that can prevent definitive conclusions from being drawn from a small scale test.

Choosing a Community

If options exist regarding where to pilot the strategy, the following points should be considered.

1. In communities requiring more than one recycling truck to complete the routes on a daily basis, it is often customary for drivers to help each other out on the routes in order to complete the day's work more efficiently. Agreements can be made with the drivers to refrain from mixing tonnage from the test and control routes with tonnage from other routes. However, when there are substitute drivers, or severe time pressure due to breakdowns, etc, the agreement may not be honored. Choosing a "one truck" community, such as Dedham, eliminates the possibility of numerous trucks from the same town mixing tonnage from more than one route.

2. In Dedham, the project staff was fortunate to be working with a very conscientious driver with an excellent attendance record. Since we depended upon the driver to start and end the test and control routes with an empty truck, this was important. It is worthwhile to ask about the reliability of the driver before choosing a pilot community.
3. Choosing a demographically homogeneous community like Dedham increased the likelihood of finding test and control routes that were demographically similar and had the other characteristics necessary for a successful evaluation.
4. Dedham's recyclables collection contract expired while the pilot was being carried out. Fortunately, Dedham renewed its contract with the same hauler. If the new contract had gone to a different hauler, the transition may have comprised our ability to obtain weight slips or to keep the test and control route tonnages isolated from that of other routes. It is advisable to choose a pilot community whose current collection contract will extend through the duration of the pilot.
5. Choosing community with an "every-other-week" pick up schedule has advantages and disadvantages:
    i. Advantages
        - Even in a "one truck" community, there are ten routes from which to choose the test and control.
        - If the strategy is tied to the collection schedule, the two weeks between collection days provides more time to carry out necessary tasks and to contemplate pilot strategy and carry out changes in strategy if necessary.
    ii. Disadvantages
        - Some of the ten routes cannot be used as test route/control route combinations because they are picked up in opposite weeks
        - If truck load weights are being used to evaluate the pilot, the every-other-week collection schedule increases the length of time required to collect an adequate number of baseline and post-test measurements. The increased length of the pilot makes it more difficult to avoid implementing the strategy during times when people are away or distracted (summer vacation season, Christmas season, etc.).

Choosing Test and Control Routes

1. Before utilizing GIS software to determine the demographics of each route, it is important to go over all of the route maps with the **driver** to ensure their accuracy. Although the driver's supervisor may be more accessible than the driver, his knowledge of the routes may not be as accurate.
2. Ask the driver if he starts out with an empty truck each morning, or if he commingles loads from any routes. In Dedham, conversations with the driver prior to the pilot revealed that the Monday A and Wednesday A routes usually required more than one load. In order to save time, the driver often completed the partial second load from Monday by filling the truck with tonnage from Tuesday. Similarly, he often topped off the partial second load from Wednesday with tonnage from Thursday. If the driver commingles loads such that the test and/or control routes will be affected, arrangements to keep the loads separate for the duration of the pilot will need to be pursued.
3. Also ask the driver, not the route supervisor, about the participation levels on each route.
4. It is important to ask driver which schools he picks up on each route. Tonnage from schools may stop and/or start during the duration of the pilot (holidays, spring break, summer vacation). If school tonnage is picked up in the residential recycling trucks, the school tonnage may need to be monitored separately so that these fluctuations can be taken into account in the pilot evaluation. Alternatively, it may be possible to choose test and control routes without schools on them.

Getting Good Quality Data

1. Before the pilot begins, request that if there is a truck breakdown while picking up on the test or control routes, and a truck from another community is called in to help out, that that truck dump any tonnage on it before picking up on the test or control routes.

2. When requesting tonnage data from the hauler, ask them from the outset to fax all relevant weight slips rather than just providing the tonnage figures. Having the weight slips allows the project staff to confirm that the weights are for the correct day and community. It also allows verification of information obtained from the driver regarding how many loads are generally picked up on each route.
3. Ensure that responsibility for faxing the weight slips is assigned to office personnel, not to the route supervisor
4. As a back up, make arrangements to get weight slips from the recycling facility, in case the hauler is not able to provide them on a timely basis.
5. Before the pilot begins, make sure that the driver, the person responsible for faxing the slips, and several levels of hierarchy above them are all aware of and in agreement with the arrangements for maintaining the integrity of the test and control route weights and for getting the information to project staff promptly and reliably. If these arrangements lead to additional expenses for the hauler that are not covered by the contract, consider providing compensation to the hauler, as an incentive for good performance throughout the pilot.
6. Review the weights slips immediately. If the weights look unusually high or low, check with the driver and the person faxing them as to their accuracy and completeness.
7. Arrange to meet with the driver regularly to ask whether anything unusual has occurred (breakdowns, etc.) that might not be evident from the weight slips.

Conclusions

It is very likely that the curbside door hanger feedback strategy motivated residents on the test route to recycle more material than they otherwise would have. However, the difference in tonnage compared to the control route was small – 3.4%. At a net cost of $268 per ton, it is unlikely that town wide implementation of the door hanger feedback strategy would be justified. These findings underscore the importance of conducting a pilot prior to community-wide implementation. The practice of testing strategies on a small scale and rigorously evaluating their effectiveness is still relatively new among Massachusetts' municipal recycling program managers. Lessons learned from the Dedham pilot add to the accumulating knowledge base that will assist managers in designing and carrying out pilot projects from which definitive conclusions can be drawn.

Appendix A: Demographic Characteristics of Dedham's Recycling Routes

Route	Avg Med. Hshld Income	Avg. Median Age	Avg. Hshld. Size	Avg % Owner Occupied	Avg. % W/ Bachelors Degree	Avg % With High School Degree	
Friday A	$78 193.99	39.83	2.56	73.02%	46.27%	89.96%	
Friday B	$97 627.33	40.99	2.69	84.10%	46.60%	87.75%	
Monday A	$66 780.86	43.21	2.67	92.96%	31.67%	87.64%	
Monday B	$66 692.92	40.19	2.75	92.36%	30.45%	91.34%	
Thursday A	$46 425.26	37.32	2.40	60.42%	28.57%	85.62%	
Thursday B	$49 401.73	38.52	2.48	54.28%	20.06%	77.53%	
Tuesday B	$64 783.44	39.98	2.76	93.21%	36.89%	93.07%	
Tuesday A	$65 323.22	38.75	2.67	81.10%	32.02%	89.54%	test
Wednesday A	$61 022.87	40.00	2.65	80.15%	28.15%	87.12%	control
Wednesday B	$66 214.92	39.92	2.63	83.58%	35.06%	92.51%	

Frequencies

	1 in 90's	all very similar	2 2.4's	1 50's	2 40's	8 hi 80's/lo 90's
	1 70's		1 2.5's	1 60's	5 hi 20's/lo 30's	1 mid 80's
	6 60's		5 2.6's	1 70's	2 mid 30's	1 hi 70's
	2 40's		2 2.7's	4 80's	1 20's	
				3 90's		
Town of Dedham	$62 591.26	39.90	2.61	79.07%	31.55%	88.01%
Statewide	$53 623.57	37.25	2.53	58.19%	32.25%	83.55%

Note: Demographic characteristics for each recycling route were determined by using the overlay function of ArcView geographic information systems (GIS) software. The GIS analysis was conducted by Dave Hirschler, Town of Dedham recycling coordinator, Michael Williams, Town of Dedham Department of Public Works and Maged Kamel, Town of Dedham Department of Public Works.

APPENDIX B
DOOR HANGERS DISTRIBUTED IN DEDHAM

Recycling Information

Dedham is conducting a study on recycling, and your household has been selected to participate in this project.

Each collection day, we'll simply be counting the number of bins and bags of recyclables set out in your neighborhood. During the duration of the study we would like to ask you to recycle as much as possible.

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post-consumer recycled paper

Door Hanger #1

Neighborhood Recycling Results

Below are the recycling participation rates of Dedham residents in your neighborhood.

Most recent collection day: June 17
Amount of paper: 633 paper grocery bags full
Amount of bottles & cans: 213 recycling bins

This is 9% more than was recycled on June 3rd. Great job!

Did you know …
recycling saves Dedham money? By recycling this much material every collection day of the year, the 805 homes on your recycling route can save the Town $13,000 -- enough money to fuel all its police, fire and DPW vehicles for one month.

Previous collection day: June 3
Amount of paper: 593 paper grocery bags full
Amount of bottles & cans: 181 recycling bins

Total since June 3rd:
Amount of paper: 1,226 paper grocery bags full
Amount of bottles & cans: 394 recycling bins

News Flash! 90% of Massachusetts residents say that recycling is good for society. Please keep recycling as much as you can.

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post consumer recycled paper

Door Hanger #2

Neighborhood Recycling Results

Below are the recycling participation rates of Dedham residents in your neighborhood.

Most recent collection day: July 1
Amount of paper: 561 paper grocery bags full
Amount of bottles & cans: 196 recycling bins

Did you know …
recycling saves energy? By recycling this much material every collection day of the year, the 805 households on your recycling collection route can save enough gas to run one car per household for **10** days, resulting in less reliance on foreign oil.

Previous collection day: June 17
Amount of paper: 633 paper grocery bags full
Amount of bottles & cans: 213 recycling bins

Total since June 3rd:
Amount of paper: 1,787 paper grocery bags full
Amount of bottles & cans: 590 recycling bins

Today's News! 82% of Massachusetts residents **always** recycle their newspapers and magazines. Please keep recycling as much as you can.

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post consumer recycled paper

Door Hanger #3

Neighborhood Recycling Results

Below are the recycling participation rates of Dedham residents in your neighborhood.

Most recent collection day: July 15
Amount of paper: 477 paper grocery bags full
Amount of bottles & cans: 197 recycling bins

Did you know …
By recycling this much material every collection day of the year, the 805 households on your recycling collection route can cover the floor of the Main House at the Endicott Estate **3** $\frac{1}{2}$ feet deep with paper, bottles and cans!

Previous collection day: July 1
Amount of paper: 561 paper grocery bags full
Amount of bottles & cans: 196 recycling bins

Total since June 3rd:
Amount of paper: 2,264 paper grocery bags full
Amount of bottles & cans: 787 recycling bins

News Bulletin! 86% of Massachusetts residents agree that recycling becomes a habit once people get started. Want to get started? Pick up a recycling bin at 55 River St. (Mon-Fri: 7:00am-3:00pm) for only $5.

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post consumer recycled paper

Door Hanger #4

Neighborhood Recycling Results

Most recent collection day: July 29

Amount of paper: 516 paper grocery bags full

Amount of bottles & cans: 216 recycling bins

This is 9% more than was recycled on July 15th. Great job!

Did you know …

By recycling this much material every collection day of the year, the 805 households on your collection route can recycle enough to manufacture:

43,641 Sunday newspapers from old newspaper	2,022 fleece jackets from old soda bottles
67,835 beer bottles from old glass bottles and jars	37 plastic park benches from old milk jugs

and numerous other products!

Previous collection day: July 15

Amount of paper: 477 paper grocery bags full

Amount of bottles & cans: 197 recycling bins

Total since June 3rd:

Amount of paper: 2,810 paper grocery bags full

Amount of bottles & cans: 1,003 recycling bins

News Flash! 75% of Massachusetts residents agree that recycling conserves resources for the future.

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post consumer recycled paper

Door Hanger #5

Neighborhood Recycling Results

Below are the recycling participation rates of Dedham residents in your neighborhood.

Most recent collection day: August 12

Amount of paper: 569 paper grocery bags full

Amount of bottles & cans: 204 recycling bins

Did you know …

Manufacturing products from recyclables saves water? By recycling this much material every collection day of the year, the 805 households on your collection route can save enough water to run the dishwasher in each household twice a week for three months.

Previous collection day: July 29

Amount of paper: 516 paper grocery bags full

Amount of bottles & cans: 216 recycling bins

Total since June 3rd:

Amount of paper: 3,379 paper grocery bags full

Amount of bottles & cans: 1,207 recycling bins

News Flash! Your neighborhood recycled 6% more material by weight on August 12th than on July 29th, and 9% more on July 29th than on July 15th. Keep up the great work!

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post consumer recycled paper

Door Hanger #6

Neighborhood Recycling Results

Most recent collection day: August 26th

Amount of paper: 512 paper grocery bags full

Amount of bottles & cans: 205 recycling bins

Did you know …

By recycling this much material every collection day of the year, the 805 households on your collection route can recycle enough to manufacture:

120 feet of railroad track from old steel cans	42,600 soda cans from old aluminum cans
62,000 cereal boxes from old cardboard boxes & junk mail	and numerous other products!

Previous collection day: August 12th

Amount of paper: 569 paper grocery bags full

Amount of bottles & cans: 204 recycling bins

Total since June 3rd:

Amount of paper: 3,891 paper grocery bags full

Amount of bottles & cans: 1,412 recycling bins

Thank you for your participation! Although this is the last door hanger we will be distributing, our recycling study continues through Spring, '04. Please keep recycling as much as you can. See back for a list of all the items that can be recycled at the curb.

Town of Dedham Recycling Program
(781) 326-1550
www.town.dedham.ma.us/recycle

This project is funded by a grant from the Massachusetts Department of Environmental Protection.

printed on 30% post consumer recycled paper

Door Hanger #7

How do I recycle?

If you need a recycle bin for $5, please visit the DPW at 55 River St.

Container Recycling

Mix plastic, metal & glass in your recycle bin

- √ Metal and aluminum cans, foil & trays
- √ Clear and colored glass bottles & jars
- √ Plastic containers other than bags

Paper Recycling

Put in paper bag or in a separate bin

- √ Newspapers and magazines
- √ Cardboard (flattened and cut to 3'x3')
- √ Phone books and softcover books
- √ Junk mail (envelope windows may stay)
- √ White and colored paper

Rules for Recycling

- ♦ **Set out recycling every other week on your regular trash day.**
- ♦ **No plastic bags, pizza boxes or dirty paper.**
- ♦ **No motor oil or chemical containers**
- ♦ **Set recycling bin away from trash**
- ♦ **Separate paper recycling from container recycling**
- ♦ **Remove caps and rinse containers. Rings and labels can stay on.**

Reverse side of Door Hanger #7

Appendix C
Conversion of Truck Load Weights to Volume Expressed as Number of Bags and Bins of Recyclables

Sample Calculations for July 29th:

Number of Grocery Bags Full of Paper

3.73 tons paper x 2000 lbs/ton x 1cy/490 lbs[11] x 27 cu. ft./cy x 1 grocery bag/0.797 cu. ft. = 516 paper grocery bags full

Number of Bins Full of Bottles and Cans

1.35 tons commingled x 2000 lbs/ton x 1cy/180 lbs[12] x 201.96 gallons/cy x 1 bin/14 gal = 214 recycling bins

[11] From DEP's "Volume-to-Weight Conversions for Recyclable Materials for use with CY02 Municipal Recycling Data Sheet." The density used in this calculation is for Mixed Paper (i.e. residential mixed paper: news, mags, junk mail, boxboard, OCC, etc.).

[12] From DEP's "Volume-to-Weight Conversions for Recyclable Materials for use with CY02 Municipal Recycling Data Sheet." The density used in this calculation is for Commingled Containers.

Appendix D
Financial and Environmental Benefits and End Products Calculations Used in the Curbside Door Hanger Feedback Pilot Project in Dedham, MA
Summer, 2003

Door Hanger #1 Text

"Dedham is conducting a study on recycling, and your household has been selected to participate in this project. Each collection day, we'll simply be counting the number of bins and bags of recyclables set out in your neighborhood. During the duration of the study we would like to ask you to recycle as much as possible."

Subsequent Door Hangers

Each subsequent door hanger described the tonnage recycled that week in terms of the number of grocery bags full of paper and recycling bins full of bottles and cans. We also calculated what the yearly tonnage would be if that week's amount were recycled every collection day of the year. We expressed the yearly tonnage in terms of a quantified financial or environmental benefit or amount of end product produced.

Many of these calculations depended upon knowing the tonnage of individual recyclable materials. A breakdown by weight of the recyclables stream was obtained from Bob Boucher of the Spiegal MRF in Avon, MA, where Dedham's material is taken.

Commingled

60% glass
20% plastic
- 40% HDPE
- 40% PET
- 20% #3-#7

8% steel
2% aluminum
10% residue

Paper

90% newspaper/magazines
10% OCC/paperboard/junk mail
- 75% OCC/paperboard
- 25% junk mail

Door Hanger #2 (June 17th)

Did you know …
recycling saves Dedham money? By recycling this much material every collection day of the year, the 805 homes on your recycling route can save the Town $13,000 -- enough money to fuel all its police, fire and DPW vehicles for one month.

Savings based on Dedham's FY2003 avoided trash disposal cost of $85 per ton.

Door Hanger #3 (July 1)

Did you know …
recycling saves energy? By recycling this much material every collection day of the year, the 805 households on your recycling collection route can save enough gas to run one car per household for 10 days, resulting in less reliance on foreign oil.

Use EPA's WARM model (http://www.epa.gov/globalwarming/actions/waste/w-online.htm) to calculate energy saved in terms of gallons of gasoline. This model contains a baseline scenario and an alternative management scenario. In the baseline scenario, the tonnage of each material is entered in the "Tons Generated" column and then again in the "Tons Combusted" column (for Dedham). The baseline scenario is what would happen if there were no recycling. The numbers entered in the "Tons Generated" column and in the "Tons Combusted" columns must be identical, or the model will not run.

In the alternative management scenario, the tonnage of each material is entered in the "Tons Recycled" column. The default transport distances were used for the various MSW management options. Select the "Units of Energy (million BTU)" format to display results. Click "Create Summary," and the model will calculate the number of gallons of gasoline saved.

The following factors were used to convert gallons of gasoline saved to "car-days" avoided:

Average fuel economy of passenger vehicles on the road in 1999 – 20.5 MPG
Average miles driven per household vehicle in 1997 – 12,100 miles

Source: http://www.sustainableenergy.org/resources/technologies/transportation.htm

While I was able to find more recent figures for fuel economy, they were separate figures for passenger vehicles and light trucks (incl. SUV's). I wasn't able to find a breakdown for the current U.S. fleet for these different types of vehicles, so I didn't use the more recent fuel economy figures. I couldn't find a more recent figure for average miles driven per vehicle.

Door Hanger #4 (July 15th)

Did you know …
By recycling this much material every collection day of the year, the 805 households on your recycling collection route can cover the floor of the Main House at the Endicott Estate 3 _ feet deep with paper, bottles and cans!

I used the densities in "Calendar Year 2002 Municipal Recycling Data Sheet: Volume to Weight Conversion Factors" at http://www.state.ma.us/dep/recycle/cities.htm to convert pounds of recyclables to cubic yards (180 lbs/cy for commingled and 490 lbs/cy for mixed paper). Then I converted each cubic yard quantity to cubic feet (27cu ft./cy). Then I divided the total cubic feet for commingled and paper by the floor area of the Main House at Endicott Estate in Dedham (5,560 sq. ft.) to get the depth to which the floor would be covered.

Door Hanger #5 (July 29th)

Did you know …
By recycling this much material every collection day of the year, the 805 households on your collection route can recycle enough to manufacture:

43,641 Sunday newspapers from old newspaper	2,022 fleece jackets from old soda bottles
67,835 beer bottles from old glass bottles and jars	37 plastic park benches from old milk jugs
and numerous other products!	

For the purpose of these calculations, I assumed that the end products had 100% recycled content. Not all of these end products typically have 100% recycled content. However, the problem with incorporating more realistic recycled content figures into the calculations is that the lower the recycled content for a product, the greater the amount of product that can be manufactured from a certain quantity of recyclables feedstock. This results in misleading information on the impact of recycling a certain amount of material, and leads to improbable numbers in some cases.

In the cases where I was able to obtain some information on recycled content, I will note it, but keep in mind that this information was not used in the calculations.

Sunday Newspapers.
According to Robin Baker of the American Forest and Paper Association, the feedstock used for the recycled content portion of newspaper is typically 90% old newspapers and 10% "mixed paper." AFandPA defines mixed paper as mainly coated newspaper inserts and old magazines, but may also contain other types of paper.

So, in calculating the number of Sunday newspapers that could be manufactured from the paper recycled on the Tuesday A route in Dedham, I assumed that the 90% of the paper recyclables stream that is newspapers and magazines would be remanufactured into newsprint. There is some fiber loss in recycled newsprint manufacture, but I was unable to find out what it is. So, my calculation does not account for fiber loss, and is therefore overly optimistic in regards to the amount of end product that could be manufactured from a certain amount of old newspaper.

The Sunday Boston Globe weighs about 4 lbs, including the advertising inserts.

Here's the calculation for July 29th:

3.73 tons paper collected on Tuesday A route x 2000 lbs/ton x 90% news & mags/ 4 lbs/Sunday paper x 26 collection days/yr = 43,641 Sunday newspapers/year

Beer Bottles
I talked with Joe Cataneo (703-684-6359) at the Glass Packaging Institute, who said that the primary end use for recycled glass is still glass containers.I talked with "Bill" at the Container Recycling Alliance (CRA) in Franklin, MA. (508-541-4600). They receive mixed glass from the Spiegal MRF and sort it using an optical sorting system. Green glass is shipped overseas to be made into wine bottles. One of their big customers is San Gobain in Milford. According to Joe Cataneo, San Gobain uses about 80% recycled glass and that they make beer bottles. Bill mentioned that San Gobain also makes clear Snapple juice bottles and other clear bottles and jars. Clear glass is not used in brown beer bottles but would be used in clear beer bottles.

Bill of CRA said that caps, labels and other contaminants make up 10-12% of the weight of the material they receive. Bill also said there is some "shrinkage" (material loss) when the bottles are made, which I calculated at about 13% based on what he told me.

I did not have a color breakdown by weight for glass, so I decided to assume that all the glass from Dedham, clear, brown and green, is made into beer bottles at San Gobain, even thought the green is actually made into wine bottles overseas.

A standard size beer bottle weighs 0.475 lbs.

Here's the calculation for July 29th:

1.35 tons commingled/collection day x 60% glass – 11% contamination – 12.5% shrinkage x 2000 lbs/ton / .475 lbs/beer bottle x 26 collection days/yr = 67,835 bottles/year

Fleece Jackets
John Fischer of DEP gave me the following figures:
One pound of PETE = 9 two liter bottles
25 two-liter bottles = one fleece jacket
one ton of PETE = 18,000 two liter bottles
one ton of PETE = 720 fleece jackets

John did not have a source for these figures, but the American Plastics Council confirmed that "The manufacture of one fleece jacket requires material equivalent to approximately 25 recycled PET bottles."

I used the breakdown from Bob Boucher at Spiegal to calculate the weight of PETE in the commingled fraction of the recyclables stream and then used the "one ton of PETE = 720 fleece jackets" to calculate the number of fleece jackets.

Park Benches
The following site states: " One 6 foot long plastic park bench can be made from 1,050 plastic milk jugs."
http://www.epa.gov/epaoswer/osw/kids/quest/pdf/24factsh.pdf
I used the breakdown from Bob Boucher at Spiegal to calculate the weight of HDPE in the commingled fraction of the recyclables stream. For the purposes of the calculation, I assumed that the entire HDPE stream was milk and water jugs. One plastic milk jug weighs .14375 lbs. I used this figure to convert the HDPE into number of jugs and then converted the number of jugs into number of benches. Remember to use the number of jugs that would be recycled in an entire year.

Door Hanger #6 (August 12th)

Did you know …
Manufacturing products from recyclables saves water? By recycling this much material every collection day of the year, the 805 households on your collection route can save enough water to run the dishwasher in each household twice a week for three months.

The 1995 Environmental Defense Paper Task Force Report, Chapter 3, February 2002 Update and Corrections to Figure 2 gives the effluent flows for a variety of virgin and 100% recycled paper grades, including newsprint, corrugated cardboard, SBS paperboard, CUK paperboard and office paper. Here is the link:
http://www.environmentaldefense.org/article.cfm?contentid=1689

According to the report's glossary, effluent flow measures the amount of water that is treated and discharged to a mill's receiving waters. It is an indirect measure of fresh water consumption. The unit of measure is gallons per tons of final product.

I made a number of assumptions here:
The recycled end products have 100% recycled content
There is no fiber loss in going from recycled feedstocks to recycled products
The 75% of the OCC/paperboard/junk mail fraction that is OCC and paperboard is 50% OCC and 50% paperboard.
The water savings for newsprint is applicable to the entire newspaper/magazine fraction (90% of the paper recyclables stream)

The first two assumptions lead to an overstatment of water savings due to paper recycling. The breakdown of the OCC/paperboard fraction is a guess, and may or may not result in an overstatement of water savings. In retrospect, assumption #1 was probably not justified. It would have been more appropriate to prorate the water savings based on more typical recycled contents for the paper grades of interest.

Here are the water savings figures I got from Figure 2 based on 100% recycled content.

Newspapers/magazines:	1,081 gal/ton of final product
OCC:	8,893 gal/ton
CUK paperboard:	9,148 gal/ton (I don't know if the recyclable paperboard stream is SBS or CUK, so I used the lower CUK paperboard figure to be conservative.)
Junk Mail:	10,195 gal/ton (I used the figure for office paper here.)

So, the calculations for August 12th for paper were:

4.12 tons paper x 90% news/mag x 1081 gal/ton = 4008 gal/collection day
4.12 tons paper x 10% OCC/PB/JKML x 75% OCC/PB x 50% OCC x 8893 gal/ton = 1374 gal/collection day
4.12 tons paper x 10% OCC/PB/JKML x 75% OCC/PB x 50% PB x 9148 gal/ton = 1413 gal/collection day
4.12 tons paper x 10% OCC/PB/JKML x 25% JKML x 10195 gal/ton = 1124 gal/collection day

Total: 7919 gal per collection day, or 205,894 gal per year

I also investigated water savings from glass recycling, but was told by Phil Ross, an engineer affiliated with the Glass Packaging Institute, that he didn't think there was much water savings from using recycled glass. I did not investigate whether there is appreciable water savings from recycling the plastics or metals. I used the water savings from paper recycling as an estimate of the water savings for the entire residential recyclables stream. If there are water savings from plastics or steel or aluminum recycling, then the estimate based on paper recycling is an underestimate of the total.

Different sources give different figures for the amount of water used per dishwasher load.

http://www.epa.gov/region03/drought/	6-12 gallons per load
http://www.stpete.org/wwwsense.htm	15 gallons per load
http://www.moontma.com/water/	15 gallons per load
http://www.ladwp.com/ladwp/cms/ladwp000448.jsp	older dishwashers use 8-18 gal; new models 7-10 gal

I don't know what the breakdown of old to new dishwashers is, so I assumed that most of them are in a range from 7-14 gallons per load, and used the midpoint of the range: 10.5 gal.

Door Hanger #7 (August 26th)

Did you know …
By recycling this much material every collection day of the year, the 805 households on your collection route can recycle enough to manufacture:

120 feet of railroad track from old steel cans	42,600 soda cans from old aluminum cans
62,000 cereal boxes from old cardboard boxes & junk mail	and numerous other products!

Railroad Track

http://www.recycle-steel.org/fact/main.html says that the electric arc furnace process, which is used to produce steel shapes such as railroad track and bridge span, uses virtually 100% recycled steel

CSX Corp. owns much of the existing railroad track in Massachusetts, and Amber, of their public relations office (904-366-2949) said that the track is made of steel, not iron, and that it weighs about 44 lbs per linear foot.

So, I used the Spiegal MRF commingled material percentage breakdown to calculate the weight of steel cans recycled on August 26th, then calculated what the weight recycled would be in a year's time. Then, I divided by 44lbs/linear foot to get the number of linear feet of track.

Soda Cans

http://www.eia.doe.gov/kids/recycling/solidwaste/metals.html says that the metal from aluminum cans is usually made into new aluminum cans. This site also says that 32 aluminum beverage cans weigh one pound. (This works out to 0.03125 lbs/can.)

http://www.alcoa.com/global/en/news/whats_new/1997/23393-2001_03_22.asp says that "Today's aluminum beverage can contains nearly 52% recycled aluminum…."

So, I used the Spiegal MRF commingled material percentage breakdown to calculate the weight of aluminum recycled on August 26th, then calculated what the weight recycled would be in a year's time. Then, I divided by 0.03125 lbs/can to get the number of cans that would result from the recycling process.

Cereal Boxes

Jeff Cumo of Natick Paperboard (508-653-9100) says that they make paperboard from 60% OCC (generally commercial), 35% "residential mixed paper" (news/mags/junk mail/paperboard) and 5% pre-consumer waste. So, saying that cereal boxes are made from cardboard (I am using the term "cardboard" here to mean OCC and paperboard) and junk mail is not technically accurate, but I assumed for the purposes of this calculation that OCC/paperboard/junk mail fraction of the recycled paper stream is used as a feedstock for paperboard.

Jeff also said that there is 7.7% "shrinkage" of the recycled feedstock, which is mostly plastics, staples, rubber. He said there is very little fiber loss.

Natick Paperboard has supplied paperboard to Post Cereal in the past. A large cereal box weighs 0.2875 lbs.

So the calculation for August 26th is:
3.7 tons paper x10% OCC/paperboard/junk mail –7.7% shrinkage /.2875 lbs/cereal box = 2,376 boxes for one collection day. This amounts to 61,769 cereal boxes per year.

Appendix E
Door Hanger Production and Distribution

Door Hanger Production

Door Hanger Production Specification

The Town of Dedham seeks copying and die cutting services as specified below.

Title: Door hanger

Quantity: 1M of each of 7 lots

Description: 4 _" x 11" door hanger

Artwork: MS Word file supplied via email by customer for each lot.

Stock: 65# cover stock with 30% post-consumer content

Ink: Soy or Vegetable Ink, Black,
Lots 1-6: one side only
Lot 7: double sided

Proof: Via email or fax

Bindery: Die cut slit and opening for door knob

Schedule:

Lot Number	Date Artwork Supplied	Door Hanger Ship Date
1 (Introductory Door Hanger)	5/22/03	6/12/03
2 (Feedback Door Hanger)	6/18/03	6/26/03
3 (Feedback Door Hanger)	7/2/03	7/10/03
4 (Feedback Door Hanger)	7/16/03	7/24/03
5 (Feedback Door Hanger)	7/29/03	8/7/03
6 (Feedback Door Hanger)	8/13/03	8/21/03
7 (Feedback Door Hanger)	8/27/03	9/4/03

Ship to: 26 Bryant St.
Dedham, MA 02026

Ship Via: Best Way

The door hangers were produced by:

Commonwealth Copy
710 Commonwealth Ave • Boston, MA 02215-2423
Ph: 617-536-6666 • Fax: 617-247-3100
Contact: Louis Lopilato • Louis@commcopy.com

The door hangers were copied (not printed), two per 8 _" x 11" sheet of 65# cover stock. The slit and opening for the door knob were then die cut. The fact that copying produced a door hanger of sufficiently good quality meant that a more expensive printing process was not needed. The door hangers cost $110 per 1000, except for the last one, which was double sided, and therefore cost an additional $25/1000.

Door Hanger Distribution

Several approaches were tried before a workable system was found for distributing the door hangers. The first approach was to try to hire a door-to-door distribution company. Although nine firms were listed in the yellow pages under "Distributing Service – Circular, Sample, Etc.," only one company responded to phone calls and does residential door-to-door distribution. This firm was unable to meet the desired specifications for distribution, which included attaching the door hangers with rubber bands to door knobs and handles, gates, fences, and railings in such a way that that the door hangers hung down, as opposed to being folded up or rolled up. Project staff felt that the manner in which the feedback was presented would itself convey a message to residents about the importance of the material, and distinguish it from commercial advertisements. Therefore, the goal was a neat and professional looking presentation, with the printed side of the door hanger visible to resident without detaching it. Furthermore, the distribution company was unable to adapt to rainy weather conditions (the door hangers were not weather-proof) by placing the door hangers in more protected locations such as door knobs and mail box hooks rather than on gates or railings.

The second approach was to hire Dedham high school students and Boston-area adults to work with the project staff in distributing the door hangers. This approach had the added advantage that project staff and their helpers had more direct contact with residents. Residents' questions and comments provided some clues about how they perceived the feedback campaign. Because most of the distributions took place during the summer school vacation, high school students were generally available. The Town's Youth Commission identified young people who were available to work. Pre-screening young people for a conscientious approach to work is important. Teaming each young person with an adult also helped ensure proper distribution.

Other information about the distribution process:

- After an efficient distribution system was devised, four people were able to distribute door hangers to 800 single family homes in a typical suburban neighborhood in about 3 hours. Although the information below will shorten the learning curve for others conducting similar distributions, it should be expected that the initial distribution will take longer than the others.
- Each of the four distributors was easily able to carry enough door hangers and rubber bands in a shoulder bag to complete their quarter of the route without having to replenish their supply.
- The distributors worked in two person teams, with each team member doing one side of each street.
- The route was divided into two roughly equal parts. Each team was assigned to complete one of these two parts, working towards each other from the ends of the route to the middle.
- If one team completed their assignment before the other team, the teams communicated via cell phone on how to divide up the remaining work.
- If there was a chance of rain during the day, door hangers were attached only to door handles and mailbox hooks, which were protected from the weather to some extent. If no rain was expected, door hangers were attached to the first available spot, which included gates, fences and railings as well as doors. Door hangers were not distributed on days when heavy rain was expected.

- Door hangers were always attached with a rubber band, as even a slight breeze can blow them off. The only exceptions were some cases in which the door hangers were inserted between a screen door and door frame.
- Door hangers were not put in mailboxes, as only mail carriers can legally put material in mailboxes.
- Distributors were paid $60 for each distribution, however, in retrospect, $45 per worker per distribution would have been sufficient.
- The Dedham police were notified prior to distributions so that they could respond appropriately if residents called with any concerns about the presence of workers going door to door in the neighborhood.