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RESOURCE RECYCLING

A CASE FOR RECOVERY RATES

Analysis of set-outs in a range of communities shows why the industry's traditional method of counting comes up short. BY TED SIEGLER

As readers may recognize, traditional recycling rates can be a poor measure of the performance of municipal recycling programs. There are too many ways to report both the numerator and the denominator to allow for accurate comparisons across programs.

A useful alternative, however, can be found in recovery rate analysis. This method provides important information on what is available for recycling in a given community, and it can show how well that community is doing in achieving high levels of recycling. Perhaps most importantly, recovery rates can give the industry apples-to-apples comparisons between communities or collection routes.

DSM Environmental Services (DSM) has used this tool to evaluate programs for nearly two decades, and recently the firm undertook a pair of detailed recovery rate analyses in Massachusetts. The first, an analysis of four representative neighborhoods in Boston for the Public Works Department, was detailed in the March 2014 edition of this magazine (and can be found at tinyurl.com/Siegler-RR).

DSM was then contracted by Massachusetts grocers and beverage companies to conduct additional recovery rate sorting in Massachusetts later in 2014. This analysis came in the run-up to a statewide ballot initiative that proposed expanding the state's bottle bill, which the state's voters rejected in November.

Below, see the results of this second Bay State recovery project. The results help further underline the advantages of using recovery rates as opposed to oft-cited recycling rates when determining the effectiveness of recycling programs.

What is a recovery rate?

Material recovery rates can be calculated for individual recyclable materials, and for the sum of all materials collected in a municipality's recycling program. For example, the recovery rate for newspaper equals the quantity of newspaper set out for recycling on a collection route divided by the quantity of newspaper set out for recycling plus the quantity of newspaper thrown away (or placed in the trash) on the same route. Summing the recovery rate for each recyclable material results in an overall recovery rate for all recyclable materials for that collection route.

By also weighing the non-recyclable material collected, the percentage of recyclable material (set out for recycling and in the trash) can be calculated. With this not only can the recovery rate indicate how many more tons might be recycled with 100 percent recovery but also what the recycling rate would be if 100 percent recovery were achieved, allowing for demographic differences to be addressed when benchmarking communities.

As an example, consider the following: x = recyclable material set out for recycling, y = recyclable material set out in trash and z = non-recyclable material.

If x = 300 pounds, y = 300 pounds and z = 1400 pounds, then the recovery rate is 50 percent and the recycling rate is 15 percent. If x = 600, y = 0 and z = 1400 pounds, then the recovery rate is 100 percent and the recycling rate is 30 percent, the highest that could be achieved accounting for these materials.

A variety of communities

In all cases during the most recent Massachusetts study, sampling was conducted on residential refuse and recycling programs only, not commercial or "on-the-go" recycling, so the resulting data can only be used to draw conclusions about residential programs.

DSM chose to focus on recycling initiatives in the City of Worcester (one of the first cities in New England to implement pay-as-you-throw pricing 20 years ago) as well as two private subscription curbside routes in central Massachusetts and a pair of drop-off locations in other areas of the state.

Three days of sorting occurred in Worcester, with the Department of Public Works electing high-, medium- and low-income neighborhoods that they believed were representative of Worcester as a whole. The two subscription curbside routes, meanwhile, were selected by the private hauler to be representative of their subscription routes. Each one of the curbside routes underwent a day of sorting.

Finally, one day was devoted to sampling at the Sherborn Transfer Station which offers "free" (paid for by property taxes) recycling and refuse disposal to users of the facility. Under a separate

contract, DSM also conducted one day of sampling at the Barnstable Transfer Station where residents purchase an annual transfer station permit, allowing them unlimited disposal of household refuse, with source-separated recycling.

Category breakdown

Because the grocers and beverage companies were interested in the impact that an expanded bottle bill would have, the emphasis was on container categories, not paper, so all fiber was lumped into a single material category, while there were many categories for containers.

Material categories sorted included those listed below. In each case "expanded" means containers not currently covered under the Massachusetts beverage container deposit that would have been under the proposed expansion.

- PET Deposit Bottles
- PET Expanded Bottles
- PET Food/Other
- PET Cups
- PET Thermoforms (except for Worcester)
- HDPE Bottles (non-deposit)
- HDPE Expanded Bottle Bill
- All Plastic Tubs, Cups + Lids

- Glass Deposit Bottles
- Glass, Expanded Bottles
- Glass Non-Deposit Bottles and Jars

- Aluminum Deposit Cans
- Aluminum Expanded Cans
- Aluminum Other (foil and food cans)
- Steel Cans
- Steel Cans, Expanded
- Paper
- Trash (all other material)

Results of the study

Worcester's program has been hailed as a particularly successful one, thanks in part to PAYT pricing in which residents purchase designated bags for refuse. This gives them an incentive to divert recyclables to save on bag costs. Worcester's single-stream program collects recyclables in 18-gallon green bins and refuse in yellow PAYT bags weekly. The trash and recycling collections happen on the same day of the week. Table 1 presents recovery rates, by material type for each sample day. The Worcester testing took place in July 2014.

Subscription service is the second most common form of collection in Massachusetts. A private hauler in central Massachusetts agreed to allow DSM to collect representative samples from their subscription collection routes in two municipalities – one suburban and one rural. Average incomes in both municipalities fall in the middle-income category for Massachusetts. In both subscription route cases, households receive every-other-week collection of single-stream recyclables via 64-gallon rollcarts, and residents can choose weekly

Table 1 | Recovery rates by collection route in Worcester, Massachusetts, in percent

	Recovery rate			
Materials	Monday	Tuesday	Wednesday	Average
Steel cans	88.3	86.7	60.3	78.5
Steel cans expanded			90.0	90.0
AL deposit	70.0	63.2	13.8	49.0
AL expanded	100.0	10.0	52.6	54.2
AL other	0.0	10.0	42.9	17.6
PET deposit	97.6	80.6	26.3	68.2
PET expanded	90.1	92.9	81.1	88.0
PET food/other	72.9	88.3	67.9	76.4
PET cups	60.0	57.9	46.2	54.7
HDPE bottles	97.9	91.5	81.7	90.4
HDPE expanded	97.1	98.0	33.3	76.1
Plastic tubs/lids	80.7	61.3	75.7	72.6
Glass deposit	48.8	34.8	63.5	49.1
Glass expanded	100.0	100.0	63.0	87.7
All other glass bottles	96.7	95.7	75.9	89.4
Mixed paper recyclables	77.6	82.0	79.3	79.6
Total:	81.0	82.0	76.4	79.8

Table 2 | Recovery rates, subscription service, Central Massachusetts, in percent

Material	Recovery rate		Average
	Suburban	Rural	
Steel cans	70.37	43.64	57.0
AL deposit	64.67	32.61	48.6
AL expanded	21.74	17.70	19.7
AL foil	11.11	0.00	5.6
PET deposit	63.22	36.08	49.7
PET expanded	72.46	42.94	57.7
PET cups	25.89	15.56	20.7
PET food	84.73	68.39	76.6
PET thermoform	53.19	44.64	48.9
HDPE bottles	82.42	57.51	70.0
HDPE expanded	100.00	58.30	79.1
Plastic tubs/lids	48.57	26.77	37.7
Glass deposit	95.78	78.06	86.9
Glass expanded	63.52	100.00	81.8
All other glass bottles	94.39	61.73	78.1
Mixed paper recyclables	84.65	62.80	73.7
Total	82.79	60.53	71.7

or every-other-week collection of refuse, also in a 64-gallon cart supplied by the hauler. Table 2 presents the results of this testing, which took place in August 2014.

Some residents of Massachusetts choose to drive their refuse and recycling to a local transfer station, rather than contract for curbside collection. DSM sampled at two integrated transfer stations where residents can drop off refuse and recyclables. One facility is located in Sherborn, a wealthy suburb of Boston, and the second is in Barnstable, located on Cape Cod (residents there are considered middle income, although there is a large second-home population). Neither facility has PAYT pricing. Instead, residents purchase an annual permit to use the facility and then may drop off unlimited refuse and recyclables. The Sherborn facility is privately owned and operated, anwd residents using the facility can recycle directly next to the hopper for refuse, with recyclables divided into mixed containers and mixed fiber.

Barnstable residents drop off refuse first, and then drive around to a separate area where they can drop off source-separated recyclables in separate hoppers. Table 3 shows the results of a September 2014 analysis of incoming materials at these facilities.

The power of PAYT

Table 4 compares the overall recovery rates for the six municipalities presented in Tables 1 through 3, with the addition of the Boston data compiled in DSM's earlier research. With the exception of Sherborn, which does not have PAYT pricing at the transfer station, the influence of PAYT pricing on recovery rates is evident, as is the combination of no PAYT pricing and source-separated recycling, as represented by Barnstable.

As illustrated by Table 4, very high recovery rates are achievable for comprehensive programs that collect materials through single-stream systems and also incorporate PAYT pricing.

Recovery rate sorting also allows for an assessment of how much contamination is occurring on each route. Table 5 presents the measured contamination rate (as a percent by weight) for each program. As would be expected, contamination rates are much lower for the dual-stream and source-separated drop-off programs, when compared to the single-stream curbside programs.

Unlike recycling rates, recovery rates are not increased by high contamination rates because the contamination is not counted as recycling.

Achievable recycling rates

Another benefit of recovery rate sorting is that it gives officials the ability to estimate maximum achievable recycling rates for the materials collected in the program. Table 6 compares recovery rates, the calculated recycling rate, and the maximum achievable recycling rate for each program based on sorting of the materials collected during sampling.

These achievable recycling rates ignore yard wastes, scrap metal and other material that is often included in recycling rates, concentrating solely on the materials actually allowed in the recycling bin. Note that one cannot simply divide the recycling rate by the recovery rate to derive the maximum achievable recycling rate because the recycling rate also depends on the amount of refuse in the denominator.

Table 6 illustrates a problem inherent in using recycling rates as the yardstick of program success. Take, for example, the differences in measured recovery rates and recycling rates for the high- and medium-income Worcester routes. Both are performing similarly. Over 80 percent of their available recyclables are set out for recycling. However, the medium-income neighborhood's recycling rate is 10 percentage points lower than that of the high-income neighborhood.

Similarly, on the two subscription routes, households on the rural route are setting out 20 percent less of their recyclable materials for recycling than are households on the suburban route. But their recycling rates only vary by four percentage points.

The reason that the recycling rates differ is that total generation of recyclables and refuse are different between these programs. Since the recycling rate depends on both the quantity of recyclables and the quantity of refuse, rates can differ due to changes in how much households generate. It is DSM's experience, for example, that high income households tend to generate significantly greater quantities of recyclables, thus inflating

Table 3 | Recovery rates, transfer station drop-off, in percent

Materials	Sherborn	Barnstable
Steel cans	85.7	43
Steel expanded	100.0	0
AL deposit	81.0	72
AL expanded	100.0	14
AL other	11.8	50
PET deposit	84.4	45
PET expanded	79.3	30
PET food/other	67.5	30
PET cups	48.0	29
PET thermoform	83.6	38
HDPE bottles	80.2	49
HDPE expanded	100.00	100
Plastic tubs/lids	72.8	26
Glass deposit	95.8	97
Glass expanded	90.3	100
All other glass bottles	97.0	41
Mixed paper recyclables	78.4	42
Total	81.9	44

Table 4 | Comparison of recovery rates, in percent

Municipality	Recovery rate		
	High	Low	Average
Subscription, suburban (modified PAYT			82.8
Sherborn (drop-off, no PAYT)			81.9
Worcester, weekly curbside (modified PAYT)	82	76.4	79.8
Subscription, rural (modified PAYT)			60.5
Boston (weekly curbside, no PAYT)	66.5	40.9	53.9
Barnstable (drop-off, no PAYT)			44.1
Average			67.2

Table 5 | Measured contamination rates, in percent

Route	Contamination rate
Worcester	
Monday	10.3
Tuesday	9.5
Wednesday	20.2
Subscription	
Suburban	14.0
Rural	9.3
Sherborn Transfer Station	4.9
Barnstable Transfer Station	2.3
Boston	
Charlestown	10.3
South End	8.4
Back Bay	13.5
Beacon Hill	8.9
Average (excluding Sherborn and Barnstable)	11.9

Table 6 | Comparison of recovery rates and recycling rates by sampled route, in percent

Municipality/Program	Measured recovery rate	Measured recycling rate	Maximum achievable rate
Worcester			
High income	81	38	47
Medium income	82	28	35
Low income	76	24	32
Boston			
Beacon Hill	41	21	46
Back Bay	50	33	50
South End	58	34	47
Charlestown	67	40	50
Subscription			
Suburban	83	32	36
Rural	61	28	42
Drop-off			
Sherborn	82	40	48
Barnstable	44	21	37

their recycling rates when compared to low income households. Recovery rates control for these variables because in all cases one is only measuring what percentage of recyclables are being set out.

One final benefit to recovery rate sorting is that rough approximations of the total pounds of recyclable materials, by material type, can be estimated from the sort data. Table 7 presents annualized estimates of each type of material generated (found in recycling bins as well as in refuse bins) for each of the collection routes where the household count was known. This excluded the low-income Worcester route (because many of the stops represented multiple families), and it excludes the drop-off locations.

It is also important to note here that these figures were calculated in a state that has a bottle bill covering carbonated beverage containers. Higher quantities of beverage containers would presumably be found in the recycling and refuse bins in non-bottle bill states, which would result in higher pounds per household available for recycling.

Table 7 | Potentially available volumes by material type (pounds/household/year)

Recyclable material category	Worcester		Subscription	
	High income	Medium income	Suburban	Rural
Steel cans	30.8	28.6	21.8	19.1
AL deposit	2.0	7.6	7.3	3.2
AL expanded	0.2	2.0	2.1	1.0
AL other	7.4	2.0	3.1	1.6
PET deposit	4.1	12.4	4.0	6.7
PET expanded	60.4	56.6	38.3	42.4
PET food/other	11.8	15.4	18.4	20.3
PET cups	13.0	3.8	8.5	8.9
HDPE bottles	56.8	54.0	31.5	32.2
HDPE expanded	3.5	4.9	3.7	3.9
Plastic tubs/lids	47.6	34.6	16.2	11.0
Glass deposit	25.0	31.0	30.6	40.4
Glass expanded	9.8	16.2	7.1	4.3
All other glass bottles	114.4	70.2	102.2	56.2
Mixed paper recyclables	618.4	518.0	544.3	604.5
Total:	1,005.2	857.3	839.2	855.6

A tool for accurate assessing

Recovery rates are an excellent measurement tool to accurately describe how well a neighborhood or municipality is doing with respect to recycling of materials typically collected in a curbside program. These rates also show what potential exists to increase recycling in a given area.

Recovery rates control for variations in generation based on income and housing size, and they can be used to definitively describe the effectiveness of a recycling program. Programs with recovery rates of 80 percent or higher can be considered high achieving programs, while recovery rates in the 60 percent range can be considered average. Recovery rates below 50 percent

mean sufficient room exists for increasing diversion. RR

Ted Siegler is partner at Windsor, Vermont-based DSM Environmental Services. He can be contacted at ted@dsmenvironmental.com.

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