MANUFACTURER RESPONSIBILITY

*2011 Recycling Costs/Ton **

Aluminum	$579.22
Glass	$84.49
#1 PET	$441.88
#2 HDPE	$519.44
#3 PVC	$817.12
#4 LDPE	$1,165.69
#5 PP	$1,045.77
#6 PS	$647.77
#7 OTHER	$709.73
Bimetal	$654.62

** 2011 Cost of Recycling per Ton with Reasonable Financial Return as published in "2011 Processing Fees" Notice, December 15, 2010.*

*2010 Annualized Scrap Values per Ton **

Aluminum	$1,401.18
Glass	$4.24
#1 PET	$307.55
#2 HDPE	$280.85
#3 PVC	$0.00
#4 LDPE	$0.47
#5 PP	$203.75
#6 PS	$10.50
#7 Other	($6.46)
Bimetal	$4.39

** For period October 2009 through September 2010, as published in "2011 Processing Fees" Notice, December 15, 2010*

*2011 Processing Fees per Container Sold**

Glass	$0.00216
#1 PET	$0.00051
#2 HDPE	$0.00472
#3 PVC	$0.00995
#4 LDPE	$0.00954
#5 PP	$0.08552
#6 PS	$0.00247
#7 Other	$0.05060
Bimetal	$0.04226

** Rates effective January 1, 2011, as published in "2011 Processing Fees" Notice, December 15, 2010.*

Total 2010 Processing Fees Paid by Manufacturers (Millions)

Glass	$6.261
#1 PET	$23.046
#2 HDPE	$5.896
#3 PVC	$0.001
#4 LDPE	$0.100
#5 PP	$0.047
#6 PS	$0.162
#7 Other	$1.942
Bimetal	$1.517
Total PF Payment	$38.972

Total 2010 Processing Payments (Millions)

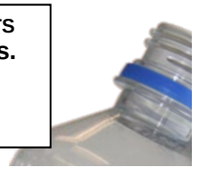
Glass	$51.160
#1 PET	$49.058
#2 HDPE	$7.952
#3 PVC	$0.000
#4 LDPE	$0.002
#5 PP	$0.004
#6 PS	$0.014
#7 Other	$0.232
Bimetal	$0.204
Total	$108.626

*2011 Processing Payments per Ton**

Glass	$80.25
#1 PET	$134.33
#2 HDPE	$238.59
#3 PVC	$817.12
#4 LDPE	$1,165.22
#5 PP	$842.02
#6 PS	$637.27
#7 Other	$716.19
Bimetal	$650.23

** Rates effective January 1, 2011, as published in 2011 Processing Fees" Notice, December 15, 2010.*

EXHIBIT D-1 – RECYCLED PRODUCTS
Document consists of 2 pages.
Entire Exhibit provided.
Meeting Date: 05-29-12



2011 CONTAINERS PER POUND

Material	*CRV**	*Non-CRV*	*Refund Value*
Aluminum	29.1	29.21	$1.54
Glass	1.86	0.95	$0.104
#1 PET	14.5	6.18	$0.93
#2 HDPE	6.5	5.04	$0.55
#3 PVC	26.7	N/A	$1.33
#4 LDPE	39.7	N/A	$1.98
#5 PP	3.2	N/A	$0.31
#6 PS	83.7	N/A	$4.18
#7 Other	4.6	N/A	$0.37
Bimetal	5.0	N/A	$0.26

** Rates effective January 1, 2011, as published in "2011 Refund Value per Segregated Pound, Refund Value per Commingled Pound, and Containers per Segregated Pound Rates" Notice, December 1, 2010.*

What is currently in the Beverage Container Recycling Program

- Beer and other malt beverages
- Wine coolers and distilled spirit coolers
- Carbonated water, including soda and carbonated mineral waters
- Carbonated soft drinks
- Non-carbonated waters
- Non-carbonated soft drinks and "sport" drinks
- Non-carbonated fruit drinks that contain any percentage of fruit juice (excluding 100% fruit juice in 46 oz. or larger containers)
- Coffee and tea drinks
- Carbonated fruit drinks
- Vegetable juices in beverage containers of 16 ounces or less

California Natural Resources Agency

CalRecycle

Department of Resources Recycling & Recovery
www.calrecycle.ca.gov/BevContainer/

Information accurate as of 6/1/2011.
Values shown may change over time.
Due to rounding,
figures may not add to 100%.

California's Beverage Container Recycling & Litter Reduction Program

FACT SHEET

In 2010, Californians recycled an average of 45,305,983 beverage containers each day. This totals 16.5 billion beverage containers for the year. By recycling these beverage containers, California recyclers saved resources and reduced greenhouse gas emissions equivalent to 631,023 metric tons of carbon equivalent. This is equivalent to reducing oil consumption by 6.9 million barrels or removing 592,109 passenger cars from our roadways for a year.

California Natural Resources Agency
Department of Resources Recycling & Recovery
Division of Recycling

SALES & RETURNS

Calendar Year 2010 (Millions of Containers)

Material	Sales	Returns
Aluminum	8,830.50	8,262.25
Glass	2,925.44	2,482.26
#1 PET	8,047.94	5,479.31
#2 HDPE	328.48	302.28
#3 PVC	0.74	0.00
#4 LDPE	17.73	0.13
#5 PP	0.70	0.02
#6 PS	61.33	4.66
#7 Other	27.48	2.86
Bimetal	23.39	2.89
All Materials	20,263.72	16,536.68

RECYCLING RATES

Calendar Years

Material	2008	2009	2010
Aluminum	84%	91%	94%
Glass	76%	80%	85%
#1 PET	62%	73%	68%
#2 HDPE	91%	109%	92%
#3 PVC	8%	0%	0%
#4 LDPE	0%	1%	1%
#5 PP	1%	1%	4%
#6 PS	1%	2%	8%
#7 Other	7%	8%	10%
Bimetal	14%	10%	12%
All Materials	74%	82%	82%

PROGRAM HISTORY

- **AB 2020 (Margolin), authorizing legislation, signed 9/28/86**
- Distributor labeling requirements and redemption payments began 9/1/87
- Dealer signage requirements and consumer redemptions began 10/1/87
- **65 Bills enacted since 1987, including:**
- SB 1221 (Hart), 1989: Two-for-a-nickel
- AB 2622 (Eastin), 1990: Glass container minimum content
- AB 1340 (Eastin), 1991: Fiberglass minimum content.
- AB 87 (Sher), 1992: Processing fees, handling fees

- SB 1178 (O'Connell, Sher), 1995: Processing fees, handling fees
- SB 1 (Sher), 1999: Extended SB 1178 for one year
- SB 332 (Sher), 2000: Added new containers, created and expanded recycling-related expenditure programs
- SB 1906 (Sher), 2001: Clarified scope of the recycling and litter reduction program, amended enforcement capabilities of the program
- SB 528 (Sher), 2001: Clarified predatory pricing provisions and enhanced the enforcement authority of the Division of Recycling
- AB 28 (Jackson), 2004: Increased CRV, revised processing fees and payments, established the Market Development and Expansion Grant Program and the Recycling Infrastructure Loan Guarantee Program
- AB 3056 (Nat'l Res Comm.), 2006: Increased CRV; reduced processing fees for 2007; increased beverage distributor's withholdings to cover their administrative costs; extended and established new grant programs; created incentive payment programs; revised the "convenience zone" and "refund value" definitions; and amended handling fee payments and future handling fee calculations
- SB1021 (Padilla) 2007: Provided for grants for source separated beverage container recycling receptacles in multifamily housing
- SB 63 (Strickland), 2009: Transferred the duties and responsibilities of the Beverage Container Recycling Program to the new Department of Resources Recycling and Recovery, merging with the programs of the former Integrated Waste Management Board
- AB 7 (8X) (Budget Comm.), 2010: Addresses matters of fiscal solvency for the Beverage Container Recycling Fund

PLASTIC RESIN CODE DESCRIPTION

1 PETE (polyethylene terephthalate)	5 PP (polypropylene)
2 HDPE (high density polyethylene)	6 PS (polystyrene)
3 V (vinyl/polyvinyl chloride)	7 OTHER (includes multilayer)
4 LDPE (low density polyethylene)	1 PETE 7 (For Example) (for three layers of PETE) A "7" shall appear below the resin abbreviation when the bottle or container is composed of more than one layer of that resin.

LOCAL COMMUNITY CONSERVATION CORPS GRANTS

Fiscal Year 2010/11

Total Funding Provided *(Millions)*	$19.5
Applicants	13

FUNDS PAID TO CITIES AND COUNTIES

Fiscal Year 2010/11

Total Funds Awarded *(Millions)*	$10.5
Total Funds Available *(Millions)*	$10.5
Eligible Cities and Counties	537
Number of Recipients	502

CALIFORNIA BEVERAGE CONTAINER RECYCLING FUND ACTIVITY

Fiscal Year 2010/11 Estimated

Estimated Revenues	(Millions)
CRV In	$1,115.3
Interest	$0.8
Estimated Expenditures	
CRV Out	$1,002.2
Processing Fee Offset	77.1
DOR Administration	49.8
Handling Fees	41.6
Curbsides/Neighborhood Dropoff Supplemental Payments	15.0
Payments to Cities and Counties	10.5
Public Education	0
Market Development and Expansion Grants	0
Local Community Conservation Corps Grants	19.5
Quality Incentive Payment Program	10.0
Plastic Market Development Payments	10.0
State Operations	5.0

PROGRAM PARTICIPANTS

Certified or Registered	(April 2011)
Processors (PR)	190
Buyback Centers (RC)	2,451
Curbside (CS)	586
Collection/Dropoff (CP/DP)	224
Community Service (SP)	119

PROGRAM PARTICIPANTS

Manufacturers & Beverage Distributors

(4/1/2011)

Beverage Manufacturers (BM)	1,509
Distributors (DS)	1,803

PARTICIPANT SHARES*

Percent Redemption Wt Calendar Year 2010

TYPE	CRV%	AL%	GL%	P1%	P2%
Traditional RCs	60	65	52	57	52
Supermarket Sited Handling Fee RCs	26	26	21	27	20
Supermarket Sited Non-Handling Fee RCs	4	4	3	4	6
Curbside Programs	8	4	20	9	18
CP/DP/SP	2	1	4	3	4

** Due to rounding, figures may not total to 100%*

CONVENIENCE ZONE RECYCLERS

Calendar Year 2010

Number of Handling Fee Sites, (*April 2011*)	1,388
Average Number of Handling Fee Sites Funded/Month	1,131
Average Handling Fee/Month/Site	$3,110

AUDITS, ENFORCEMENTS, & INSPECTIONS

Calendar Year 2010

Compliance Audits Completed	89
Audit Findings *(Millions)*	$9.4
Processor Load Inspections	12,500
Claims Denied or Reduced	126
Claim Payment Reductions	$865,799
Recycler Inspections Conducted	2,392
Notices of Noncompliance Issued	703
Notices of Violation Issued	20
Investigations Completed	268
Placed on Prepayment Controls	32
Probationary Reviews Completed	231
Dealer Inspections Conducted	2,197
Notices of Noncompliance Issued	280
Notices of Violation Issued	55

Reprinted from RESOURCE RECYCLING

A COMMON THEME

IS SINGLE-STREAM RECYCLING SERVICE THE SALVATION OF ALL RECYCLING PROGRAMS OR IS THERE A BETTER WAY FORWARD? OUR AUTHOR DIGS INTO THE UNTOLD STORY OF REAL RESIDUE RATES AND A PREFERABLE METHOD TO TRULY RECYCLE MORE MATERIALS AT MATERIALS RECOVERY FACILITIES.

BY SUSAN COLLINS

The importance of preserving material quality and avoiding cross-contamination has become a common theme in many recent technical reports on recycling. Indeed, the Container Recycling Institute's (CRI) website features over a dozen reports and articles about the issue of quality problems with single-stream recycling collection and processing. Unfortunately, there is widespread confusion about what losses in materials mean. Most studies rely on the materials recovery facility (MRF) residue rate, without quantitative consideration of additional losses that occur post-MRF. As the data in this article show, the additional losses after materials leave the MRF can be up to twice as large as the MRF residue rate. With an overall loss rate of 22 to 27 percent by weight, single-stream recycling is a system that is far from optimal.

In the average single-stream collection program, if you collect 100 tons of recyclables at the curb, 73 to 78 tons will actually be recycled into new products, and most of the rest will be landfilled.

There are existing systems in different parts of the world that use multiple streams of collection in order to maximize tonnage recovered, while delivering high-quality recyclables.

As we seek new policies to increase recycling rates, we need to start reporting what is *actually* recycled, not just what is *collected* for recycling. Collection and processing methods have changed dramatically in the last two decades, but reporting mechanisms haven't evolved to capture new recycling rate information correctly. Process losses occur at the MRF when contaminants are removed, and even greater levels of contamination are removed when materials arrive at paper mills, plastics reclaimers and other materials processing facilities.

In the average single-stream collection program, if you collect 100 tons of recyclables at the curb, just 73 to 78 tons will actually be recycled into new products, with most of the rest landfilled.

Continuation of CRI's single-stream research

In the 2009 report, *Understanding the economic and environmental impacts of single-stream recycling*, CRI detailed the contamination rates and yield losses for specific recyclables, but at that time, there was not enough data to create an overall yield loss number for all recyclables

collected through single-stream curbside recycling. A key element that was missing was the average composition of single-stream residential recyclables. *Resource Recycling* released the results of their first annual survey of materials recovery facility (MRF) operators in the Jan. 2011 issue, and the results included the composition of recyclables at MRFs.

Moving materials at MRFs

Resource Recycling received survey responses from 200 MRF managers of large and small facilities in 44 states. Some facilities were dual-stream, some single-stream. A few used mixed waste processing. The source of materials varied, from residential to commercial, to a mix of both. Incoming material types varied as well, with some facilities excluding such materials as glass, Nos. 3-7 plastics or other categories.

For this project, we selected all of the facilities that both processed all residential recyclables from single-stream collection, and were from states without a container deposit program. There were eight facilities that met these criteria located in eight different states. The average composition of the materials sorted by these MRFs is indicated in Table 1, with the majority of the material stream being paper. Note that the residual rate for these selected facilities, eight percent, is lower than the average residual rate of 10 percent for the entire list of facilities surveyed. Also, due to a lack of data about the contamination rate for "other" recyclables, we assumed, for the sake of these calculations, that there was no contamination. This is an unlikely scenario – therefore, the overall contamination calculation would likely be higher than that shown in Table 1.

Averages and ranges

The data are presented here as averages and ranges. There isn't a single, specific number that represents the total yield loss from single-stream collection. Brokers, mills and processors will nearly always say "it depends on the MRF" when asked about quality and percent contamination. Brokers often go on to say that they have some single-stream MRF clients that produce lower levels of contamination than source-separated programs. The variation is due to different program parameters, such as types of materials accepted, type and frequency of public education, pay-as-you-throw or incentive-based programs, versus unlimited service, as well as the demographics of each community. All of these factors affect the percent residuals that will be received by the MRF due to improper sorting by residents. Therefore, if you want to know the quality and contamination levels achieved by a certain program, consult the documentation specific to that program.

It is important to understand that some of these losses are due to the collection and sorting method, while other losses are consistent across all collection methods. There will be unavoidable losses from processing even the cleanest materials. Some "contaminants" are attached to the recyclable, such as polypropylene caps on most PET bottles, or metal caps on glass bottles. We have explained the nature of the losses in the description for each material type.

PET yield loss

Like paper mills, PET reclaimers carefully measure yield loss for different sources of materials. Yield loss measurement is critical to their financial health – they must know how much material they will be able to sell after cleaning and processing incoming bales. These reclaimers must also know how much the cleaning process will cost and the amount of material they will need to landfill.

Some of the yield loss in PET bottles is naturally attached to the bottle, such as caps, labels and adhesives, which, collectively, make up approximately 13 percent of the weight of PET bottles (note that this number varies from bottle to bottle, because bottle designs are so different). Many of the caps are polypropylene, and they are often removed and recycled, but the labels and adhesives are generally disposed of. Other contaminants may be "look-alike" bottles that were mistakenly added to the PET bale, but are a different resin type, and so they must be separated before the bottles are recycled.

The yield loss for PET is used as a proxy for all plastics in Table 1, but this may overstate yield losses for all plastics. The bale yield loss rate for "all bottles" was significantly lower (22.1 percent in 2009) than the yield loss rate for PET bottles (32.2 percent for 2010), but 2010 "all-bottle" data are not available. PET bottles make up more than half of all bottles recovered in the U.S., by weight, according to 2009 data from the American Chemistry Council (ACC).

If recycling rates are reported without removing yield loss from the contamination, it can lead to inflated recycling rates and double-counting. For example, when the polypropylene caps are recycled, the weight of those caps is counted in the polypropylene recycling rate. The labels, adhesives and other contaminants are disposed of, but their weight has already been counted as "recycling" in the annual National Association for PET Container Resources (NAPCOR) and Association of Postconsumer Plastic Recyclers (APR) report. For these reasons, the U.S. Environmental Protection Agency has recently adjusted its calculation

Table 1 | Losses through single-stream recycling in states without container deposit programs

	Composition per 100 tons, as sorted at the MRF (%)	Percent loss at secondary processing facility	Remaining amount that is actually recycled (%)
Glass	17	21 to 40	10.2 to 13.43
Paper	55	15 to 18	45.1 to 46.75
Plastic	10	32.2	6.78
Steel	4	0	4
Aluminum	3	2 to 11	2.67 to 2.94
Other (recyclables)	4	unknown	4
Residual	8	100	0
TOTAL	101	22.10 to 27.255	72.75 to 77.90

Note: total adds to 101, due to rounding.
Source: Container Recycling Institute, 2012

of the PET recycling rate to include only the amount of PET that is actually recycled, and to exclude contaminants, other materials and yield losses.

Plastics

In 2009, *Plastics News* conducted a survey of HDPE and PET reclaimers, and the results indicated that yields in 2009 were 10 points lower than in 2007. The NAPCOR/APR *2010 Report on Post-Consumer PET Container Recycling Activity* has detailed information about yield losses, noting in 2010, "U.S. reclaimers reported yield losses ranging from 24.4 percent for deposit bottles to 32.2 percent for curbside material," which is an increase of about seven percentage points from 2009.

For non-bottle rigid plastic recycling, similar contamination issues exist, and they are also a threat to the plastics recycling industry and the jobs they create. As the ACC reported in its *2009 United States National Post-Consumer Plastics Bottle Recycling Report*, "This lack of adherence to quality standards is a significant barrier to developing more domestic reclamation capacity."

Paper

In CRI's 2009 report, *Understanding economic and environmental impacts of single-stream collection systems*, we found that paper mills that receive materials from single-stream MRFs have contamination rates that are as high as 18 percent. Individual interviews with several paper mills indicate an average contamination rate of 15 percent, but these mills are all in regions that have container deposit programs, which remove most of the glass and much of the plastic from the curbside stream.

Aluminum

An interview with the largest aluminum recycler, cited in the 2009 CRI single-stream report, give us the average contamination rate range of 2 to 11 percent. Like other materials, aluminum recyclers report that contamination rates are increasing, and that they have made additional investments in pre-treatment facilities to improve material quality. Contamination in aluminum is not merely inconvenient – there can be serious consequences. For decades, the aluminum industry has fervently warned against the inclusion of plastics in the aluminum stream because of safety concerns in processing and melting.

Glass

It is important to know the breakdown of the amount of glass that is recycled for use as cullet to make glass bottles or fiberglass, versus the amount of glass that is used for aggregate or landfill daily cover. Recycling tonnages are often used in calculations of energy savings, greenhouse gas and other emission savings, and job creation, and there is a potential to overstate these environmental and economic benefits if the use of the glass is misunderstood.

Data from a dozen glass processing (beneficiation) facilities indicate that 60 percent of glass coming from single-stream programs is useable for making glass bottles or fiberglass. Another 19 percent is undersize material, some of which can be used as road base or landfill daily cover, and 21 percent is a combination of non-glass residue and undersize material, which is not useable and is sent directly to landfill.

In contrast, 90 percent of glass from dual-stream programs can be recycled into containers and fiberglass, with the remaining 10 percent being glass fines used for low-end applications. Glass from container deposit programs is color-sorted, resulting in 98 percent being recycled and only 2 percent marketed as glass fines.

Alternatives to single-stream collection

Multi-stream collection is the norm in European countries such as Germany and Belgium, where municipalities collect all glass separately in neighborhood drop-off igloos, while paper and paperboard are collected separately from containers and packaging. European glass recycling rates reached 67 percent in 2009, around twice the U.S. glass recycling rate.

In addition to accepting glass in its curbside recycling program, the City of Fort Collins, Colorado encourages residents to use glass-only drop-off bins to ensure that 100-percent of the glass can be used to make new glass bottles.

Mark Bowers, of Sunnyvale, California, reports that his community has provided dual-stream collection, using split carts, for over a decade. Mr. Bowers concludes that, "Based on our data compared to data from single-stream conversions, it is clearly the cart, not the ability to put all of one's recyclables in one container, that spurs the increase in recycling when people switch to carts and (coincidentally) single-stream. That is, you get the same participation boost by going to carts and dual stream. At the same time, processing capital and operating costs are lower and you maintain the value of the fibers by keeping them separate from the other materials."

The City of Auburn, Maine had implemented a single-stream recycling program, but decided to convert the program to a dual-stream collection program, in order to preserve material quality. A 2011 report by the Waste & Resources Action Programme in the U.K. goes a step farther, and recommends curbside sorting of materials, to preserve maximum quality.

Daniel Lantz, of Cascades Recovery Inc., reports that the City of Ottawa conducted a survey of the public and, in response, they chose to retain their dual-stream collection system, relying on alternating week collection to provide the same cost savings as single-stream.

Conclusion

While there have been many debates about the merits of single-stream versus dual-stream recycling, they have occurred in the absence of complete data on the total losses that occur as a result of single-stream collection systems. This article attempts to quantify the amount that is *actually* recycled as a result of single-stream collection, which provides a correction to the previous error in the calculations of recycling rates and recycling tonnages. However, there is much more work to be done to correct cost-per-ton calculations and convert to cost-per-ton-recycled, as well as to research best practices for dual- or multi-stream collection that achieve the best possible cost efficiencies. With better data, we can make better decisions. RR

Susan Collins is the executive director of the Container Recycling Institute. She can be reached at scollins@container-recycling.org. CRI has more information about single-stream recycling on its website at http://www.container-recycling.org/issues/singlestream.htm.

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RESOURCE RECYCLING

RETURNING TO WORK

WORKERS ARE NEEDED IN LANDFILLING, CURBSIDE RECYCLING AND CONTAINER DEPOSIT RETURN, BUT WHICH SECTOR BRINGS THE MOST MUCH-NEEDED JOBS TO THE STRUGGLING U.S. ECONOMY? OUR AUTHORS PROVIDE A DETAILED ANALYSIS OF THE POSITIVE IMPACT BEVERAGE CONTAINER DEPOSIT PROGRAMS CAN HAVE ON JOB CREATION.

BY CLARISSA MORAWSKI AND JEFF MORRIS

With less than a year to go before the U.S. election, Democrats and Republicans seem more divided than ever on the issues facing the nation. But the one thing that does seems to unite all Americans, left or right, is the shared goal of getting people to return to work. The domestic jobs increases associated with waste diversion instead of disposal have been examined in a number of recent studies by a variety of sources, including the Institute for Local Self-Reliance; Pricewaterhouse Coopers in Germany; Eunomia in England; and the Institute of Scrap Industries, Inc. Last month, the Tellus Institute prepared a report, which was released to much fanfare (see page 52 of this magazine for more) that found a 75-percent diversion rate would produce 1.5 million jobs and provide a tremendous boost to the U.S. economy.

They all report a significant increase in jobs from greater levels of recycling. From wood waste recycling, to tire crumbing, or turning broken glass into new glass bottles, recycling is both good business and creates jobs. *Resource Recycling*'s lead story from this past summer (*Recycling = Jobs*, July 2011) revealed convincing statistics from the U.S. Department of Labor that show robust growth for the recyclable materials industry. Since 2005, the number of people employed in this sector rose by eight percent and during the 10-year period ending 2007, sales rose by nearly 50 percent.

Effectively, the business of resource extraction (mining and oil drilling) and material conversion is transferred "above ground" to where recyclables are collected, transported, processed and converted (secondary process). Equipment and energy costs for resource extraction are replaced by the labor costs associated with resource recovery.

Measuring domestic jobs impacts from recycling

Understanding what these jobs impacts are, at each and every stage of extraction or recovery, is what guided new research just released by the Container Recycling Institute (CRI). "*Returning to Work: Understanding the Jobs Impacts From Different Methods of Recycling Beverage Containers*" reports the net gains in full-time-equivalent (FTE) domestic jobs when beverage containers are recovered through various waste management schemes.

The findings include a new excel-based jobs model, *Measuring the Impact from Recycling on Jobs Calculator* or "MIRJCalc," which was created by Jeffrey Morris, Sound Resource Management Group with research and analysis from Clarissa Morawski, CM Consulting.

The team set out to quantify, in terms of net impact on domestic jobs, the number of FTE jobs associated with every 1,000 tons of

beverage container material recovered and recycled. Materials included in the study were beverage containers sold in the U.S., made from aluminum, glass and PET. Collectively, these represent over 220 billion units available for recycling each year, weighing over 1.5 million tons of aluminum, 9.6 million tons of glass, and 2.7 million tons of PET.

Three different materials management schemes were analyzed: container deposit return (CDR); residential curbside recycling; and disposal. For each option, the research team figuratively "traveled" along the same path that all three materials will travel and identified how many jobs are directly associated with the tonnage throughput along the way.

For example, in the case of glass recovery, there are jobs associated with collection, transportation, processing in a material recovery facility (MRF), more transportation and glass beneficiation (secondary processing or "conversion"). Jobs were counted along the way until the material gets shipped to a product manufacturer. Jobs in manufacturing were excluded because it is confirmed that in most cases irrespective of whether the raw material is virgin or recovered (secondary), the impact on manufacturing jobs is neutral. In addition, if material like PET is exported overseas, counting jobs stops. Lastly, if any material is lost along the way as "residual" during processing, the counting shifts to the number of jobs associated with disposal of the material.

The research also attempts to quantify job losses that may occur upstream during virgin material extraction when recovered material substitutes for virgin. Extracting raw materials for use in glass bottles, fiberglass and aggregates for example, includes mining for silica, soda ash, aplite, limestone and borates. The raw material "recipes" per ton of manufactured product were provided by manufacturers.

Beverage container throughput (in tons) is based on average recovery rates for state-based CDR systems; residential curbside recycling and enhanced curbside, which includes recycling of containers generated away-from-home, as well as recycling of containers generated by multi-family residents and single-family households without access to curbside (households required to self-haul to a recycling depot).

Figure 1 | Jobs created (U.S.) from beverage container recycling

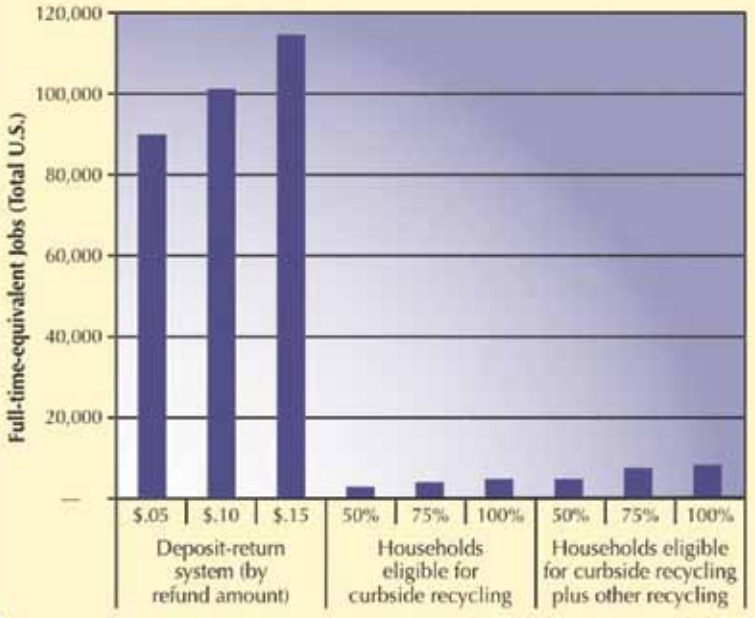
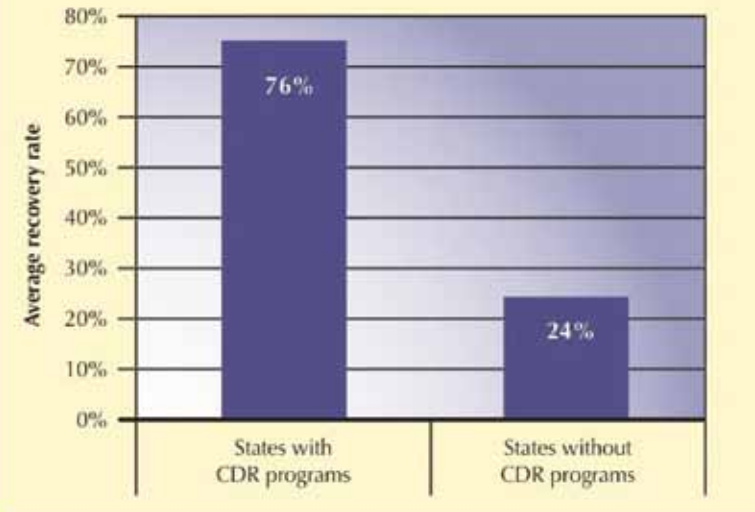


Figure 2 | Recovery rates for beverage containers in CDR vs non-CDR programs



User inputs

Users of MIRJCalc input name of the state, and several primary variables which have a measurable impact on amount of beverage container recovered (e.g., the amount of tonnage to run through the model). The model incorporates state-specific data, such as population; single-family versus multi-family share of households; and beverage sales by type.

For example, in the CDR scenario, the user identifies the deposit level (a 5-, 10- or 15-cent deposit) which specifies the average performance rate of 75 percent, 85 percent and 95 percent collection, respectively. Users may also enter another recovery rate if they choose to. For the non-CDR scenario, users are asked to provide the percent of eligible households with curbside collection service.

For other important variables, defaults are provided which represent average rates in the U.S. For example, for non-CDR recovery, default capture rates are provided for glass, PET and aluminum containers from single- and multi-residential generators with collection services, away-from-home and self-haul recycling. In addition, the proportion of manual versus automated curbside collection is also assumed at 23 percent and 77 percent, respectively. Users may change the default to better reflect the situation in their state.

Defaults also exist for both CDR and non-CDR options, relating to the export rate for PET, as well as yield loss rates for glass, PET and aluminum. These loss rates are based on reports from the secondary processing industry and represent actual experience with both curbside and CDR streams of material.

The final results

The analysis provides a compelling case for increasing recovery rates and maintaining high-quality glass, PET and aluminum recovered

Figure 3 | Jobs created in recovering PET vs producing virgin raw materials for PET resin

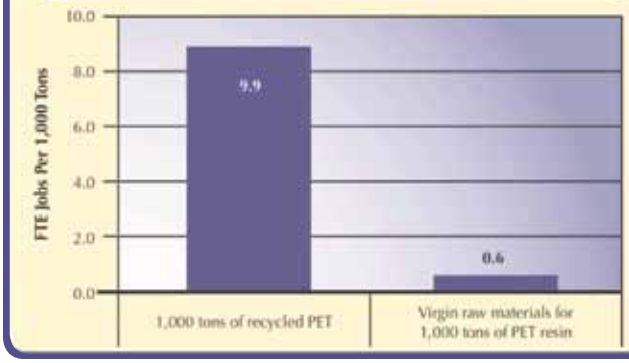
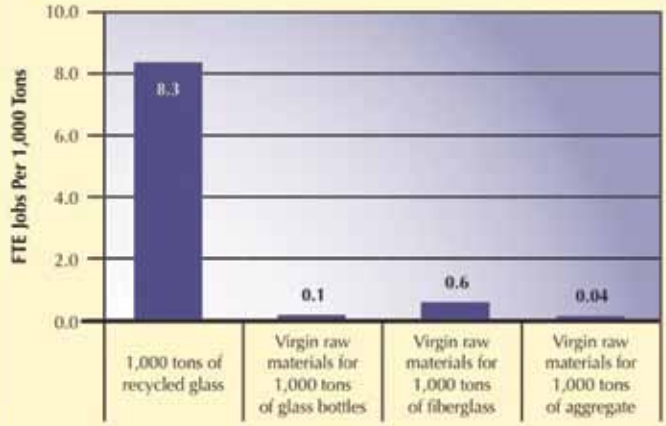


Figure 4 | Jobs created in recovering glass vs extracting virgin raw materials for glass



materials. Maximizing recovery rates ensures the greatest volume of containers moves through each recovery stage and gains the associated domestic jobs. In addition, maintaining high-quality material results in the least amount of yield loss (contamination) to disposal, where there are fewer jobs, ton for ton.

The following provides a summary of findings based on a set of default inputs which are reflective of status quo rates in the U.S. today. While the model is designed for a state-by-state analysis, the results below are for the entire country.

Using deposit return as a means of collecting beverage containers instead of a curbside recycling program creates more jobs. Using primary system parameters as the base scenario (5-, 10-, or 15-cent refund value in a CDR system, and 50-, 75- or 100-per-cent curbside eligibility for a non-CDR system), deposit-return systems create significantly more jobs. (See Figure 1).

Beverage container deposit systems provide 11 to 38 times more direct jobs than curbside recycling systems for beverage containers.

The primary driver of direct jobs from recovery operations is the amount of material ("throughput") entering and leaving the system. Deposit-return systems recover approximately three times more beverage container material than the closest competitor, curbside recycling. Specifically, in the U.S., deposit-return systems recover approximately 76 percent of all beverage containers covered by deposit laws, compared to approximately 24 percent of beverage containers collected through curbside programs and other methods (see Figure 2).

The secondary driver of direct jobs in container recycling systems relates to the number of workers needed to collect and sort the containers and transport them to the MRF or secondary processor. Deposit-return systems require 1.5 to 4.0 times as many employees for these tasks as do curbside systems. Specifically, approximately 7.34 FTEs are required per 1,000 tons of material collected in a deposit-return system, compared to 4.46 FTEs in a manual curbside system and 1.66 FTEs in an automated curbside system.

Replacing virgin material with secondary materials in manufacturing recycled-content products may displace some domestic jobs in mining, oil extraction, polymerization and other virgin material extraction industries. However, extraction industries tend to be more machine intensive than labor intensive (see Figures 3 and 4). As such, the net employment impact favors jobs in recovery industries.

Moving from the micro to the macro

The analysis is a micro look at the impact of recycling materials through various collection mechanisms, and presents only a portion of the benefits related to job creation. These are the direct jobs only. Excluded are all of the job increases that arise from businesses in the region that supply goods and services to the recycling business ("indirect jobs").

In addition, businesses that provide goods and services to the individuals with the direct jobs also create additional new jobs ("induced jobs"). And then there are the induced jobs from the indirect jobs, and on and on. Both indirect and induced effects will have a multiplier effect on the direct jobs from recycling, which further emphasize the benefits of increasing recycling in the U.S.

While MIRJCalc treats the domestic manufacturing jobs as neutral, the report recognizes that for many U.S. consumer-products manufacturers who use recycled container material in everything from bottles and fleece to fiberglass, they do so to reduce energy use, emissions and other pollution, reduce production costs and meet internal or industry sustainability goals.

Increasing the quantity and quality of recovered glass containers available for beneficiation, for example, can increase the amount of high-value, furnace-ready cullet for bottle manufacturing and decrease the amount sent to landfill as residual.

Superior performance rates for recovered quantities and improved quality of material is consistently higher in CDR versus curbside collection systems. In fact, glass manufacturers report a strong correlation between their level of cullet use and the availability of cullet from states with CDR programs. Specifically, one large bottle glass manufacturer with facilities throughout the U.S. reports average recycled-content rates of 72 percent in CDR states;

24 percent in states that border CDR states; and 12 percent in non-CDR states.

Similarly, increasing the recovery of high-quality PET bottles is paramount to the domestic reclamation industry. In 2009, about 41 percent of U.S. PET processing capacity sat idle, while 56 percent of all bottles recovered (primarily those from curbside programs) were shipped overseas. This represents another 400,000 tons of material that could potentially generate 800 new direct jobs in PET reclamation alone, and many more indirect and induced jobs.

Last spring, *Plastics News* reported that while domestic capacity expansion in the last two years totaled some $350 million in investments, there would have been further expansions had it not been for the fact that "tight supplies have caused some PET capacity expansions to be cancelled or delayed." Such market dynamics illustrate the economic opportunity and increased jobs available when greater quantities of high quality material are recovered.

The analysis reveals stage by stage how recovering materials for recycling stimulates job growth. And, while the scope of materials is limited to only three types of beverage containers, and direct jobs only, it provides helpful insight around setting priorities for federal and state recycling policy.

A strategy which targets very high collection rates, material by material, and ensures recyclables can be converted domestically, will not only increase jobs involved in collection, transport and processing, but support U.S. manufacturing as well. This is the "restoration of economic growth" that needs no federal stimulus dollars. RR

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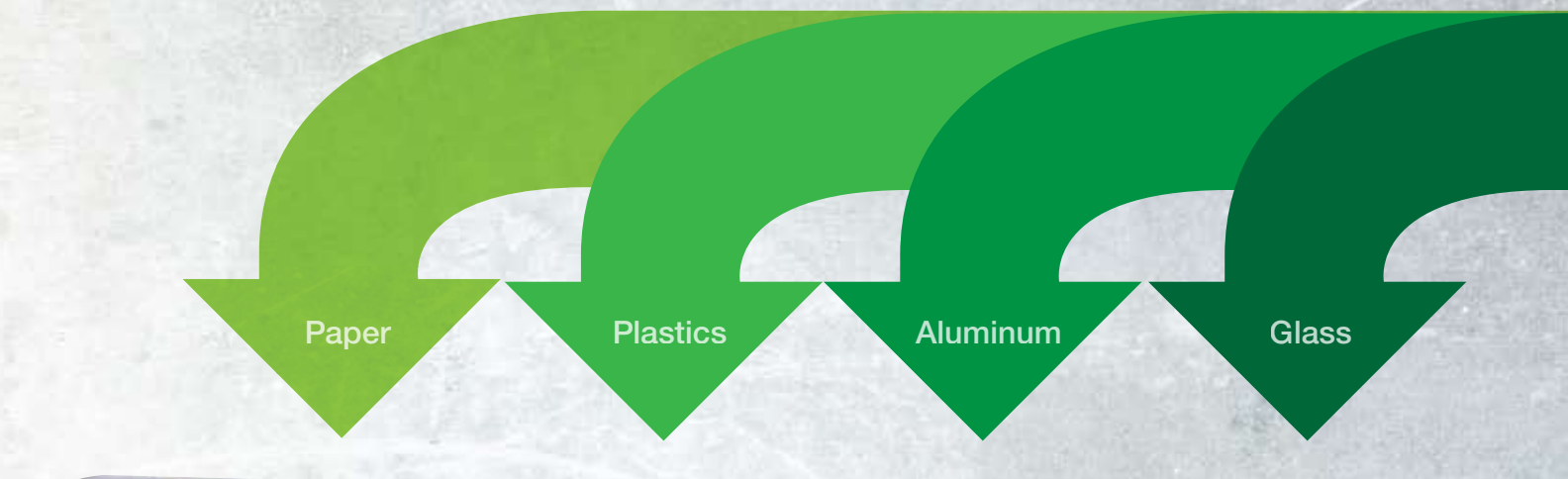
RESOURCE RECYCLING

SINGLE-STREAM UNCOVERED

A new study presents some surprising findings on the economic and environmental impacts of single-stream recycling.

By Clarissa Morawski



Over the past decade, hundreds of communities throughout North America have shifted their municipal recycling collection program from a dual- or multi-stream approach to one that commingles recyclables into one container, due mainly to the convenience factor for residents and costs savings for the local government. However, though municipalities may be switching collection schemes in droves, the success of these programs has been mixed (no pun intended).

For example, volumes may rise with the switch in collection approaches, but many key issues have also been noted from the use of a single-stream collection service, including end-market concerns over product quality – particularly from the fiber end-markets – increased quantities of residues being managed by material recovery facilities (MRFs), and labor and overall processing costs in excess of expectations.

So, in 2008, the Container Recycling Institute (CRI) commissioned Ontario, Canada-based CM Consulting to embark on a research project to examine the economic and environmental impacts of single-stream collection systems. The task involved interviewing recycling executives, city staff and experts, and researching published reports and trade publication articles – including almost two dozen *Resource Recycling* articles dating as far back as 1998 – in order to obtain enough data and information to attempt to qualify and quantify where possible, the impacts. The following results were published in a recently-published CRI report, entitled *Understanding Economic and Environmental Impacts of Single-Stream Collection Systems*.

Rapid growth

Single-stream recycling collection began in California, as municipalities were looking to find a way to increase diversion to meet legislated recycling targets, all while keeping recycling costs down. The existing dual-stream and drop-off mechanisms for collection were not achieving sufficient success, as citizens were not participating enough, education programs were too costly, and collection and processing costs were too high.

For a recycling program to be viable, municipalities require a collection method that yields high participation rates in a cost-effective manner. Because single-stream systems are convenient and simple, recycling rates should increase significantly. On the collection side, the use of a large rollcart allows collectors to automate pick-up from inside the truck cab, and single-compartment trucks save labor and transportation costs. And, with the potential economic savings offered by single-stream collection to haulers, single-

Table 1 | Effects of single-stream on a paper mill

Time period	Feedstock source (as a percent of total incoming material)	Outthrows	Prohibitives	Glass rate	End-market	Pulper yield loss
2001 and prior	Curbside sort (100 percent)	0.25 percent-0.5 percent	0.0	0.0	ONP #8	one percent
2003-2005	Single- or dual-stream (42 percent)	5.7 percent	1.3 percent	0.1 percent	ONP #7, #8	nine percent
Sep.– Dec. 2006	Single or dual-stream (68 percent)	15 percent	3.4 percent	0.33 percent	ONP #8 & #7	N/A

Source: *The Effects of Single-stream on a Paper Mill*, W. Sacia and J. Simmons, 2005

stream collection began to move east.

A July 2005 survey released by R.W. Beck, Inc. found that, in 2000, roughly 11 percent of the U.S. population with access to curbside recycling had single-stream collection. However, by 2007, the American Forest & Paper Association reported that number had increased to 50 percent, with single-stream recycling experiencing a 72.4-percent increase in growth from its 2005 level of 29 percent. And, with each year, hundreds of cities across North America and Europe are shifting to a single-stream collection approach; and it's no wonder, given the benefits single-stream collection is guised to offer.

The dark side: Quality

Unfortunately, processors tell quite a different story about the effectiveness of single-stream collection. In fact, ask any post-consumer materials processor about single-stream collection and it's more than likely they will tell you that handling commingled recyclables is problematic.

In 2005, William Sacia and Jay Simmons published a compelling report, *The Effects of Single-stream on a Paper Mill*, measuring the impacts of residuals on the NORPAC paper mill in Longview, Washington. Prior to 2001, all of the mill's incoming feedstock came from 100-percent source-separated programs, which required an additional 2,500 tons of fiber to replace the rejects. Between 2003 and 2005, the study reported that the mill's input changed dramatically. During that period, roughly 42 percent of incoming secondary newsprint came from commingled (single- or dual-stream) programs and the need for replacement fiber ballooned five-fold to 20,000 tons per year. At the same time, the mill's annual cost base for replacement fiber and disposal increased to $2 million per year. From September 2006 to December 2006, when commingled material increased to 68 percent of the total incoming fiber, outthrows, prohibitives, and glass rates all increased significantly (Table 1).

With the growth of single-stream collection, paper manufacturers have seen their costs escalate. Specifically, these are the additional expenses related to cleaning and screening poorly processed materials, repairing damage to equipment, more frequent equipment cleaning, equipment replacement, buying new raw materials to replace those that were unusable, and disposal of the residual materials that cannot be used.

Sacia and Simmons' report revealed that, prior to receiving commingled materials (from either single or dual-stream collection), the NORPAC paper mill managed the costs associated with maintenance from contamination in their budget, and did not have to spend money to improve incoming material quality. However, in the post-commingling period, from 2004 to the present, the company reported a four-fold increase in maintenance costs related to contamination, as capital investment to improve the quality of incoming material exceeded $100,000.

In a regression analysis from 2004, representatives with the Jaakko Poyry Group and Skumatz Economic Research Associates, Inc. (SERA) interviewed a number of paper mill representatives and extrapolated data on the production costs of new newsprint. Found within the report, entitled *Single-Stream Recycling-Total Cost Analysis*, their findings showed a strong correlation between using recycled content and increased production costs. More specifically, at 100-percent recycled content, there was a cost increase of $6.50 per ton produced.

These results indicate there are significant costs associated with the use of secondary fiber, which creates a disincentive for manufacturers to use recycled materials or to increase recycled content. The analysis further calculates an estimated cost to paper mills if all dual-stream recycling systems were converted to single-stream. The analysis determined that the industry would annually incur an additional $48 to $51 million in costs associated with increased production costs stemming from increased contamination.

In terms of the annual net costs affecting the entire stakeholder group, the analysis done by Jaakko Poyry and SERA shows that, while there is a $10 to $20 per ton (a total savings of $90 to $105 million) average decrease in collection costs for paper products, this would be offset by a $5 to $15 per ton (a total increase of $60 to $70 million) increase in processing costs. Combined with additional papermaking costs of $5 to $13 per ton (a total increase of $48 to $51 million), this resulted in an overall net increase of about $3 per ton (a total increase of $18 to $21 million).

Paper

Assessing the impact on paper quality on the recycling sector is difficult because paper mills receive their secondary feedstock from a variety of suppliers, all of which have different collection methods. It is estimated, however, that for paper pulpers, single-stream material has eight times the yield loss of curbside-sorted material. As Sacia and Simmons conclude, "In the drive to reduce recycling collection costs, the

recovered-fiber-consuming mill has been substantially and adversely affected." There is, they conclude, "a strong need for more balance in the system."

Plastics

Plastics processors report that, in general, material from single-stream MRFs has a yield rate of about 68 percent to 70 percent, compared to dual-stream systems that usually yield about 75 percent to 78 percent. Bales of polyethylene terephthalate from deposit return systems generally have a yield rate of about 85 percent (Figure 1). While a yield differential of five percent to 10 percent may not seem like a lot, consider that if a facility has an annual capacity of 60 million pounds per year (five million pounds per month), every one percent of lost yield represents about 50,000 pounds of new waste, for an average $7,500 loss in value to the processor. MRFs that average just five percent loss in yield, due to poor quality, are losing about $37,500 per month, not including the cost of sending these residuals to disposal.

Aluminum

The aluminum industry reports similar issues associated with single-stream MRFs. Novelis, one of the world's largest aluminum rolling producers and aluminum can recyclers, explained that voluntary supplier action was not yielding measurably improved quality. This was true even during the 2007–2008 commodities boom, during which material revenue and supplier profit far exceeded historical standards. As a result, Novelis implemented a financial penalty for poor suppliers, discounting prices paid by 10 cents per pound.

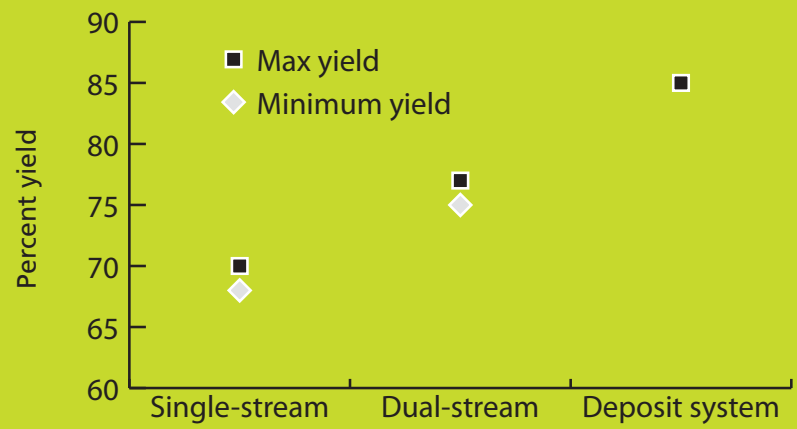
Though it might seem a rigorous measure, the surcharge did not fully compensate Novelis for profit losses, due to low productivity from substandard materials. Recently, a number of suppliers left, and many more have been redirected to a special off-site cleaning facility, where markedly lower prices will be applied to offset the site's operating costs and investment return. Novelis' action highlights how serious the company is about not accepting low-quality material. The company has indicated that other aluminum buyers, such as Alcoa, Inc. and Aleris International, are also serious, and the rest of the industry is coming on-line as well.

Glass

Glass is the material most affected by the approach of a collection system. In single-stream programs, it is virtually impossible to prevent glass from breaking as it goes to the curb, is dumped in the truck, gets compacted, gets dumped on the tipping floor of the MRF, is repeatedly driven over by forklifts, and is dumped on conveyor belts to be processed.

On average, about 40 percent (a range of 20 percent to 60 percent) of glass from single-stream collection winds up in landfills, while 20 percent is small broken glass (fines) used for low-end applications. Only about 40 percent (a range of 20 percent to 60 percent) is recycled into containers and fiberglass. The most likely end-uses for mixed cullet from a MRF is sandblasting base, aggregate material, or alternative daily cover (ADC) for landfills. In contrast, dual-stream systems have an average yield of 90 percent, and container-deposit systems yield 98 percent glass available for use in bottle making (Figure 2).

Figure 1 | Estimated yield rates from collected plastic *



*Based on qualitative information from interviews with plastic end-markets.
Source: Container Recycling Institute, 2008

Economic uncertainty and single-stream

The research for CRI's single-stream report began in the summer of 2008, at the height of nearly a decade of unprecedented economic growth. Crude oil was up over $100 per barrel and demand for secondary feedstock was higher than ever, both domestically and internationally. Strong global demand meant that MRF operators were able to sell to China and other Asian countries. These markets were not concerned with the quality of the materials because cheap labor in these developing countries allowed them to further clean the material. Even in North America, paper mills became significantly less discriminatory about quality because they needed to secure secondary feedstock and were competing with China.

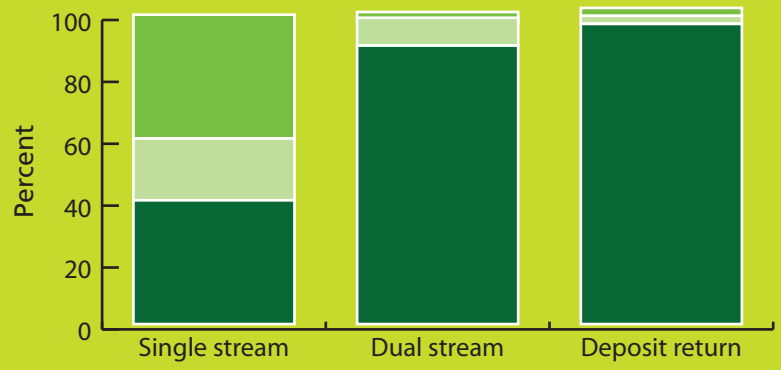
But, by the end of summer 2008, everything changed. I can still remember interviewing a single-stream MRF operator in late October 2008, who explained to me that he could not move most of his fiber material, and that prices for all commodities were dramatically lower than in the previous years. He was looking for warehouse space to store the material until market conditions improved.

The economic collapse of 2008 created an entirely new marketplace, one that has, in effect, tested the single-stream system. The new marketplace enabled processors to discriminate among suppliers, allowing them to choose high-quality feedstock over suppliers whose quality had never achieved the processors' standards in the first place; many of those being single-stream MRFs. Shortly after the economic collapse, Roy Hathaway, head of waste regulation and business waste for the U.K.'s Department for Environment, Food and Rural Affairs, explained that the quality of material would play an increasingly pivotal role in trade, with the market set to face short-term financial constraints. "It is going to be the low-quality end of the spectrum," said Hathaway, "which is going to be squeezed out by an economic downturn."

From an environmental perspective, the key to successful recycling is to keep the material circulating for as many product lives as possible. This is the closed loop

that reduces the need for virgin materials, thus avoiding the energy consumption and greenhouse gas emissions associated with primary materials extraction, transportation and processing. Recycling glass bottles back into bottles, over and over again, is by far the best use of secondary glass, just as it is for aluminum cans. Recycling reduces the need for extraction of raw material, and recycling consumes less energy compared to manufacturing from raw materials. The upstream environmental benefit of recycling materials is 10- to 20-times greater than downcycled.

Table 3 | End-markets for collected glass



Recycled (end-market: Containers and fiberglass)
Glass fines (end-market: Sandblasting, landfill daily cover and road base)
Trash (landfill)

Source: Strategic Materials, Inc., 2009

Similar findings

From an international perspective, CRI's findings seem consistent with other assessments. Last summer, U.K.-based Waste & Resources Action Programme (WRAP) published *Kerbside Recycling: Indicative Costs and Performance*, a report favoring curbside sort on cost, quality and environmental performance. The report disputes the claim that capture rates are higher for commingled even when the contamination is accounted for.

Andy Bond, a U.K.-based MRF operator of both single-stream and curbside sort systems for the past two decades, says, "WRAP confirmed what we have known for several years, namely that there is no evidence to support this [increased recovery], except where the frequency and volume of containment provided restricted material captures in curbside sort schemes relative to commingled. Where equivalent containment is provided, capture rates are comparable."

Today, about one-third of current U.K. curbside programs are single-stream, and many exclude glass. "There is unlikley to be further growth. In fact, we are now seeing a reversal," reports Bond. "Even some of the keenest advocates and larger MRF operators are generally moving to two-stream, and a number of local authorities are switching back to curbside sort."

In Canada, Daniel Lantz, director of environmental and engineering services for Toronto-based Metro Waste Paper Recovery, analyzed recovery rates for three single-stream and four dual-stream programs operating in Ontario. According to findings reported by Lantz in his December 2008 *Resource Recycling* article, entitled "Mixed Results," the weighted averages of recovery increases from 2003 to 2007 were virtually the same for both systems, 6.9 percent and seven percent. Lantz highlighted the fact that increased participation rates may not be solely the result of the collection method; they may also be impacted by other factors that usually come with the introduction of any new recycling program, such as increased promotional efforts, distribution f larger recycling containers to residents, bag limits or user-pay programs for garbage.

The study also found that a drop in collection costs translates to a commensurate rise in processing costs. Lantz concluded that the supposed benefits of single-stream systems over dual-stream do not outweigh their costs. Lantz writes, "In summary, increased processing costs and lost revenues, in total, far exceed collection savings in most instances (and zero under alternating-week collection), overall single-stream recycling does not show the cost advantage that was originally anticipated. As well, the expected increases in capture rate are also not apparent. Overall, dual-stream recycling still appears to be more advantageous."

A chain is only as strong as its weakest link

Susan Kinsella, executive director of Conservatree, and Richard Gertman, consultant/owner of Environmental Planning Consultants, have undertaken a significant amount of work to study single-stream systems, coming up with a series of best practices provided in *Single Stream Recycling Best Practices Implementation Guide, 2007*. When CRI released its report, Gertman contacted CM Consulting, stating, "I believe it possible to do single-stream right – no one is currently doing this, but it could be done. The key is to separate the breakables (glass and ceramics) from the fiber before they are broken at the MRF, instead of intentionally breaking the glass, then trying to sort it all back apart (as is the current practice)." Gertman also added, "The problem is that breakables are crushed at the MRF when the recyclables are both pushed into big storage piles and loaded into the processing system. But, if they are separated first on rubber conveyor belts, then the current processing equipment will produce much cleaner commodities for market."

Applying best practices in any single-stream recycling system is essential for sustainable recycling. Each and every component of recycling, from relationships, communication, education, collection system design, processing system design, contract terms and low-risk sustainable marketing, must be considered equally. If any one component is not properly implemented, the entire system can be compromised.

Moving forward

As we move forward with recycling, the issue of quality is perhaps more important than ever. "With our understanding of the impacts of global warming, we need to refocus on the resource value of recyclables,"

said Gertman. "That means maintaining the quality of the collected materials for use in high-quality products."

Manufacturers of new glass, metal, plastic and fiber products continue to encourage clean collection so that they can use secondary feedstock instead of virgin material for manufacturing. While manufacturers will continue to invest capital into their systems to increase recycled inputs, these investments will remain contingent upon a regular supply of clean material. RR

The report, *Understanding Economic and Environmental Impacts of Single-Stream Collection Systems*, is available at CRI's Web site, www.container-recycling.org.

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