2015 Processing Fee and Handling Fee Cost Surveys

Processing Fee Final Report

CalRecycle

California Department of Resources Recycling and Recovery

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Crowe Horwath LLP

2015 Processing Fee and Handling Fee Cost Surveys

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Table of Contents

Acknowledgments ..... **iii**
Executive Summary **1**
A. Processing Fee Cost Survey Background 1
B. Processing Fee Cost Survey Objectives 2
C. Processing Fee Cost Survey Results 3
D. Processing Fee Cost Survey Tasks 8
E. Processing Fee Cost Analyses 9
F. Processing Payments and Processing Fees 11
1. Processing Fee Cost Survey Methodologies **12**
A. Survey Design 12
B. Survey Scheduling, Logistics, and Confidentiality 16
C. Training Manual Updates 17
D. Surveyor Training 18
E. Cost Model Updates 19
F. Calibration of the Indirect Cost Allocation Sub-Models 19
G. Site and Survey Tracking 20
H. Cost Survey Procedures 21
I. Quality Control and Confidentiality Procedures 22
2. Processing Fee Cost Calculations and Results **23**
A. Cost Calculations 23
B. Cost Results 26
3. Processing Fee Cost Analyses **32**
A. Historical Trends in Cost per Ton Results 32
B. Comparison of 2002-2014 (Every Two Years) Cost per Ton Results for Aluminum, Glass, PET #1, and HDPE #2 34
C. Cost per Ton Results for Six Minority Material Types (2014) 39
D. Changes in Number of Recyclers and Recycled Tons 39
E. Changes in Recycling Center Population Dynamics 45
F. Comparison of Population Size, Recycling Tons, Costs, and Payments by Strata 50
G. Cost Survey Methodology Validation 56
H. Summary of Processing Fee Cost Analyses 60

4. Processing Payments and Processing Fees 61

A. Processing Payment and Processing Fee Calculations 61

B. Scrap Values 63

C. Comparison of 2004, 2006, 2008, 2010, 2012, 2014, and 2016 Processing Payments and Processing Fees 64

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Executive Summary

The processing fee and handling fee cost surveys were performed under contract by Crowe Horwath LLP (Crowe) for the California Department of Resources Recycling and Recovery (CalRecycle). This report provides estimates of the cost per ton to recycle aluminum, bimetal, glass, and plastic (for seven different resin types) beverage containers. This report also summarizes tasks that Crowe and its subcontractors conducted to obtain the final statewide weighted-average processing fee recycler costs per ton. Finally, this report provides analyses of the results of this processing fee cost survey and recommendations for future cost surveys.

This executive summary is organized as follows:

A. Processing Fee Cost Survey Background
B. Processing Fee Cost Survey Objectives
C. Processing Fee Cost Survey Results
D. Processing Fee Cost Survey Tasks
E. Processing Fee Cost Analyses
F. Processing Payments and Processing Fees

A. Processing Fee Cost Survey Background

In 1986, the California State Legislature enacted the California Beverage Container Recycling and Litter Reduction Act (AB 2020). This “bottle bill” program is the only one of its kind in the nation in terms of this unique program structure.

A major subprogram within AB 2020 is processing fees on beverage manufacturers, which are paid to recyclers as processing payments to help cover costs of recycling. Processing fees are arguably one of the more complex aspects of AB 2020.

Most recyclers in the AB 2020 program are required to redeem all beverage container material types. Scrap values of glass, plastics, and bimetal are not sufficient to cover their cost of recycling. These non-aluminum beverage container recycling costs are subsidized by paying recyclers a processing payment. The cost to recycle beverage containers is determined by a processing fee cost survey.

Public Resource Code section 14575 directs CalRecycle to calculate processing payments and fees. Processing payments are defined as the difference between the statewide, weighted-average cost of recycling a beverage container material in the AB 2020 program, including a reasonable financial return, and the scrap value for the material. The processing fee is imposed on beverage manufacturers, and along with supplemental funds from unredeemed containers, these two sources of funds are used to provide processing payments to recyclers.

If an AB 2020 material scrap value is high enough to cover recycling costs, including a reasonable financial return, no processing fee is imposed. If a material scrap value is less

than the statewide, weighted-average recycling costs, including a reasonable financial return, then a processing fee is supposed to make up this difference, or net cost.

Between 1992 and 2001, processing fees and processing payments were based on legislatively set costs of recycling, as compared to actual measured costs for recycling centers (excluding those receiving handling fees) of receiving, handling, storing, transporting, and maintaining equipment for each container sold using a statistically significant sample of certified recycling centers. SB 332 (Statutes of 1999) required the Department of Conservation (DOC) to conduct cost surveys every third year (starting in 2000 for the 2001 processing fees).

The DOC conducted a processing fee cost survey in 2000, using 1999 calendar year costs, for the January 1, 2001, processing fees. This was the first of the “every third year” processing fee cost surveys under SB 332. The second “every third year” processing fee cost survey under SB 332 was conducted in 2003, using 2002 calendar year recycling costs, and was used to determine January 1, 2004, processing fees.

Assembly Bill 28 (Statutes of 2003) became effective January 1, 2004. AB 28 moved the measurement of actual recycling costs for processing payments and fees from every three years to every two years. AB 28 required the DOC to determine the actual costs for certified recycling centers on and after January 1, 2004, every second year. This current cost survey is the sixth of the “every second year” surveys to determine the costs of recycling. The next cost survey after this report will have recycling center costs surveyed in 2017 (using 2016 financial statements) for a processing fee effective January 1, 2018.

Assembly Bill 3056 (Statutes of 2006) added a new cost survey: the handling fee cost survey. The handling fee cost survey is to be implemented in conjunction with the processing fee cost survey, to determine statewide, weighted-average costs per container to recycle for recycling centers that do not receive handling fees (processing fee recyclers), and recycling centers that do receive handling fees (handling fee recyclers). Results of the handling fee cost survey are discussed in a separate series of reports.

Similar to 2012, the 2014 processing fee cost survey included 151 sites which is the highest number of any previous processing fee cost. The Crowe team completed 151 recycler cost surveys during a compressed 14 weeks of field work (July 20, 2014, to October 26, 2015) to obtain these cost survey results.

B. Processing Fee Cost Survey Objectives

This cost survey was used to estimate statewide, weighted-average costs to recycle aluminum, glass, PET #2 and HDPE #2 beverage containers, as well as calculate estimated costs to recycle bimetal and plastics #3 to #7 beverage containers. Recycler center costs were surveyed in 2015, using recycler center calendar year 2014 financial statements. Recycler center costs measured by this survey were used for the processing fee calculation, effective January 1, 2016.

Exhibit ES-1
Plastic Resin Types

Plastic Resin	Abbreviation	Plastic Resin	Abbreviation
Polyethylene terephthalate	PET #1	Polypropylene	PP #5
High-density polyethylene	HDPE #2	Polystyrene	PS #6
Polyvinyl chloride (vinyl)	PVC #3	Other plastic resins/blended resins	Other #7
Low-density polyethylene	LDPE #4		

The recycler costs per ton presented in this report reflect four months (mid-July to mid-November 2015) of research, development, and implementation effort on a cost survey of California certified recycling centers. The actual cost survey field work was performed over a compressed 14 weeks of field work between July 20, 2014, and October 26, 2015.

Historically, processing fees have been imposed on bimetal, glass, and PET (#1 resin type) plastic materials. When additional plastic resin types were incorporated into the AB 2020 program in 2000, a processing fee was established for six additional (#2 through #7) plastic resin types, based on the costs of recycling PET #1 plastics. In 2003, actual costs of recycling plastics #2 through #7 were determined for the first time, with the results used to determine the January 1, 2004, processing fees and processing payments. **Exhibit ES-1** describes plastic beverage container resin types.

Senate Bill 1357 (Padilla, Statutes of 2008) eliminated the requirement to calculate material-specific costs per ton for recycling of materials that comprise less than 5 percent of all CRV containers recycled. Thus, for the third time, costs per ton for plastics #3 to #7 and bimetal were based on the percent change in HDPE #2 cost per ton between the prior processing fee cost survey (in this case, 2012) and the current cost survey (in this case, 2014).

This processing fee cost survey consisted of one stratified random sample, eliminating the need for (1) simple random samples of bimetal and plastic #7, and (2) census' of plastics #3 to #6. This processing fee cost survey was consistent with prior cost surveys in terms of quantitative information obtained for each recycling site. Finally, this cost survey error factor was generally equal in achieving the already high level of accuracy obtained in previous processing fee cost surveys.

C. Processing Fee Cost Survey Results

The statewide recycler costs per ton for the 10 material types in the beverage container recycling program are presented in **Exhibit ES-2**. Exhibit ES-2 compares 2014 costs per ton to 2012, 2010, 2008, 2006, 2004, and 2002 costs per ton, the six most recent years in which CalRecycle and the (former) Department of Conservation measured recycler costs. **Exhibit ES-3** provides the two-year percent change in cost per ton between cost surveys.

Exhibit ES-2
Summary Comparison of Cost Survey Results for Processing Fee Recyclers
(2002-2014, every 2 years)

Material Type	Statewide Cost per Ton[a]						
	2002	2004	2006	2008	2010	2012	2014
1. Aluminum	$418.95	$465.90	$516.13	$559.23	$537.06	$609.81	$537.29
2. Glass	79.81	82.45	94.98	81.60	89.76	92.88	97.50
3. PET #1	479.63	493.31	477.73	426.76	440.61	462.79	428.55
4. HDPE #2	645.91	671.73	500.64	501.67	611.62	612.50	524.23
5. Bimetal	508.18	607.03	883.55	632.22	770.80	771.88	660.65
6. PVC #3	1,064.52	1,583.72	731.37	789.16	962.14	963.49	824.65
7. LDPE #4	3,324.89	1,889.50	1,858.09	1,125.80	1,372.58	1,374.50	1,176.43
8. PP #5	1,478.77	809.42	787.83	1,009.99	1,231.38	1,233.10	1,055.41
9. PS #6	6,137.30	3,051.82	623.11	625.60	762.73	763.80	653.74
10. Other #7	759.32	1,264.47	741.93	685.44	835.69	836.86	716.27

[a] Without reasonable financial return (RFR).

Exhibit ES-3
Percent Change in Statewide Recycler Cost per Ton, by Material Type
(2014-2002, every 2 years)

Material Type	Two-Year Percentage Change (2012 to 2014)	Two-Year Percentage Change (2010 to 2012)	Two-Year Percentage Change (2008 to 2010)	Two-Year Percentage Change (2006 to 2008)	Two-Year Percentage Change (2004 to 2006)	Two-Year Percentage Change (2002 to 2004)
1. Aluminum	**-12%**	+14%	-4%	+8%	+11%	+11%
2. Glass	**+5%**	+3%	+10%	-14%	+15%	+3%
3. PET #1	**-7%**	+5%	+3%	-11%	-3%	+3%
4. HDPE #2	**-14%[a]**	0%[a]	+22%[a]	0%	-25%	+4%
5. Bimetal	**-14%**	0%	+22%	-28%	+46%	+19%
6. PVC #3	**-14%**	0%	+22%	+8%	-54%	+49%
7. LDPE #4	**-14%**	0%	+22%	-39%	-2%	-43%
8. PP #5	**-14%**	0%	+22%	+28%	-3%	-45%
9. PS #6	**-14%**	0%	+22%	0%	-80%	-50%
10. Other #7	**-14%**	0%	+22%	-8%	-41%	+67%

[a] The -14% change from 2012 to 2014, the 0% change from 2010 to 2012, and the 22% from 2008 to 2010 are rounded. Between 2012 and 2014, the actual HDPE percent change, which was used to calculate bimetal, and plastics #3 to #7, cost per ton was -14.44%. Between 2010 and 2012 the actual percent change was 0.14%. Between 2008 and 2010, the actual HDPE percent change for the same calculation was 21.92%.

Compared to 2012 costs per ton, the 2014 costs per ton for aluminum decreased 12 percent, glass increased 5 percent, and PET #1 decreased 7 percent. The 2014 recycling volumes for aluminum decreased 6 percent, glass decreased 16 percent, and PET #1 decreased 2 percent compared to 2012.

The decrease in aluminum cost per ton was the largest percent decrease in the cost per ton of aluminum in the past six cost surveys. The 2014 aluminum cost is 23 cents higher than the 2010 cost per ton. Among the four surveyed materials, aluminum had the second-smallest percentage decrease in tons recycled, with a 6 percent decrease in tons recycled between 2012 and 2014. The percent share of aluminum tons recycled increased modestly by 1.2 percent. In 2014, aluminum made up 17.3 percent of the tons of CRV material recycled by processing fee recyclers.

The glass cost per ton to recycle increased 5 percent from 2012 to 2014 after a 10 percent increase from 2008 to 2010. Glass volumes decreased 16 percent between 2012 and 2014, the first major decrease in the past six cost surveys, marking a deviation of the general increase in glass volumes since 2002. The cost per ton for glass, now at $97.50, is the highest it has been since 1987. Overall, glass costs per ton continue to be relatively stable, ranging from $80 to $100 per ton. In 2014 glass was its lowest historical percent share of CRV material recycled. In 2014, glass made up 58.7 percent of tons of CRV material recycled, compared to a high of 67.8 percent in 2002.

The 7 percent decrease in the cost per ton to recycle PET #1 results in the second-lowest PET #1 cost per ton since 2002. For PET #1, the cost per ton has generally fluctuated from year to year within a relatively narrow band ($425 to $495 per ton). The 7 percent decrease in PET #1 cost per ton is the second-largest decrease since 2002. However, the cost per ton to recycle PET #1, at $428.55, is still in the range of its historical costs.

The historical trend of increasing PET #1 recycling volumes overall, and as compared to aluminum and glass, continued in 2014. The 2 percent decrease in tons of PET #1 recycled between 2012 and 2014 was the lowest decrease of any of the four major materials. The share of tons of CRV material recycled continued to shift from aluminum and glass to PET #1. The PET #1 percentage of all tons of CRV material recycled increased to an all-time high of 22.7 percent. Since the 2002 cost survey, the share of PET #1 containers recycled has more than doubled, from its initial value of 9.9 percent.

Costs per ton for HDPE #2 decreased 14 percent, while HDPE #2 volumes decreased 58 percent to the lowest levels since 2002. The large decrease in HDPE #2 volume was primarily due to the elimination of the commingled rate option. The 2014 HDPE #2 cost per ton of $524.23 is the third-lowest since 2002 and well within its historic range.

This is the third processing fee cost survey in which the cost per ton for bimetal and plastics #3 to #7 was indexed to the percentage change in HDPE #2 cost per ton. Senate Bill (SB) 1357 (Padilla, Chapter 697, Statutes of 2008) provides that CalRecycle shall adjust the costs of recycling for material types that make up less than 5 percent of the total number of containers recycled by the percentage change in the most recently

measured cost of recycling HDPE #2 beverage containers (even if HDPE #2 makes up less than 5 percent of total containers recycled).

In calendar year 2014, HDPE #2 made up only 1.2 percent of all beverage container tons recycled. Bimetal and plastics #3 through #7 combined made up 0.10 percent of tons recycled. Thus, while HDPE #2 recycling is minimal as compared to aluminum, glass, and PET #1, it is still substantial as compared to the other six minority material types. The cost per ton to recycle bimetal and plastics #3 to #7 was based on the calculated 14 percent decrease (-14.41 percent) in HDPE #2 costs per ton between 2012 and 2014. Thus, for the 2014 cost per ton for each of these six minority materials (bimetal, PVC #3, LDPE #4, PP #5, PS #6, and Other #7), cost per ton increased by calculating 0.8559 times the respective minority material cost per ton calculated in 2012.

Exhibit ES-4, on the next page, provides the 2014 sample error rates for each material type, when relevant. In 2014, the only materials for which error rates were applicable were aluminum, glass, PET #1, and HDPE #2. In all four cases, the error rates were well below the 10 percent error rate at the 90 percent confidence level threshold.

Regulations require that the cost per ton be estimated at an 85 percent confidence interval (CI), and CalRecycle policy further specifies a 10 percent error rate. For the seventh consecutive survey, the 2014 sampling plan was based on a more accurate 90 percent confidence interval, and a 10 percent error rate.

The error rates in 2014 were among the lowest error rates for each of the four materials over the last six cost surveys. The error rate in 2014 for aluminum was 5.86 percent, the fourth-lowest since 2002. The error rate in 2014 for glass was the third-lowest measured for all seven surveys. PET #1 had the second-lowest error rate since 2002, and HPDE #2 had the lowest error rate ever measured for the material. Because costs per ton for bimetal and plastics #3 to #6 were based on the percent change in HDPE #2 cost per ton, there were no calculated error rates for these six materials.

Exhibit ES-5 provides the 2014 sample size and sample method for each of the relevant material types. The costs per ton for the four major materials, aluminum, glass, PET #1, and HDPE #2, were calculated from a stratified random sample. The costs per ton for bimetal and plastics #3 to #7, which are recycled by a much smaller percentage of recyclers overall, were calculated based on the percent change in the cost per ton to recycle HDPE #2 between 2012 and 2014. This approach, now used for the 2010, 2012 and 2014 cost surveys, was the result of SB 1357, eliminating the need to conduct a large number of additional recycling center surveys for the small amount of these materials recycled.

Exhibit ES-4
Sample Error Rates for Processing Fee Recyclers, by Material Type
(2002-2014, every 2 years)

Material Type	2014 Error Rate (90% CI)	2012 Error Rate (90% CI)	2010 Error Rate (90% CI)	2008 Error Rate (90% CI)	2006 Error Rate (90% CI)	2004 Error Rate (90% CI)	2002 Error Rate (90% CI)
1. Aluminum 4	**5.86%**	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass 3	**6.49%**	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1 2	**6.23%**	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2 1	**6.86%**	7.63%	7.33%	8.27%	8.97%	7.47%	9.78%
5. Bimetal	N/A	N/A	N/A	6.89%	8.31%	9.83%	7.57%
6. PVC #3	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
7. LDPE #4	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
8. PP #5	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
9. PS #6	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
10. Other #7	N/A	N/A	N/A	9.53%	9.95%	100% Sample	100% Sample

Exhibit ES-5
Sample Sizes and Sample Method by Material Type
(2014)

Material Type	2014 Sample Size	2014 Sample Method
1. Aluminum	**151**	Stratified Random Sample
2. Glass	**151**	
3. PET #1	**151**	
4. HDPE #2	**146**	
5. Bimetal	N/A	None Required
6. PVC #3	N/A	None Required
7. LDPE #4	N/A	None Required
8. PP #5	N/A	None Required
9. PS #6	N/A	None Required
10. Other #7	N/A	None Required

D. Processing Fee Cost Survey Tasks

These are the major tasks the Crowe team conducted for the processing fee cost survey.

- **Developed and documented the sample design framework, and randomly selected recycling centers for the cost survey.** Crowe determined the number of recycling centers to be selected for the stratified random sample used to measure costs of aluminum, glass, PET #1, and HDPE #2 recycling. Following the sample design, Crowe randomly identified certified recycling centers selected to participate in the cost survey.
- **Updated and calibrated the labor allocation cost survey model**. Crowe used a 14-worksheet, Excel-based computer model to allocate recycling center costs to beverage container material types based on labor allocations. Crowe updated the cost survey model to reflect 2014 container per pound and CRV payment information, as well as procedural changes to the cost survey.
- **Updated the cost survey training manual**. Crowe evaluated the 700-page training manual used in prior years and removed outdated and duplicative information. Seventeen training modules were identified for revision, and new learning objectives and interactive exercises were developed for each. The new training manual focuses on key areas necessary to successfully conduct cost surveys. In addition, Crowe developed 17 Prezi presentations covering topics in the training manual and including videos of a cost survey site visit. Crowe created numerous new work assignments and interactive exercises as part of its training update. The updated training modules reflected the change to the file assembly and review process from a manual, paper-based process to a secure, online, SharePoint-based process.
- Conducted a 32-hour training session for new members of the cost survey team, and a 16-hour refresher training session for five highly experienced returning members of the cost survey team. This training, conducted in Crowe's Sacramento training facilities, included lectures, group work, reading materials, role-playing, study exercises, and problem solving.
- **Scheduled, conducted, and completed 151 recycling center on-site visits.** During the compressed 14 weeks between July 20, 2014 and October 26, 2015, we conducted on-site visits, which were selected using the statistical sample frame developed by Crowe. Throughout the scheduling and site visits, the Crowe team built upon the field working relationships established in 2013 with the program's recyclers. These on-site working relationships were important to the success of this cost survey, and should carry over into future cost surveys. All of the cost surveys were conducted by a team of one or two auditors, including accountants and/or recycling experts. It typically took between two to four hours to complete the on-site survey. In addition to the on-site time, usually more than eight hours of additional time was required after each site visit to analyze data,

and to follow-up with each recycler to obtain complete financial and labor information.

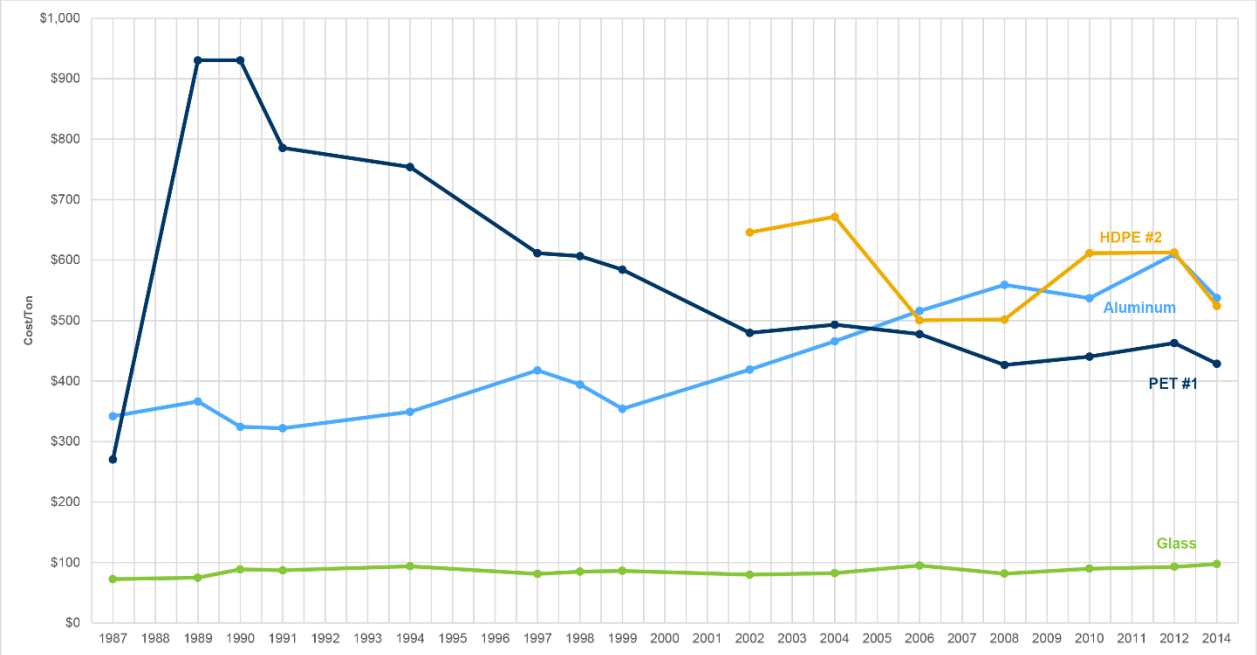
- **Conducted intensive quality control procedures.** Our quality control procedures included 13 hours and five different levels of review (site team review, independent first review, manager review, CPA partner review, and project director review), for each site file. This review took place before the site files were released for data processing and data analysis. These quality assurance steps ensured that each site file was complete and accurate and that all results from the labor allocation model and the indirect cost allocation sub-models were accurate. In total, more than 30 hours generally were spent for each completed recycler site, including the site team and quality control hours.
- **Analyzed the primary database and determined final costs per ton by material type**. Using an automated process, Crowe extracted results from each of the 151 completed labor hour allocation cost models. Crowe utilized an Excel workbook to calculate total costs by material type, total tons by material type, and costs per ton, for each of the four beverage container material types. Crowe also calculated the percent change in HDPE #2 cost per ton between 2012 and 2014, which was used to calculate the 2014 cost per ton for bimetal and plastics #3 to #7. Calculations used one of two different methods, depending on the material and sample characteristics: (1) weighted-average by strata (aluminum, glass, PET #1, and HDPE #2), or (2) indexing the 2014 cost per ton on the percent change in HDPE #2 cost per ton between 2012 and 2014 (bimetal and plastics #3 to #7). Using defined and documented statistical procedures, Crowe calculated error rates at a 90 percent confidence interval for the four relevant material types.

E. Processing Fee Cost Analyses

Crowe conducted a number of analyses of the cost per ton results for the survey. These analyses included an examination of historical cost survey results; analysis of changes in recycler population and tonnage; analysis of recycler strata population, tonnage, and cost per ton; analysis of proportional tons and costs by material; and confirmation of our cost survey methodology. These analyses are summarized below:

- Examined historical processing fee cost survey results. This cost survey represented the fifteenth time that the State determined the cost of recycling since inception of the Beverage Container Recycling Program in 1987. The historical costs per ton for aluminum, glass, and PET #1 are illustrated in **Exhibit ES-6**. This exhibit illustrates the decrease in aluminum and PET #1 and the increase in the glass cost per ton in 2014.

Exhibit ES-6
Historical Processing Fee Recycler Cost per Ton (without RFR)
(1987 through 2014)



- Evaluated changes in recycling center productivity between 2012 and 2014. Between 2012 and 2014, the number of recycling centers (RCs) decreased while for many materials the total tons of material recycled also decreased at varying levels. The analysis of the sample shows that the changes in volume outpaced changes in cost, especially for aluminum and PET #1.
- Analyzed recycler strata population, tonnage, and cost per ton. The year 2014 saw major changes in the composition of strata populations for many materials, especially for glass. The percentage of strata recyclers and tons recycled increased for strata 2 and 3 and decreased for strata 1. This shift to less efficient recyclers was a major contributor to the increase in statewide cost per ton for glass. Another aspect of the cost survey analyses that has implications for recycler profitability is a comparison of cost per ton results by strata. Consistent with prior surveys, for all four major material types, stratum 2 and 3 recycling costs were above the statewide, weighted-average cost. When the recycler cost per ton to recycle is above the statewide weighted average, the implication is that for those materials with a processing payment, recycling costs are not fully covered by the combined processing payment and scrap value. Conversely, large stratum 1 recyclers tend to have lower costs to recycle than the statewide weighted-average, and thus receive more processing payments than are needed to cover their costs.

- Confirmed cost survey methodology. The cost per ton results from this 2014 processing fee cost survey are lower than the 2012 cost per ton results for aluminum and PET #1 and higher for glass. We conducted several additional analyses to test the validity of the survey results. We concluded that our methodology was consistent with prior years. We are confident that the cost per ton results consistently reflect recycler operations and costs.
- Analyzed proportional tons and costs by material. 2014 saw changes in the full population's number of recyclers and tons, which decreased. A comparison of the reduced populations illustrates the shifts in proportions for tons and costs for each material.

F. Processing Payments and Processing Fees

The processing payment is defined as the difference between the statewide, weighted-average cost of recycling (as determined by this survey), multiplied by a reasonable financial return and a cost of living adjustment (COLA), and the average scrap value paid to recyclers. The processing payment is paid by CalRecycle to processors, who then pass the payment on to recyclers, based on the weight of material redeemed.

The processing fee, earlier in the history of the beverage recycling program, was equal to the processing payment, and was paid to the State by beverage manufacturers on every container sold. Over time, the processing fee has been modified. Currently, when funds are available in the Beverage Container Recycling Fund, the amount of the processing fee paid by beverage manufacturers is reduced, based on the recycling rate of the material. The difference between the processing fee paid to the Department, and the processing payment paid to recyclers, is made up with funds from the California Beverage Container Recycling Fund, essentially from CRV paid on unredeemed containers.

Exhibit ES-7, below, illustrates the January 1, 2016, per ton processing payments, and per container processing fees.

Exhibit ES-7
Processing Payments and Processing Fees
January 1, 2016

Material	Processing Payment (per Ton)	Processing Fee (per Container)	Material	Processing Payment (per Ton)	Processing Fee (per Container)
1. Aluminum	None	None	6. LDPE #4	1,179.64	0.00924
2. Glass	$101.07	$0.00232	7. PP #5	1,064.38	0.05765
3. PET #1	165.96	0.00024	8. PS #6	562.76	0.00166
4. HDPE #2	183.01	0.00140	9. Other #7	706.23	0.07173
5. PVC #3	845.24	0.00755	10. Bimetal	624.03	0.03027

1. Processing Fee Cost Survey Methodologies

This section describes the cost survey methodologies. There are nine key tasks described in this section:

A. Survey Design
B. Survey Scheduling, Logistics, and Confidentiality
C. Training Manual Updates
D. Surveyor Training
E. Cost Model Updates
F. Calibration of the Indirect Cost Allocation Sub-Models
G. Site and Survey Tracking
H. Cost Survey Procedures
I. Quality Control and Confidentiality Procedures

A. Survey Design

Crowe Horwath LLP (Crowe) personnel, for the seventh time, developed the survey design for the cost survey. Crowe generally utilized the survey design methodology that we developed for the previous cost survey.

Crowe followed processing fee and handling fee cost survey procedures consistent with the six prior cost surveys. While Crowe introduced several new features for this 2015 cost survey, including electronic file review and a revised training approach, the fundamentals of conducting the cost survey remain consistent. This consistency is reflected in the 2014 cost per ton results. Costs per ton for aluminum, glass, PET #1, and HDPE #2 in 2014 are historically consistent and show low error rates (5 percent to under 7 percent).

This processing fee cost survey was used to estimate California statewide, weighted-average, 2014 certified recycler costs per ton, for four (4) beverage container material types, and the percent change in HDPE #2 cost per ton between 2012 and 2014. Recycler center costs were surveyed and analyzed in 2015 (mid-July through mid-November), using recycler center calendar year 2014 financial statements. Recycler center costs measured by this survey will be used for the processing fee calculation, effective January 1, 2016.

The population of PF to PF recycling centers eligible for the cost survey was defined as all recycling centers: (1) not receiving handling fees between January 2014 and December 2014, (2) certified and operational on or before March 1, 2014, (3) reported redemption volume between January 2014 and December 2014, and (4) not subsidized by the Department of Rehabilitation. There were 997 recycling centers in this total traditional recycling center population.

This overall 2014 processing fee cost survey had the same sample size as the previous processing fee cost survey (151 unique sites). The Crowe team completed 151 recycler cost surveys during a compressed 14 weeks of field work (July 20, 2015, to October 26, 2015) to obtain these cost survey results.

This processing fee cost survey consisted of one stratified random sample. This processing fee cost survey was consistent with prior cost surveys in terms of quantitative information obtained for each recycling site.

For the current 2014 cost survey, Crowe removed RCs subject to investigation by CalRecycle for significant infractions from the population and the survey sample. For the 2012 survey, we removed 269 RCs being investigated for significant or probationary reasons from the full population, creating a “reduced” population of RCs not being investigated. In 2012, we used the reduced population of RCs not being investigated to determine the required sample size, to select the sample of RCs to be surveyed, and to determine statewide, weighted-average cost per ton results.

Following the 2012 cost survey, Crowe recommended removing only the RCs being investigated for major violations from the population and the sample. We reasoned that removing only major investigated RCs from the full population would eliminate potential site visits to RCs that might be in an adversarial relationship to CalRecycle, or which might be recycling large volumes of illegitimate containers. Keeping the probation-investigated RCs in the population would likely not result in sending survey teams to RCs that might be in an adversarial relationship with CalRecycle.

For the current processing fee cost survey, we removed the 42 processing fee RCs that were under major investigation from the full population of all RCs prior to selecting the sample. Those 42 RCs account for approximately 4 percent of the full population of RCs and approximately 9 percent of material recycled, indicating that these recyclers were generally handling larger volumes than those not under investigation. The resulting processing fee recycler population consisted of 955 RCs.

All 151 recyclers were treated equally in terms of scheduling, site visits, and quality control. This survey was the third consecutive survey in recent years for which the State has not determined costs per ton for all 10 beverage container material types. Senate Bill 1357 (SB 1357, Statutes of 2008) states that the Department shall adjust the costs of recycling for material types that make up less than 5 percent of the total number of containers recycled by the percentage change in the most recently measured cost of recycling HDPE #2 beverage containers (even if HDPE #2 makes up less than 5 percent of total containers recycled). In calendar year 2014, HDPE #2 made up only 1.1 percent of all beverage containers recycled. Bimetal and plastics #3 through #7 made up between 0.000002 percent and 0.104 percent of containers recycled.

Thus while HDPE #2 recycling is minimal as compared to aluminum, glass, and PET #1, it is still substantial compared to the other six minority material types. This SB 1357 program change significantly reduced the number of samples and recyclers in the processing fee cost survey, compared with the 2008 cost survey. For example, the 2008

processing fee cost survey included the stratified random sample for aluminum, glass, PET #1, and HDPE #2, two simple random samples (for bimetal and plastic #7), and a census of all sites recycling plastics #3 to #6, for a total of 198 recyclers.

To increase precision and confidence in random sample results for all recycling centers while minimizing overall sample size, the traditional recycling center reduced population was divided into three strata based on glass volume, as shown in **Exhibit 1-1,** below. These strata definitions were identical to the strata definitions for the previous processing fee cost survey.

Exhibit 1-1
Stratum Definitions for Processing Fee Recyclers
(2014)

Stratum	Annual Glass Volume
1	Greater than, or equal to, 550 tons
2	Greater than, or equal to, 150 tons, up to 549 tons
3	Less than 150 tons

Sample Design Results

Exhibit 1-2, on the next page, provides a comparison of the error rates for the relevant material types. Regulations require that the cost per ton be estimated at an 85 percent confidence interval (CI), and CalRecycle policy further specifies a maximum 10 percent error rate. For the seventh consecutive survey, the 2014 sampling plan was based on a more accurate 90 percent confidence interval and a 10 percent error rate.

In 2014, the only materials for which error rates were applicable were aluminum, glass, PET #1, and HDPE #2. In all four cases, the error rates were well below the 10 percent maximum error rate at the 90 percent confidence level threshold.

The error rates in 2014 were consistent with the low error rates for each of the four materials over the last six cost surveys. Because costs per ton for bimetal and plastics #3 to #6 were based on the percent change in HDPE #2 cost per ton, there were no calculated error rates for these six materials.

Exhibit 1-3, on the next page, provides the sample size and method for each of the 10 material types. The statewide weighted-average costs per ton for the major materials—aluminum, glass, PET #1, and HDPE #2—were calculated from a stratified random sample.

Exhibit 1-2
Sample Error Rates for Processing Fee Recyclers
(Even Years, 2002-2014)

Material Type	2014 Error Rate (90% CI)	2012 Error Rate (90% CI)	2010 Error Rate (90% CI)	2008 Error Rate (90% CI)	2006 Error Rate (90% CI)	2004 Error Rate (90% CI)	2002 Error Rate (90% CI)
1. Aluminum	**5.86%**	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass	**6.49%**	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1	**6.23%**	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2	**6.86%**	7.63%	7.33%	8.27%	8.97%	7.47%	9.78%
5. Bimetal	N/A	N/A	N/A	6.89%	8.31%	9.83%	7.57%
6. PVC #3	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
7. LDPE #4	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
8. PP #5	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
9. PS #6	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
10. Other #7	N/A	N/A	N/A	9.53%	9.95%	100% Sample	100% Sample

Exhibit 1-3
Sample Sizes and Sample Method by Material Type
(2014)

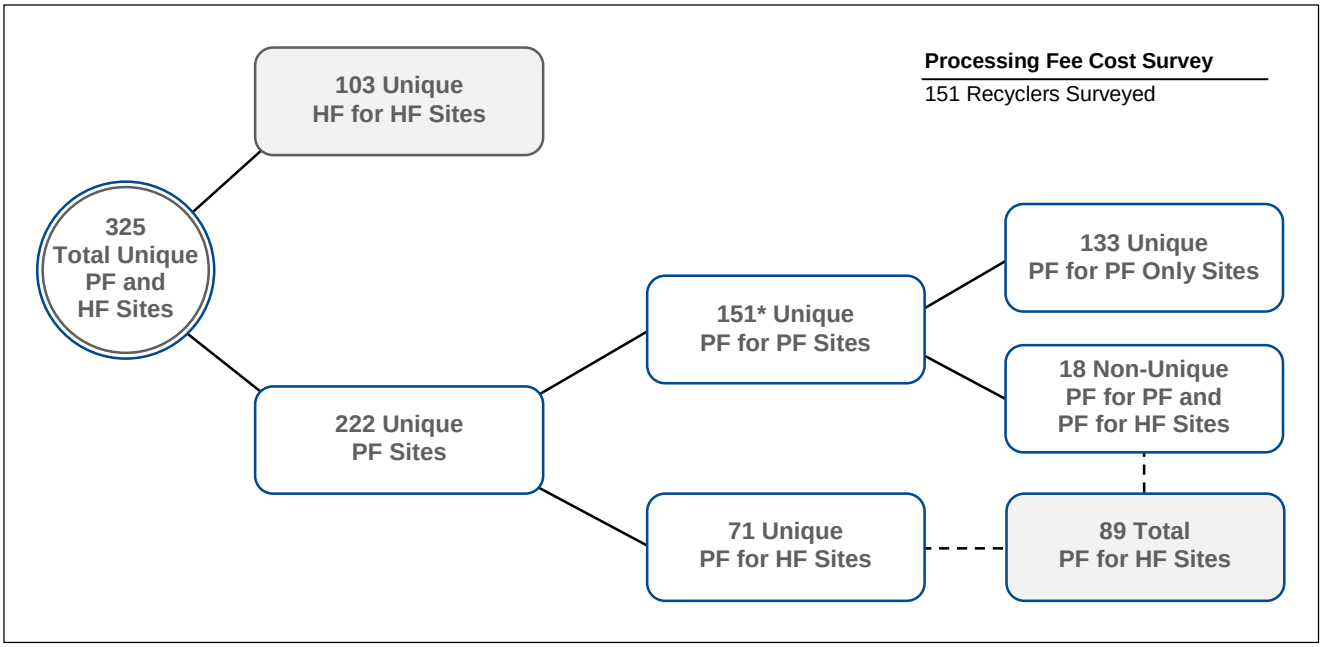
Material Type	2014 Sample Size	2014 Sample Method
1. Aluminum	**151**	Stratified Random Sample
2. Glass	**151**	
3. PET #1	**151**	
4. HDPE #2	**146**	
5. Bimetal	N/A	None required
6. PVC #3	N/A	None required
7. LDPE #4	N/A	None required
8. PP #5	N/A	None required
9. PS #6	N/A	None required
10. Other #7	N/A	None required

Sample Selection

This processing fee cost survey was part of a broader combined processing fee and handling fee cost survey that included 222 processing fee recyclers and 103 handling fee recyclers. The final 222 processing fee recyclers included 151 unique sites for the processing fee cost survey. **Exhibit 1-4,** on the next page, illustrates the total number of

processing fee and handling fee recyclers surveyed, and the number of recyclers in the processing fee cost survey.

Exhibit 1-4
Processing Fee and Handling Fee Cost Survey Sample
(2014)



*18 PF sites within the 151 also were within the handling fee cost survey PF for HF sites, for a total 89 (71+18) PF sites used for the cost per container calculation.

B. Survey Scheduling, Logistics, and Confidentiality

A significant component of the cost survey involved scheduling site visits and communicating with recyclers chosen from the sample frame. Two Crowe staff members were employed during the project start-up and survey months (July through October) to coordinate scheduling and communicate with recyclers.

Because conducting a cost survey fundamentally entails the collection of proprietary financial information, sensitivity to stakeholder relations is highly important. Without willing and active cooperation from the selected recycling center operators, determining the real costs of beverage container recycling would be exceptionally difficult and the results would be hard to support. Our approach was to communicate with site operators and managers from the start of the process to help them understand what the cost survey entailed, what information we were seeking to obtain, and, perhaps most importantly, to correct misunderstandings about the purpose of the cost survey.

The first stage of recycler communication was a letter, on CalRecycle letterhead, informing the recycler that they were selected to participate in the processing fee cost survey. The

letter also identified the expectations of the recycler and introduced Crowe as CalRecycle's cost survey contractor. Introduction letters were sent to all selected recyclers starting in June 2015. In the second stage of communication, a Crowe scheduling coordinator established telephone contact with the recyclers to schedule site visits.

The survey team contacted the recycler directly approximately one week before the site visit for final visit confirmation. Site visits were generally conducted by a team of two surveyors, including accountants and/or recycling experts. Each survey team generally included at least one member with experience on prior cost surveys. Survey teams made their own travel arrangements.

The scheduling coordinators conducted many behind-the-scenes tasks to ensure overall success of the project. For example, to reduce travel expenses, the coordinators utilized specialized mapping software to efficiently schedule consecutive site visits first within regions, and then within nearby locations. Scheduling coordinators also sent additional letters and emails to many recyclers to confirm site visit logistics.

The coordinators also were tasked to optimize site visit efficiency based on the varying schedules of 15 site survey team personnel, diverse geographic locations, and availability of the recycling centers. During any given week, up to three different survey teams were simultaneously in the field. In most cases, one site visit, with some telephone follow-up, was sufficient to obtain all the information needed to complete the survey of each site. A few sites required repeated telephone follow-up.

The coordinators also implemented and maintained a secure Microsoft SharePoint site for the transfer and storage of all cost survey recycling center site files. The site allowed our cost survey team members to securely access files in the field, facilitated the review of recycling centers, and tracked the status of each center. The secure SharePoint site was backed up automatically on a daily basis by Crowe's IT systems.

To ensure confidentiality of recyclers' proprietary information, every Crowe and subcontractor employee that worked on the processing fee cost survey contract signed individual confidentiality agreements to prevent disclosure of any information made available by any certified recycler. Each company contractor—Crowe Horwath LLP (Prime Contractor); Richardson & Company (Subcontractor); Geiss Consulting (Subcontractor); Encina Advisors, LLC (Subcontractor); Boisson Consulting (Subcontractor), Vforce Consulting (Disabled Veteran Business Enterprise Subcontractor) and Leon E. Tuttle, CPA (Disabled Veteran Business Enterprise Subcontractor)—also signed company confidentiality agreements.

C. Training Manual Updates

The first "Processing Fee Cost Survey Training Participant Manual" was prepared by NewPoint Group in 1995 to support the cost survey training provided to (then) Division of Recycling (DOR) staff. This manual contained hundreds of example case studies, problem sets, quizzes, sample financial documents, handouts, reading assignments,

and procedures to develop skills needed to conduct successful processing fee cost surveys. Because the training manual was originally prepared in 1995, it required extensive revisions and adjustments.

For the current cost survey, Crowe evaluated the entire 700-page training manual used in prior years, removing outdated and duplicative information. We identified 17 training modules for revision, developing learning objectives and interactive exercises for each. The new training manual focuses on key areas of learning necessary to successfully conduct cost surveys. In addition, Crowe developed 17 Prezi presentations covering topics in the training manual. The presentations, which are significantly more interactive and engaging than traditional PowerPoint presentations, include videos of a cost survey site visit.

Crowe created numerous new work assignments and interactive exercises as part of its training update. The updated training modules reflected the change to the file assembly and review process from a manual, paper-based process to a secure online, SharePoint-based process.

The updated training manual consisted of two volumes:

- "Participant Manual, Volume 1" (the primary training manual)
- "Field Manual, Volume 2" (a summary version of the site visit procedures)

After completion of the training program, Crowe made further revisions to the training manual volumes to reflect actual classroom experience, discussions, and questions. The training manuals, to be provided to CalRecycle as one of the project hard copy reports, will reflect these updates.

D. Surveyor Training

Successfully completing the processing fee cost survey site visits required knowledge of recycling, recycling practices, the beverage container recycling program, the specific procedures of site visits, auditing, and financial cost-accounting. The Crowe-trained surveyor team consisted primarily of accountants and recycling experts.

Five of the individuals who conducted site visits for this survey had previous experience in the previous processing fee cost surveys (every other year beginning in 2002), had completed the training sessions, and in some cases also completed a 24-hour refresher training in prior years. These surveyors already had extensive experience in auditing and financial accounting procedures, as well as practical site visit and recycling program experience. These returning team members still completed another 16-hour in-house refresher course in 2015. The new survey team members, and some returning survey team members, completed the full in-house 32-hour training program in 2015.

The first phase of classroom training consisted of 32 hours of in-class lectures, group work, reading materials, study exercises, and problem-solving. The classroom training was held at the Crowe offices. Training for new surveyors took place over three days; experienced surveyors attended the third day.

The second component of training consisted of five site visits at a recycling center that had been randomly selected for the cost survey. Each new surveyor was paired with a highly experienced surveyor. Each team went into the field to conduct five "training" site visits. The highly experienced team member conducted the cost survey, with the new surveyor observing and asking questions. The experienced survey team member guided the new team member, who took on increasing levels of responsibility for the on-site and post-site visit procedures over the course of the five visits. This field training provided new team members with valuable on-site experience and provided a refresher for those who had previously conducted site visits. Once each team had completed its five site visits, Crowe held one additional follow-up day of classroom training during which teams presented the results of their visits and shared their experiences.

For the classroom component of the training, Crowe prepared and gave a Prezi presentation for 17 modules in the training manual. A significant segment of both the full and refresher training sessions were spent on hands-on activities and preparing an actual site file from information and videos obtained from a site visit conducted prior to the training class. The training allowed team members to better understand the many variations of financial information, and other complicating issues, they would likely face in the field. The training session included extensive role-playing interviews. The classroom training was led by the Crowe team.

E. Cost Model Updates

The labor allocation cost model (cost model) is a Microsoft Excel workbook consisting of 14 worksheets. The model was first developed to improve the methodology of the 1995 cost surveys. Since that time, it has been updated and revised to accommodate legislative and regulatory changes, as well as upgrades of Excel. In 2000, the survey team and the DOR conducted a significant model revision to add plastic resins #2 to #7 to the model, and to upgrade to Excel 1997, which replaced old Excel macros with Visual Basic programming.

The current version of the cost model represents several legacy generations (and layers) of modifications and updates, including a significant number of improvements that were made immediately following the 2002–2012 cost surveys (conducted every two years). Prior to conducting the current cost survey, Crowe reviewed and updated the cost model to reflect 2014 container per pound and CRV payment information, as well as procedural changes to the cost survey.

F. Calibration of the Indirect Cost Allocation Sub-Models

As a result of the introduction of new containers to the Beverage Container Recycling Program in 2000, the 2002–2008 cost surveys (conducted every two years) included calculating the cost per ton for 10 different material types: six plastic resins, PET #1, glass, aluminum, and bimetal. A key task of the 2002 cost survey project was to develop a costing methodology for plastics #2 to #7 and bimetal. For this 2014 cost survey, we

still applied this same indirect cost allocation sub-model procedure to determine costs per ton for the minority material types that was developed in 2002, and used again in every two years from 2004 to 2012. In addition, we calibrated the Indirect Cost Allocation Sub-Models for Aluminum/Bimetal and All-Plastics with 2014 survey information. These sub-models, now incorporated into the Labor Allocation Cost Survey Model, ensure rational allocation of costs and labor to bimetal and plastic resins HDPE #2, PVC #3, LDPE #4, PP #5, PS #6, and Other #7. While the survey no longer directly measures the cost per ton for bimetal and plastics #3 to #7, the sub-model is still utilized to help determine aluminum, PET #1, and HDPE #2 costs per ton.

The purpose of the two sub-models, the Indirect Cost Allocation Sub-Model for All Plastics, and the Indirect Cost Allocation Sub-Model for Aluminum/Bimetal, was to separate the individual majority and minority material costs from the larger indirect cost categories: all plastics and aluminum/bimetal. Using operational and material handling factors, the sub-models provide a consistent, site-specific, and sub-material specific approach for determining the costs per ton for both the high-volume majority materials and low-volume minority materials.

Four operational/material handling factors (weight of containers, number of containers, volume of containers, and commingled rate), along with a weighting allocation across these factors, formed the basis of the indirect cost allocation sub-models for the two majority and seven minority materials (glass does not require a sub-model). The sub-models were integrated into the Labor Allocation Cost Model for each site.

G. Site and Survey Tracking

For this cost survey, Crowe completed and tracked site and survey process via a secure online SharePoint site instead of the former hard-copy system. All site files were electronically uploaded to the secure portal where reviewers could access them conveniently. The use of the SharePoint site increased security and efficiency. The SharePoint tracking list, augmented by an Access database, incorporated all previous information associated with the prior reporting system, including: a row of descriptive information on each processing fee and handling fee recycling sites.

At any point in time during the surveys, the Crowe business analyst could quickly identify how many sites were in each of nine status completion states, and where each individual site was in the site completion process. Crowe also utilized the site status reporting systems to help prepare monthly progress reports for CalRecycle.

H. Cost Survey Procedures

There were three phases of an individual cost survey:

- **Pre-site visit:** model population, data review, and travel logistics
- **On-site visit:** site tour, cost survey, and labor interviews
- **Post-site visit:** data entry, analysis, and follow-up.

Pre-Site Visit

Before conducting the on-site cost survey, the survey team obtained all available information about that site. Crowe entered recycling volumes for 2014 into the cost model Excel file for each site. The survey team evaluated the beverage container tons information to identify the approximate size and scope of the survey. Much of the pre-site visit time was spent on travel logistics and mapping.

On-Site Visit

Each site visit typically lasted from two to four hours, depending on the size and complexity of the site. The primary data-gathering effort took place during the site visit. Survey teams carefully followed procedures outlined in the training manual. The survey team first toured the site with site management to view and inquire about the site's operations, such as materials handled, equipment, recycling procedures, and material shipping.

Another key on-site task was reviewing the financial information with site management, or a financial officer, to identify and categorize allowable and non-allowable costs for calculating processing fees, direct and indirect costs, and beverage container indirect (BCI) and all materials indirect (AMI) costs.

The next key task was conducting structured labor allocation interviews to determine the allocation of each employee's time first to recycler, processor, or other business, then to direct yard labor or all other labor, and finally by CRV material type or other non-CRV material type. The cost model used this labor allocation information to allocate indirect costs and wages.

Post-Site Visit

After the site visit, the survey team spent from four to 10 or more hours further compiling the site data, entering information into the cost model, completing the site memorandum and site file, and reviewing the site file. In many cases, site managers did not have all the necessary information available at the site visit, and the survey team had to telephone the recycler to request additional information or to ask specific questions about the data.

Following the site visit, the team entered the labor information for each employee, as well as the cost summary and direct cost information, into the cost model. Once the data were entered into the cost model, the model calculated costs per ton for each of the CRV material categories recycled at the site. Finally, the survey team compiled and checked all paperwork and conducted an initial review of the survey results before uploading the files to the secure SharePoint site for the manager to conduct the first of several independent office review steps.

I. Quality Control and Confidentiality Procedures

Data quality control (QC) was a primary focus of the cost survey project. Quality control procedures included five separate levels of review, and totaled on-average 13 hours per site. These data QC procedures were essential to ensure that the cost survey results were fair, equitable, accurate, reasonable, justifiable, and defensible.

This extensive quality control process, with six different individuals or staff teams, determined that each site file was complete and accurate before it was released for data processing and data analysis. Site files that did not meet all the quality control criteria were returned to the original survey team for corrections, if appropriate. Crowe approved data for the final cost per ton calculations described in Section 2 after this extensive series of quality control reviews was complete.

Confidentiality was important for the cost survey. The data from each recycling site were not to be disclosed, as release of the data could potentially be compromising to a recycling business. As a result, Crowe developed formal policies regarding confidentiality. Each project team member signed an employee confidentiality statement, and in addition, each project team firm signed a similar statement. Records from each site were maintained securely at the Crowe offices after they were completed, and financial printouts and worksheet drafts with site-specific information were shredded. The final site electronic site files will be delivered to CalRecycle for their secure record retention. Computers were protected against unauthorized access through use of security software that requires a password to use our laptops. All electronic files related to site visits were stored on the secure SharePoint site within Crowe's domain, accessible by password only, to survey team members.

2. Processing Fee Cost Calculations and Results

This section describes the calculations used, and the final results for, the statewide, weighted-average cost per ton for recycling each of the 10 beverage container material types in the California Beverage Container Recycling program. This section is organized as follows:

A. Cost Calculations
B. Cost Results

A. Cost Calculations

The statewide statistical methodology (stratified weighted-average cost) used for the cost per ton calculations for aluminum, glass, PET #1, and HDPE #2 was pre-determined by sample design.* For this 2014 processing fee cost survey, Crowe Horwath LLP (Crowe) utilized only one type of sample design, a stratified random sample based on tons of glass recycled.

For the stratified random sample, Crowe used a weighted-average by strata calculation to determine cost per ton. We calculated the cost per ton for the remaining six material types (bimetal and plastics #3 to #7) based on the percent change in HDPE #2 costs per ton between the 2012 and 2014 cost surveys. **Exhibit 2-1,** on the next page, illustrates the two calculation approaches we used for determining processing fee recycler costs per ton for 10 beverage container material types.

* The Beverage Container Recycling Act specifies that cost per ton calculations be based on a statewide, weighted-average. The Act eliminated the calculation of a simple average (taking the average of each site, and dividing by the total number of sites).

Exhibit 2-1
Cost per Ton Calculations for Processing Fee Recyclers
(2014)

Approach A: Aluminum, Glass, Plastics #1, and Plastics #2 Cost per Ton

$$\frac{\text{Glass Stratum 1 Sample Costs}}{\text{Glass Stratum 1 Sample Volumes}} \times \text{Glass Stratum 1 Population Volumes} = \text{Glass Stratum 1 Total Population Costs}$$

$$+$$

$$\frac{\text{Glass Stratum 2 Sample Costs}}{\text{Glass Stratum 2 Sample Volumes}} \times \text{Glass Stratum 2 Population Volumes} = \text{Glass Stratum 2 Total Population Costs}$$

$$+$$

$$\frac{\text{Glass Stratum 3 Sample Costs}}{\text{Glass Stratum 3 Sample Volumes}} \times \text{Glass Stratum 3 Population Volumes} = \text{Glass Stratum 3 Total Population Costs}$$

$$\frac{\text{Total Glass Population Costs}}{\text{Total Population Volumes}} = \text{Statewide Stratified Weighted-Average Cost Per Ton}$$

Approach B: Bi-Metal, and Plastics #3 to #7 Cost per Ton

1. Determine HDPE percent change in cost per ton between 2012 ($612.50) and 2014 ($524.23):

$$\text{Percent change} = \frac{\$524.23 - \$612.50}{\$612.50} = \frac{-\$88.27}{\$612.50} = -14.41\%$$

2. Calculated cost per ton for bi-metal and plastics #3 to #7 =

2012 cost per ton + (2012 cost per ton × -14.41%)

Approach A: Aluminum, Glass, PET #1, and HDPE #2

Most recyclers in the total population accept and recycle these four material types.† As a result, for these materials, we used a weighted (by stratum) average statewide cost per ton. There were 151 recyclers in the random sample, divided into three strata. Within each of the three sample strata, we determined the total sample costs and the total sample tons. CalRecycle provided the 2014 tons data for both the sample and

† Somewhat fewer recyclers accept HDPE #2, but the number of HDPE #2 recyclers is still quite large, although the tons are significantly less than for the other three materials, aluminum, glass, and PET #1.

population. The next step was to calculate the average cost per ton by stratum, equal to the sample stratum cost divided by the sample stratum tons. Next, we multiplied this figure by the stratum population tons, to determine the total population‡ costs for each stratum, for each material type. Finally, we determined the statewide, weighted-average cost per ton by summing the three strata total population costs, then dividing by the total population tons. The approach is illustrated in **Exhibit 2-1A**. **Exhibit 2-2,** below, provides an example of the actual step-by-step calculation for the cost per ton for glass.

Exhibit 2-2
Weighted-Average by Strata Calculation Example for Processing Fee Recycler Glass Cost per Ton
(2014)

Stratum	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton
Stratum 1	55,427.95	$3,926,699.66	$70.84
Stratum 2	19,915.84	2,111,052.87	106.00
Stratum 3	2,596.20	402,719.80	155.12
Sample Total	77,939.98	$6,440,472.33	$82.63

1. Simple weighted-average cost per ton for each stratum, and simple weighted-average for the sample

2. Total costs for each stratum, calculated by multiplying sample cost per ton from above, by total glass tons, summed for entire population

Stratum	Reduced Population Glass Tons	Reduced Population Glass Cost	Reduced Population Cost per Ton
Stratum 1	106,306.11	$7,530,724.48	$70.84
Stratum 2	117,646.43	12,470,521.55	106.00
Stratum 3	31,810.31	4,934,415.45	155.12
Population Total	255,762.85	$24,935,661.48	$97.50

3. A statewide, weighted-average result of $97.50 per ton, calculated by dividing total population glass costs by total population glass tons

Approach B: Bimetal and Plastics #3 to #7

This 2014 cost survey was the third time since 2002 (the first was the 2010 cost survey) that the State did not calculate material-specific costs per ton for bimetal and plastics #3 to #7. Senate Bill 1357 (SB 1357, Statutes of 2008) states that the Department shall adjust the costs of recycling for material types that make up less than 5 percent of the total number of containers recycled by the percentage change in the most recently measured cost of recycling HDPE #2 beverage containers (even if HDPE #2 makes up less than 5 percent of total containers recycled). Thus, the cost per ton to recycle bimetal and plastics #3 to #7 was based on the calculated -14.41 percent change in HDPE #2 costs per ton between 2012 and 2014. For the 2014 cost per ton for each of

‡ For purposes of calculating the statewide, weighted-average cost per ton, the "total population" is equal to the reduced population.

these six minority materials (bimetal, PVC #3, LDPE #4, PP #5, PS #6, and Other #7), the cost per ton decreased by calculating 0.8559 times the respective minority material cost per ton measured in 2012. The approach is illustrated in **Figure 2-1B.**

Financial Return

By statute, recycling costs per ton used to determine the processing fees and payments are to include a reasonable financial return. CalRecycle regulations require that the financial return figure, which is multiplied by the cost per ton, is the "average return on costs for the Scrap and Waste Materials Industry (SIC 5093), as determined from data contained in the most recent Dun and Bradstreet Standard Three Year Norm Report" (California Code of Regulations, §2975).

The reasonable financial return (RFR) used for this cost survey was 0.92 percent, based on an average (median) return on costs for SIC 5093 in 2014, as determined by Dun & Bradstreet. This RFR is slightly lower than the RFRs of the past two years (4.1 percent in 2014 and 2.81 percent in 2015).

The cost to recycle used to determine processing fees and processing payments for January 1, 2016, also included a cost of living adjustment (COLA) of 1.6 percent. This was the third time that CalRecycle has utilized a COLA in the cost of recycling calculation. The addition of a COLA was a mechanism to account for the fact that the 2014 cost data was already more than a year old when the processing fees and processing payments went into effect on January 1, 2016.

B. Cost Results

The costs per ton to recycle for each of the 10 material types with and without the reasonable financial return are summarized in **Exhibit 2-3,** on the next page. Exhibit 2-3 also shows the 2014 survey sample size for each of the four relevant material types.

Exhibit 2-4, on the next page, provides the costs per ton (without financial return) in rank order. The costs per ton fall into six general cost ranges. Glass has the lowest cost, less than $100 per ton. PET #1 is alone in the $400 range. Aluminum and HDPE #2 costs are in the next range of less than $600 per ton. Two of the minority materials, PS #6 and bimetal, are in the next cost range, $600 to $700 per ton. Other #7 is in its own cost range, above $700 per ton. PVC #3 is also in its own cost range, above $800 per ton. Finally, PP #5 and LDPE #4 are in the highest cost range, at more than $1,000 per ton.

Exhibit 2-5, following Exhibit 2-4, shows the strata and population tons and costs used in the final calculations for aluminum, glass, PET #1, and HDPE #2, as well as the calculation used to determine costs per ton for bimetal and plastics #3 to #7.

Exhibit 2-3
Statewide Costs per Ton to Recycle for Processing Fee Recyclers
(2014)

Material	Cost per Ton without Financial Return	Cost per Ton with Financial Return and COLA[a]	N = Sample Number of Sites[b]
1. Aluminum	$537.29	$550.83	151
2. Glass	97.50	99.97	151
3. PET #1	428.55	439.41	151
4. HDPE #2	524.23	537.52	146
5. Bimetal	660.65	677.40	NA
6. PVC #3	824.65	845.55	NA
7. LDPE #4	1,176.43	1,206.25	NA
8. PP #5	1,055.41	1,082.16	NA
9. PS #6	653.74	670.31	NA
10. Other #7	716.27	734.43	NA

[a] The reasonable financial return (RFR) is 0.92 and the COLA is 1.6%.

[b] Overall, 151 sites were completed to obtain these results. The cost per ton for bimetal and plastics #3 to #7 was determined by the percent change in HDPE cost per ton.

Exhibit 2-4
Statewide Costs per Ton in Rank Order for Processing Fee Recyclers
(2014)

Material	Cost per Ton without Financial Return
1. Glass	$97.50
2. PET #1	428.55
3. HDPE #2	524.23
4. Aluminum	537.29
5. PS #6	653.74

Material	Cost per Ton without Financial Return
6. Bimetal	$660.65
7. Other #7	716.27
8. PVC #3	824.65
9. PP #5	1,055.41
10. LDPE #4	1,176.43

Exhibit 2-5
Strata and Population Costs and Tons for Processing Fee Recyclers
(2014)

2014 Random Reduced Population Data by Strata – Cost Per Ton Calculations

Stratum 1 – High Glass Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 1 Total Costs
Aluminum	$5,928,025.15	12,809.46278	25,806.43941	$11,942,704.03
Glass	3,926,699.66	55,427.94733	106,306.10499	7,530,724.48
PET #1	6,886,452.87	18,540.92884	37,872.84791	14,066,733.17
HDPE #2	443,518.16	968.42412	1,817.95638	832,587.66

Stratum 2 – Medium Glass Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 2 Total Costs
Aluminum	$3,342,125.92	5,974.48276	36,765.21132	$20,566,459.21
Glass	2,111,052.87	19,915.83764	117,646.42973	12,470,521.55
PET #1	3,845,293.12	8,598.12709	49,051.33743	21,936,739.13
HDPE #2	234,530.46	438.98953	2,654.43341	1,418,131.05

Stratum 3 – Low Glass Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 3 Total Costs
Aluminum	$662,502.20	1,081.80340	14,777.91098	$9,050,140.46
Glass	402,719.80	2,596.19944	31,810.31104	4,934,415.45
PET #1	595,286.11	1,164.79936	15,123.86827	7,729,204.12
HDPE #2	34,959.55	53.06281	697.33744	459,426.83

Combined Population Strata

Material Type	Population Costs	Population Tons	Statewide Cost per Ton
Aluminum	$41,559,303.70	77,349.56171	**$537.29**
Glass	24,935,661.48	255,762.84576	**97.50**
PET #1	43,732,676.42	102,048.05361	**428.55**
HDPE #2	2,710,145.54	5,169.72723	**524.23**

Minority Materials

Material Type	2012 Cost/Ton	14.41% Decrease	2014 Cost/Ton
PVC #3	$963.49	-$138.84	**$824.65**
LDPE #4	1,374.50	-198.07	**1,176.43**
PP #5	1,233.10	-177.69	**1,055.41**
PS #6	763.80	-110.06	**653.74**
Other #7	836.86	-120.59	**716.27**
Bimetal	771.88	-111.23	**660.65**

Exhibit 2-6
Sample Error Rates for Processing Fee Recyclers, by Material Type
(2002-2014, every 2 years)

Material Type	Error Rate at 90% Confidence Interval						
	2002	2004	2006	2008	2010	2012	2014
Aluminum	7.82%	5.55%	6.61%	5.66%	6.27%	5.71%	5.86%
Glass	9.21	7.35	8.17	6.19	7.52	5.24	6.49
PET #1	9.77	7.33	8.05	6.39	7.56	5.18	6.23
HDPE #2	9.78	7.47	8.97	8.27	7.33	7.63	6.86
Other #7	N/A	N/A	9.95	9.53	N/A	N/A	N/A
Bimetal	7.57	9.83	8.31	6.89	N/A	N/A	N/A

Error Rates and Confidence Intervals for Costs per Ton

The California Beverage Container Recycling and Litter Reduction Act requires CalRecycle to conduct "a survey of a statistically significant sample of certified recycling centers, excluding those receiving a handling fee" (SB 1357, Padilla, Chapter 697, Statutes of 2008.) In California Code of Regulations section 2000(a)(47), a "statistical sample" is defined as an estimate with an 85 percent confidence level. Internal CalRecycle policy further establishes a 10 percent error rate.

In developing the sample design, Crowe determined that, rather than set the sample to achieve an 85 percent confidence interval and then oversample, it would be more statistically accurate to set the confidence interval higher, at 90 percent. Thus, the sample size was developed, based on 2002 cost survey results, to achieve a 90 percent confidence interval with a 10 percent error rate. Only after the survey was complete could we determine whether the actual specifications of a 90 percent confidence interval, and the target of a 10 percent error rate, were met.

The analysis of the final data shows that, for the seventh time, the processing fee cost survey met and exceeded all a priori statistical requirements. (The 2002–2014 surveys of recycler costs, conducted every two years, also met and exceeded these requirements.) In all cases, the error rate at the 90 percent confidence level was below 10 percent. The error rate at the 90 percent confidence interval for each of the four relevant materials is provided in **Exhibit 2-6,** above. For comparison, Exhibit 2-6 also provides the error rates at the 90 percent confidence interval for each of the five (or six) relevant material types from the 2002–2014 processing fee cost surveys, conducted every two years.[§]

[§] The bimetal error rate at the 90 percent confidence interval is slightly higher in 2004, as compared to 2002. However, for the first time, the 2004 bimetal sample was a statistically valid random sample drawn specifically for bimetal, as opposed to the "hybrid" sample of available sites that was used in 2002 to determine bimetal costs per ton. In 2004, 2006, and 2008, the bimetal sample consisted of a statistically valid random sample drawn specifically for bimetal. The 2006 cost survey was the first time that we utilized a random sample (rather than a census) for Other #7, and thus the first time that we calculated error rates for this plastic

The 2014 cost survey generally achieved a similar high degree of statistical confidence as the six previous cost surveys. This degree of accuracy reflects extensive experience of the survey team, in addition to extensive quality control processes built into this cost survey. The Crowe methodology continued to include substantial site file oversight and quality control review. Five levels of review were conducted for each site and some site files were sent back to the original survey team for additional investigation, and revisions before they were approved.

Exhibit 2-7, below, provides a summary comparison of the cost per ton results for the cost surveys from 2002 to 2014, conducted every second year. The cost per ton decreased from 2012 to 2014 for all materials except glass, which increased. The cost per ton for aluminum reversed a trend of increasing since 2002, with a slight decrease between 2008 and 2010. The cost per ton for aluminum increased in 2012 and decreased in 2014. The cost per ton for glass increased between 2002 and 2006, dropped closer to historic levels in 2008, and then increased in 2010, 2012, and again in 2014. The cost per ton for PET increased slightly between 2002 and 2004, decreased in 2006 and again in 2008, increased slightly in both 2010 and 2012, and decreased in 2014. The cost per ton for HDPE increased slightly between 2002 and 2004, dropped significantly in 2006, and was essentially the same in 2008. In 2010, the HDPE cost per ton increased closer to 2002 and 2004 levels, remained essentially unchanged in 2012, and dropped to the 2008 level in 2014.

Exhibit 2-7
Summary Comparison of Cost Survey Results for Processing Fee Recyclers
(2002-2014, every 2 years)

Material Type	Statewide Cost per Ton[a]						
	2002	2004	2006	2008	2010	2012	2014
1. Aluminum	$418.95	$465.90	$516.13	$559.23	$537.06	$609.81	$537.29
2. Glass	79.81	82.45	94.98	81.60	89.76	92.88	97.50
3. PET #1	479.63	493.31	477.73	426.76	440.61	462.79	428.55
4. HDPE #2	645.91	671.73	500.64	501.67	611.62	612.50	524.23
5. Bimetal	508.18	607.03	883.55	632.22	770.80	771.88	660.65
6. PVC #3	1,064.52	1,583.72	731.37	789.16	962.14	963.49	824.65
7. LDPE #4	3,324.89	1,889.50	1,858.09	1,125.80	1,372.58	1,374.50	1,176.43
8. PP #5	1,478.77	809.42	787.83	1,009.99	1,231.38	1,233.10	1,055.41
9. PS #6	6,137.30	3,051.82	623.11	625.60	762.73	763.80	653.74
10. Other #7	759.32	1,264.47	741.93	685.44	835.69	836.86	716.27

resin. We again utilized a random sample for Other #7 in the 2008 cost survey. For the 2010, 2012, and 2014 cost surveys, costs per ton for plastics #3 to #7 and bimetal were based on the percent change in HDPE #2 cost per ton between the prior processing fee cost survey (in this case, 2012) and the current cost survey (in this case, 2014).

[a] Without reasonable financial return (RFR).

Exhibit 2-8
Summary Comparison of Number of Surveyed Sites for Processing Fee Recyclers (2002-2014, every 2 years)

Material Type	Number of Sites						
	2002	2004	2006	2008	2010	2012	2014
1. Aluminum	136	117	123	116	129	151	151
2. Glass	131	115	121	112	128	147	151
3. PET #1	132	115	122	115	129	148	151
4. HDPE #2	119	108	118	110	127	144	146
5. Bimetal	65	52	40	40	N/A	N/A	N/A
6. PVC #3	23	14	12	11	N/A	N/A	N/A
7. LDPE #4	11	10	13	20	N/A	N/A	N/A
8. PP #5	11	12	14	21	N/A	N/A	N/A
9. PS #6	12	11	15	32	N/A	N/A	N/A
10. Other #7	49	67	40	40	N/A	N/A	N/A

Costs per ton for bimetal and plastics #3 to #7 were variable between 2002 and 2008. In 2010 and 2012, these costs per ton all reflected the percent change in HDPE #2 costs from the prior cost survey. For 2010, the HDPE #2 cost change was a 21.92 percent increase, and in 2012, the HDPE #2 cost change was a 0.14 percent increase. In this 2014 cost survey, HDPE #2 cost per ton decreased 14.41 percent, to slightly above the 2008 level.

Exhibit 2-8, above, provides a summary comparison of the number of surveyed sites for each material type for the cost surveys from 2002 to 2014 (conducted every two years). The stratified random sample for this 2014 processing fee cost survey was larger than the six prior cost surveys in most categories (with the exception of aluminum, which remained the same as 2012).

3. Processing Fee Cost Analyses

This section provides analyses of the cost per ton results for the cost survey. The section is organized as follows:

A. Historical Trends in Cost per Ton Results
B. Comparison of 2002–2014 (Every Two Years) Cost per Ton Results for Aluminum, Glass, PET #1, and HDPE #2
C. Cost per Ton Results for Six Minority Material Types (2014)
D. Changes in Number of Recyclers and Recycled Tons
E. Changes in Recycling Center Population Dynamics
F. Comparison of Population Size, Recycling Tons, Costs, and Payments by Strata
G. Cost Survey Methodology Validation
H. Summary of Processing Fee Cost Analyses

A. Historical Trends in Cost per Ton Results

Recycler costs per ton for processing fees were first determined in 1987, after the passage of AB 2020. The initial survey for 50 recyclers represented the first time that such costs had been measured and calculated.

Over the last 28 years, the Department of Conservation and CalRecycle have developed and refined the processing fee cost survey methodology. The current high degree of accuracy of the cost survey reflects many years' experience and evolution of the cost survey process. Cost per ton results from the earliest years of the program represented far fewer recyclers and used a much less refined costing methodology. However, even in the early years, California's cost per ton studies provided far greater detail than any other existing studies and represented state-of-the-art research for that time.

Exhibits 3-1 and **3-2,** on the next page, provide the historical cost per ton results for all fifteen years in which recycler cost surveys were conducted. These costs per ton reflect actual dollar values for the years in which they were determined and thus have not been adjusted for inflation.

Aluminum

The aluminum cost per ton has been trending upward over time. Since the 1999 cost survey, the cost per ton of aluminum has increased approximately $200. This significant increase has occurred during a long period of market shift from aluminum to PET #1. With this 2014 cost survey, both the costs to recycle aluminum and market share decreased as compared to 2012. In 2014, the cost dropped to $537.20 per ton, a decrease of 12 percent from 2012.

Exhibit 3-1
Historical Processing Fee Recycler Cost per Ton (without RFR)
(1987 through 2014)

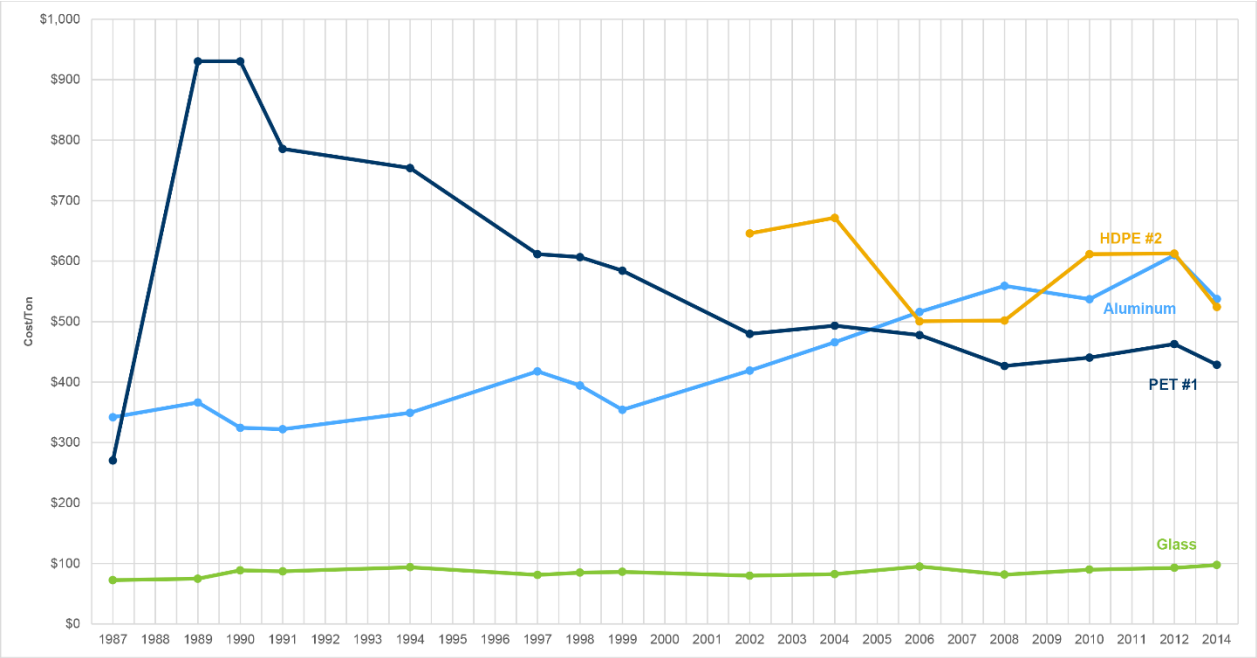


Exhibit 3-2
Historical Costs per Ton (Without Reasonable Financial Return) for Processing Fee Recyclers
(1987 through 2014)

Cost Survey Number	Year	Aluminum	Glass	PET #1
1	1987	$342.09	$72.52	$270.29
2	1989	366.39	74.84	930.42
3	1990	324.32	88.69	930.42
4	1991	322.02	86.98	785.56
5	1994	349.07	93.75	754.16
6	1997	417.60	81.09	611.74
7	1998	394.41	84.85	606.62
8	1999	354.30	86.25	584.14

Cost Survey Number	Year	Aluminum	Glass	PET #1
9	2002	$418.95	$79.81	$479.63
10	2004	465.90	82.45	493.31
11	2006	516.13	94.98	477.73
12	2008	559.23	81.60	426.76
13	2010	537.06	89.76	440.61
14	2012	609.81	92.88	462.79
15	2014	537.29	97.50	428.55

Glass

The cost per ton to recycle glass has been relatively stable over the 27 years of cost per ton results, varying within approximately $20 per ton. Between the 2004 and 2006 cost surveys, the cost increased by a fairly significant 15 percent. Between the 2006 and 2008 cost surveys, the cost decreased by 14 percent, back to approximately the 2004 cost per ton. This significant decrease was likely driven by a 24 percent increase in tons of glass recycled between 2006 and 2008. Between 2008 and 2010, glass tons recycled decreased by 1 percent, and glass recycling cost per ton increased by 10 percent to $89.76, slightly below the 2006 levels. Between 2010 and 2012, the glass tons recycled increased by 6 percent, and glass recycling costs per ton increased by 3 percent to $92.88, still slightly below the 2006 levels. Between 2012 and 2014, glass tons recycled decreased by 16 percent, and glass recycling costs per ton increased by 5 percent to $97.50.

PET #1

The cost per ton to recycle PET #1 has dropped substantially since the second cost survey in 1989. In 1987, when a cost per ton for PET #1 was determined for the first time, PET #1 recycling was not established, and the resulting cost per ton figure was extremely low compared to all the following years. For the fifth time since 1987, the 2014 PET #1 cost per ton to recycle was lower than the 2014 aluminum cost per ton to recycle.

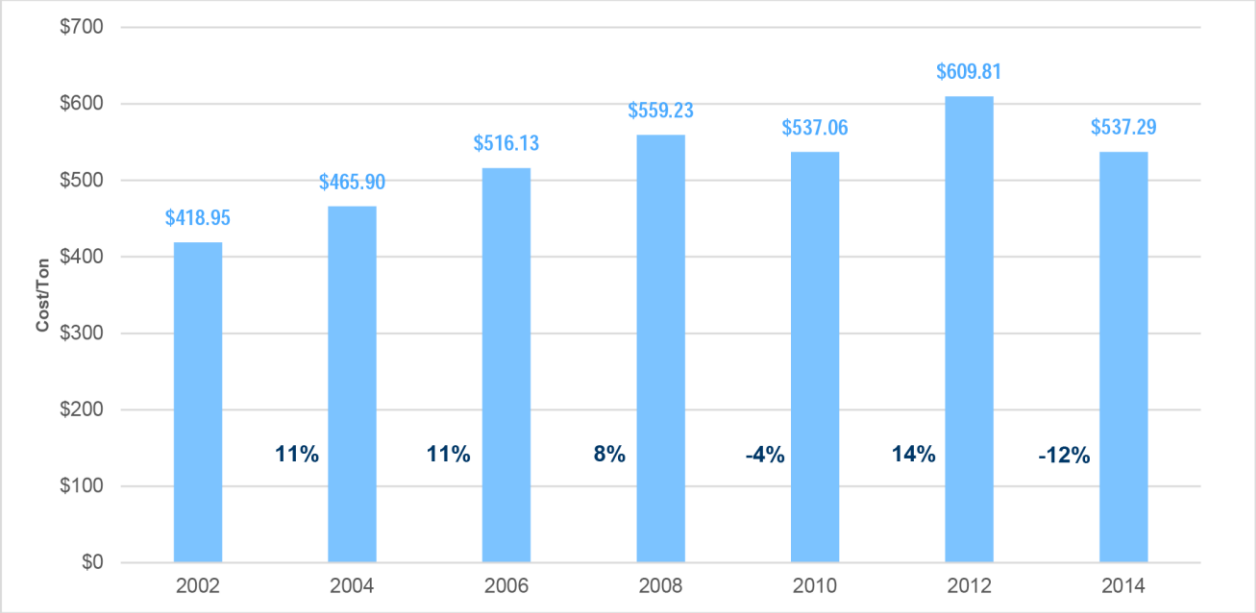
Between 1990 and 2002, the cost per ton for PET #1 has secularly dropped each year, from over $900 to under $500. This large cost per ton reduction over time was likely related to improved recycling practices as PET #1 recycling has become a mainstream, established business. The historical declining PET #1 cost per ton also is likely due to significant increases in tons recycled.

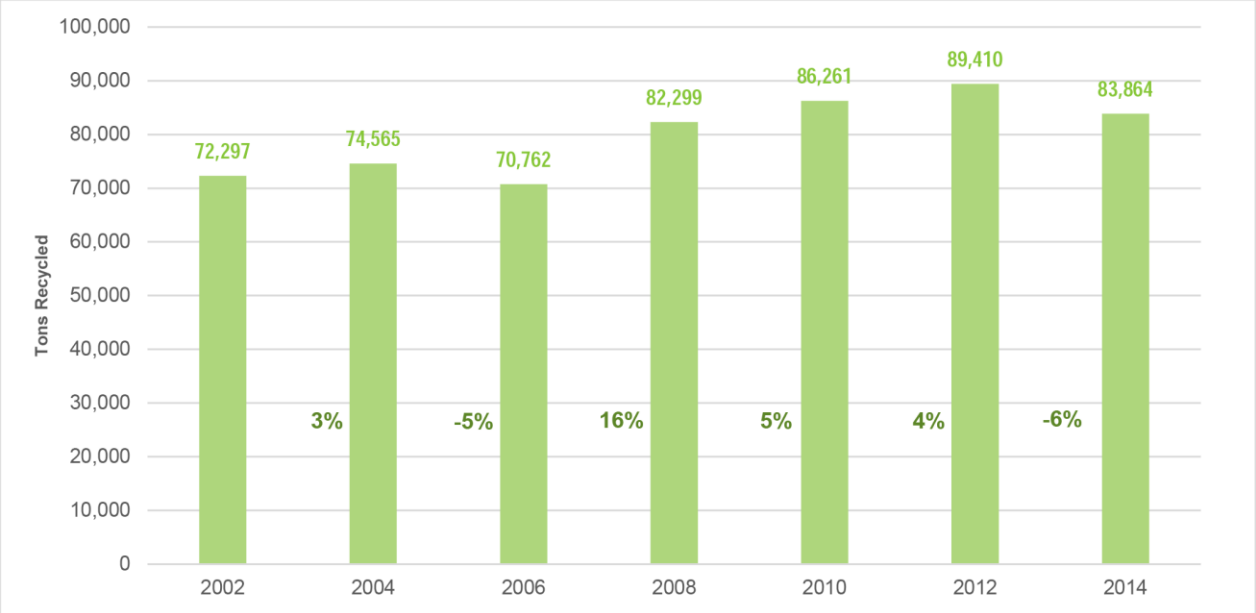
After a one-time increase in the PET #1 cost per ton between 2002 and 2004, the cost per ton to recycle PET #1 decreased between 2006 and 2008 to a new all-time low of $426.76 per ton. In 2010 and 2012, the cost per ton for PET #1 increased, 3 percent and 5 percent respectively. In 2014 the cost per ton for PET #1 decreased 7 percent to a near-2008-level of $428.55.

B. Comparison of 2002-2014 (Every Two Years) Cost per Ton Results for Aluminum, Glass, PET #1, and HDPE #2

Exhibits 3-3, 3-4, 3-5, and **3-6,** beginning on the next page, provide comparisons of the processing fee recycler costs per ton and recycling tons over the last seven cost surveys, for the four majority material types. These comparisons are discussed above for aluminum, glass, and PET #1, and below for HDPE #2. The percent figures next to each column show the percentage change from the previous two years.

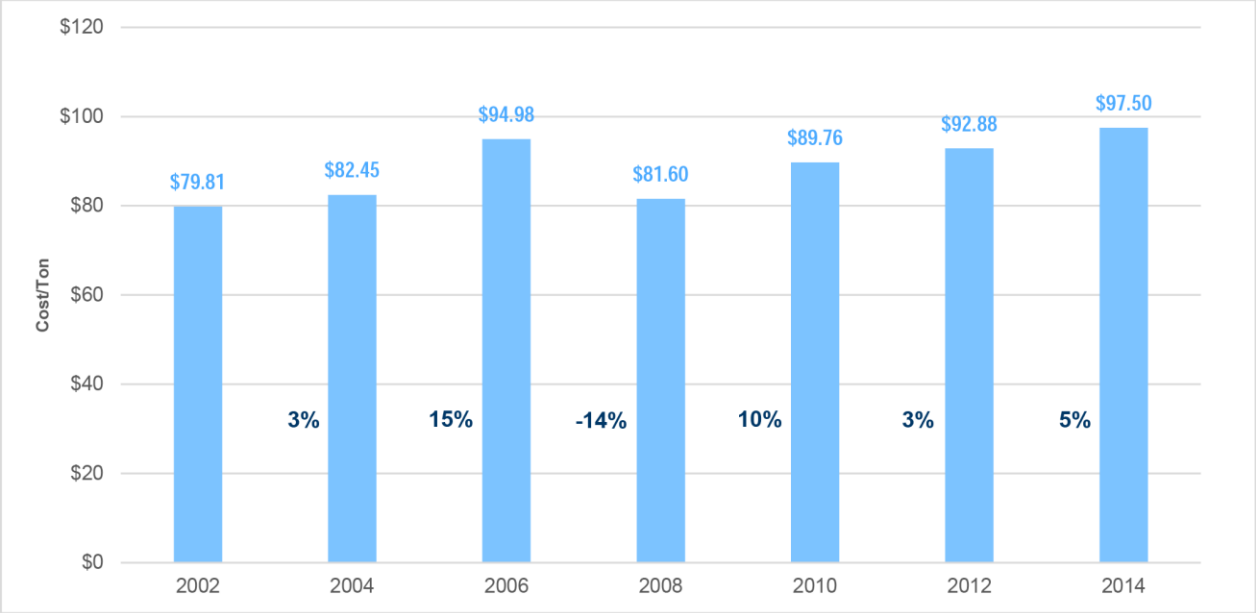
Exhibit 3-3
Comparison of Processing Fee Recycler Costs per Ton and Tons Recycled for Aluminum (2002-2014, every 2 years)[a]

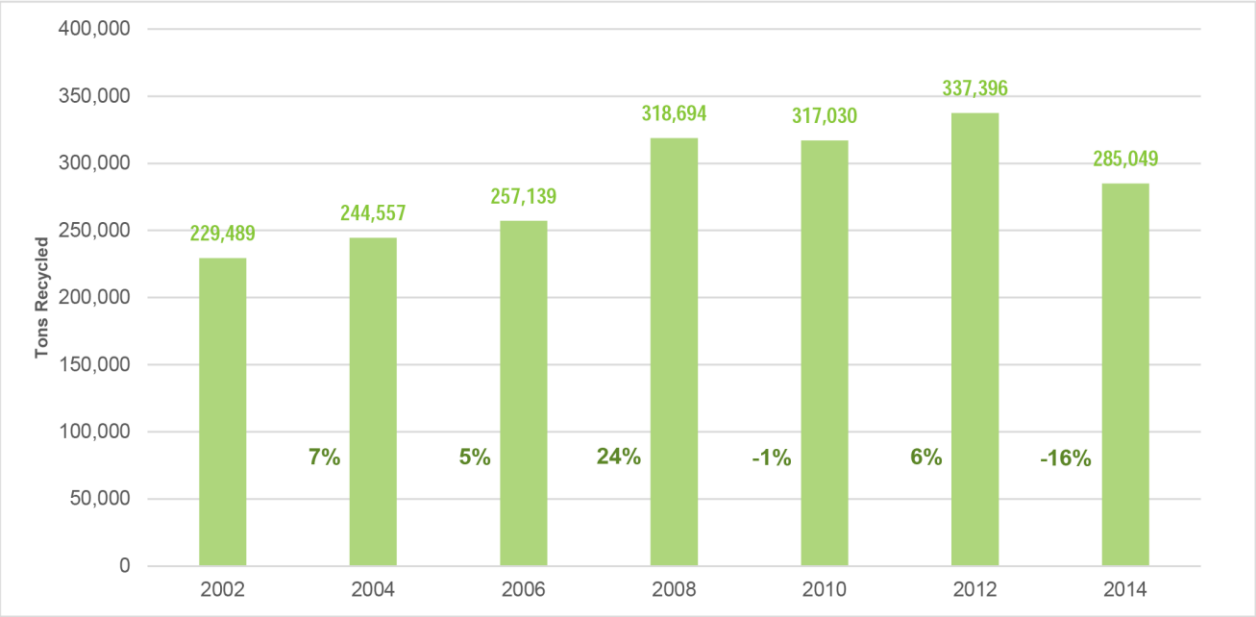




[a] For the 2012 and 2014 cost surveys, 269 and 42 processing fee recyclers (respectively) that were being investigated by CalRecycle were removed from the full population prior to selecting the processing fee (PF) cost survey samples. The cost per ton calculation for both 2012 and 2014 is based on a reduced population. The 2012 and 2014 bars on the tons recycled graph shows the full population tons with investigated RCs, which is a better representation of the level of recycling in 2012 and 2014.

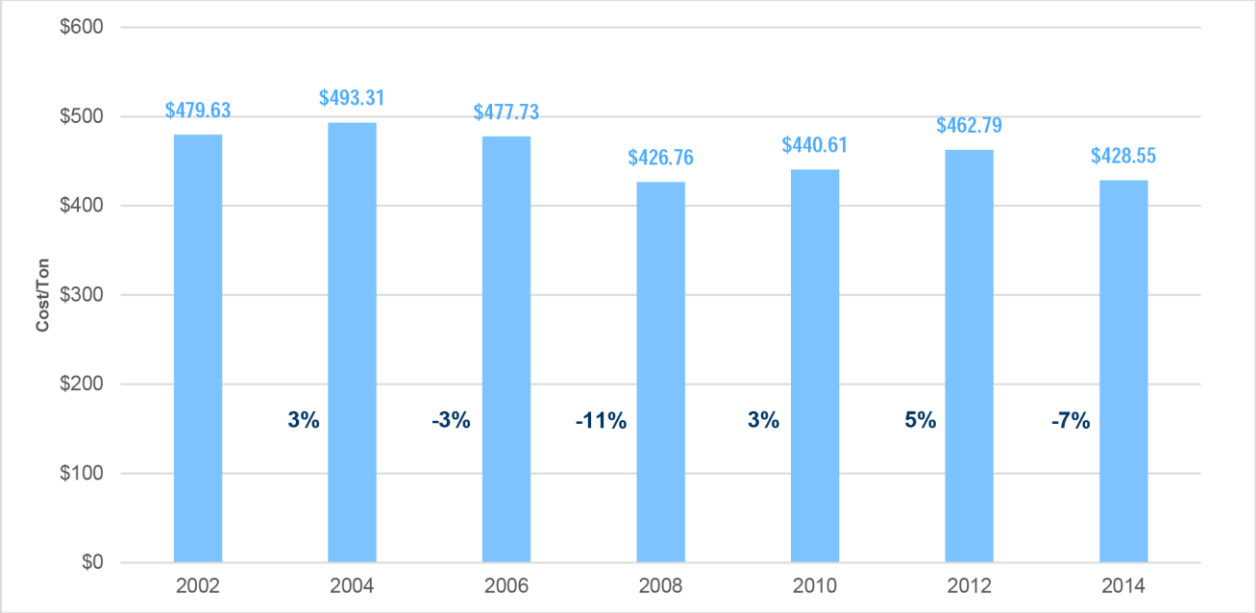
Exhibit 3-4
Comparison of Processing Fee Recycler Costs per Ton and Tons Recycled for Glass (2002-2014, every 2 years)[a]

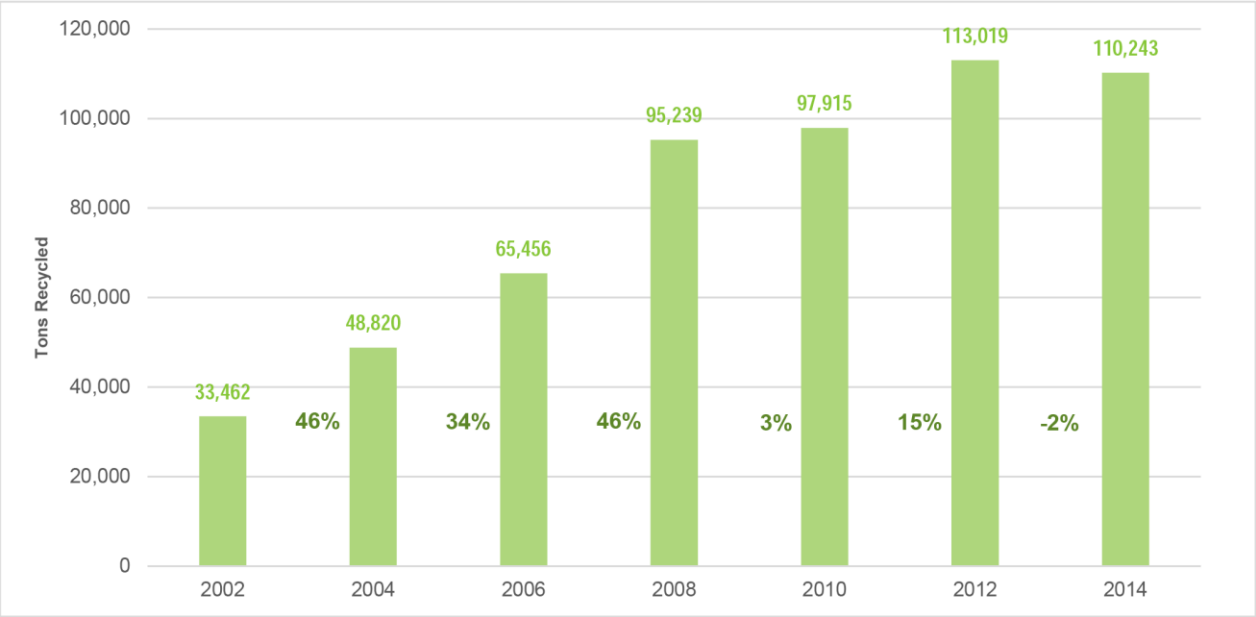




[a] For the 2012 and 2014 cost surveys, 269 and 42 processing fee recyclers (respectively) that were being investigated by CalRecycle were removed from the full population prior to selecting the processing fee (PF) cost survey samples. The cost per ton calculation for both 2012 and 2014 is based on a reduced population. The 2012 and 2014 bars on the tons recycled graph shows the full population tons with investigated RCs, which is a better representation of the level of recycling in 2012 and 2014.

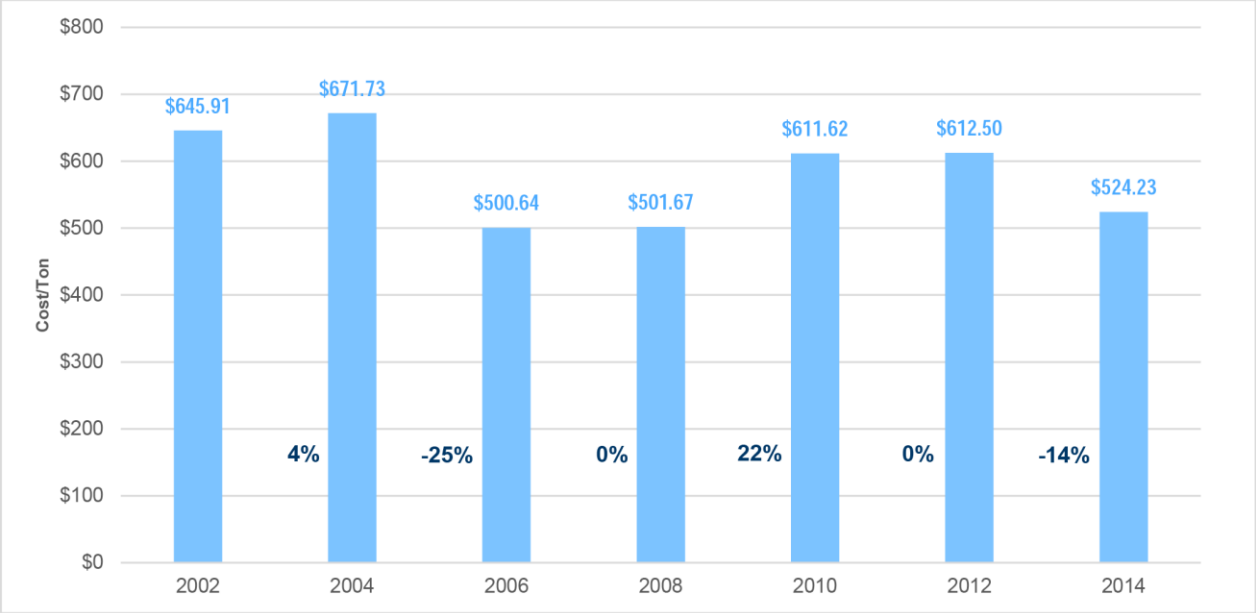
Exhibit 3-5
Comparison of Processing Fee Recycler Costs per Ton and Tons Recycled for PET #1 (2002-2014, every 2 years)[a]

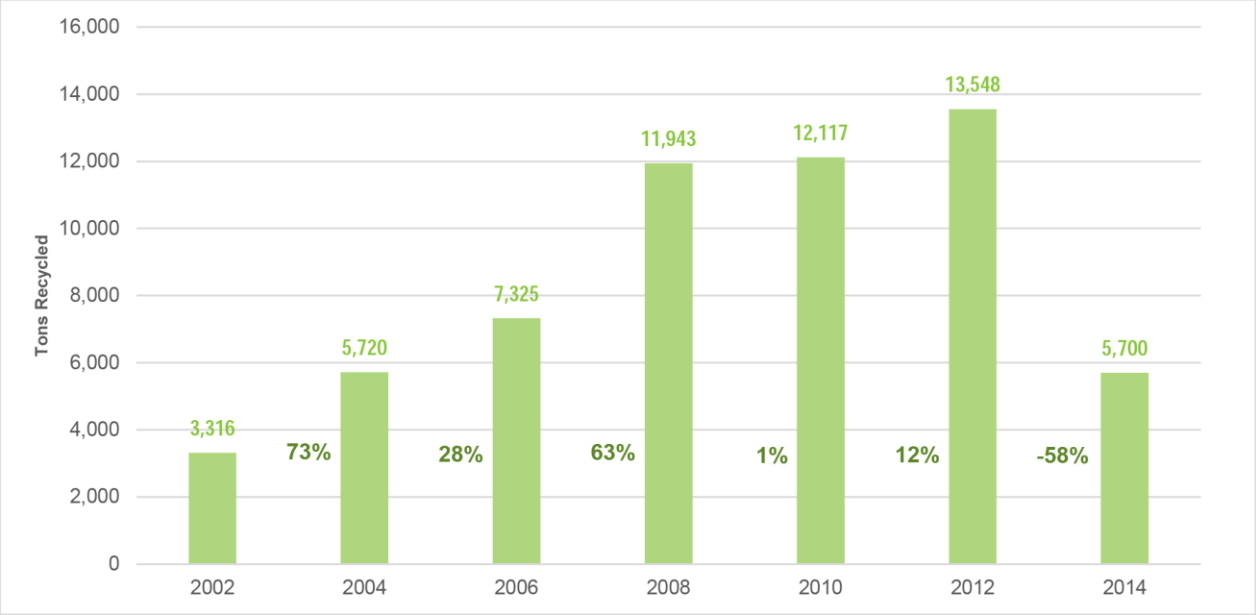




[a] For the 2012 and 2014 cost surveys, 269 and 42 processing fee recyclers (respectively) that were being investigated by CalRecycle were removed from the full population prior to selecting the processing fee (PF) cost survey samples. The cost per ton calculation for both 2012 and 2014 is based on a reduced population. The 2012 and 2014 bars on the tons recycled graph shows the full population tons with investigated RCs, which is a better representation of the level of recycling in 2012 and 2014.

Exhibit 3-6
Comparison of Processing Fee Recycler Costs per Ton and Tons Recycled for HDPE #2 (2002-2014, every 2 years)[a]





[a] For the 2012 and 2014 cost surveys, 269 and 42 processing fee recyclers (respectively) that were being investigated by CalRecycle were removed from the full population prior to selecting the processing fee (PF) cost survey samples. The cost per ton calculation for both 2012 and 2014 is based on a reduced population. The 2012 and 2014 bars on the tons recycled graph shows the full population tons with investigated RCs, which is a better representation of the level of recycling in 2012 and 2014.

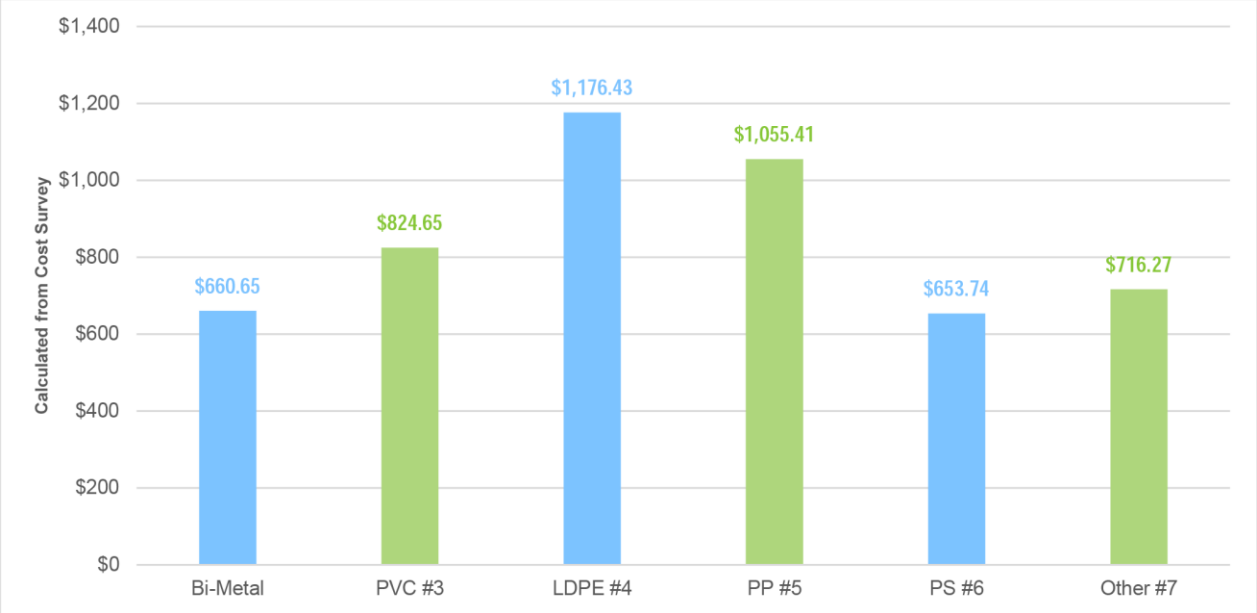
HDPE #2

The cost per ton for HDPE #2 decreased 14 percent between 2012 and 2014 and remains closer to levels it had been in 2006 and 2008. HDPE #2 tons increased 1 percent between 2008 and 2010 and 12 percent between 2010 and 2012. However, in 2014 HDPE #2 tons decreased by 58 percent, representing the second-lowest level since 2002.

C. Cost per Ton Results for Six Minority Material Types (2014)

Exhibit 3-7, below, illustrates the processing fee recycler costs per ton for each of the six minority material types, bimetal, and the five plastic resin types: PVC #3, LDPE #4, PP #5, PS #6, and Other #7. As noted previously, for the past two surveys the cost per ton for these minority materials is based on the change in cost per ton for HDPE #2. Based on the 2014 survey results, costs per ton for each of these materials decreased 14 percent, as compared to their 2012 cost per ton.

Exhibit 3-7
Processing Fee Recycler 2014 Costs Per Ton for Bimetal and Plastics #3 to #7



D. Changes in Number of Recyclers and Recycled Tons

The cost per ton to recycle in any given year and for any given material is based on numerous factors. There is not a direct linear relationship between cost of recycling and tons recycled. In addition, the relative increase or decrease in costs and tons between any two given cost surveys are not necessarily the same. Below, we present a series of

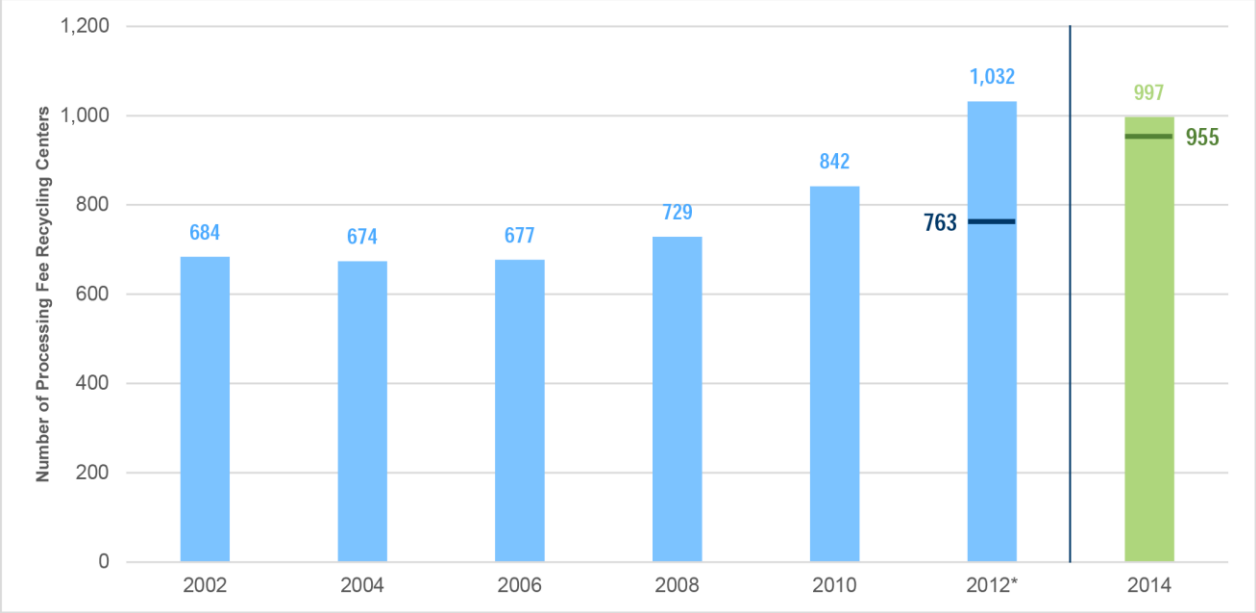
graphs that explore the relationship between recycling costs and tons recycled and how changes in these two variables impact changes in the cost per ton, over time. In the subsection that follows, we examine the impact of these changes on cost per ton results.

Historical Trends in Population Number of Recyclers

The recycling costs and recycled tons are related, to some extent, to the number of recyclers in the population. In any given survey year, each recycler in the population may recycle more, or less, CRV materials. Generally, higher-tonnage recyclers have a lower cost per ton than lower-tonnage recyclers.

Exhibit 3-8, below, provides the number of PF recyclers in the population for each of the six prior, and current, processing fee cost surveys. The number of PF recyclers generally has been increasing over time, particularly since 2006. Between 2012 and 2014, the number of recycling centers declined, but is still the second-highest number of RCs over the last 12 years.

Exhibit 3-8
Number of Processing Fee Recycling Centers
(2002-2014, every 2 years)



* In 2012, Crowe reduced the population from 1,032 RCs to 763 RCs by removing all 269 RCs that were under investigation by CalRecycle, including those only under probation investigation. In 2014, Crowe removed only 42 RCs that were under investigation by CalRecycle for major violations.

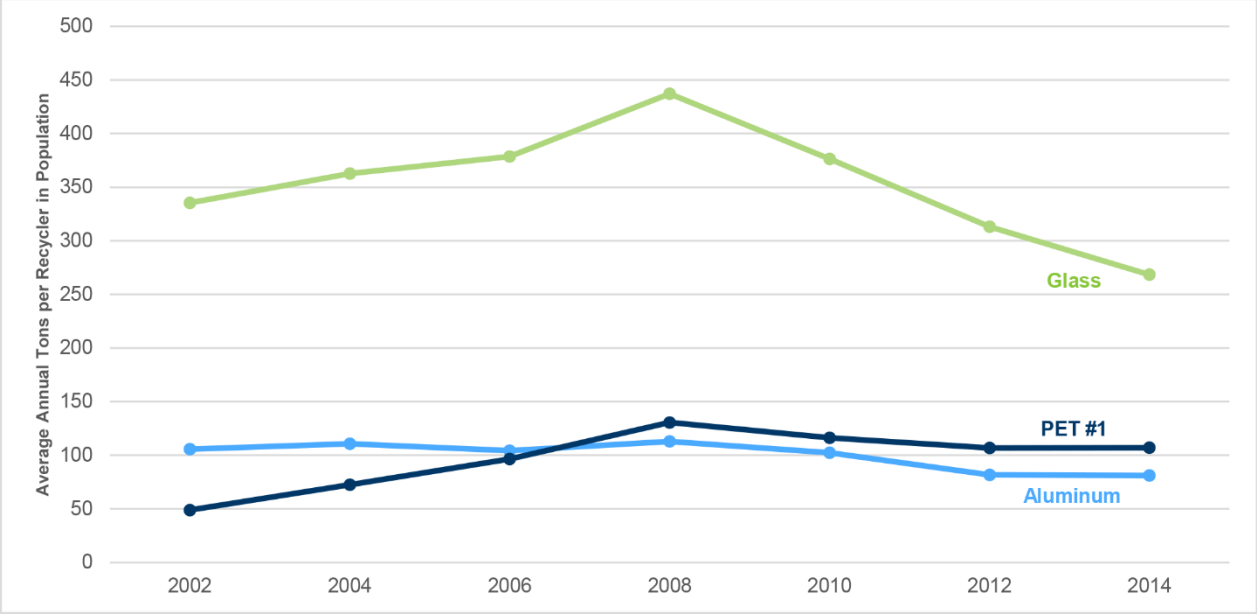
There was significant growth in the recycler population between 2010 and 2012. When the number of RCs increases more quickly than the tons of CRV material recycled increase, the amount of recycled material available to each RC, on average, decreases. This, in turn, reduces recycler profitability. The decrease in number of processing fee recyclers from the full population in 2012 to 2014 (either with, or without the major investigated recyclers) is likely a correction from the earlier population growth.

Average Tons Recycled per Recycling Center

There has been a significant decline in recycling center productivity since 2008. The decline in productivity reflects the significant increase in the number of RCs in the population since 2008. Starting with the economic downturn in 2008 and continuing into 2012, RCs were opening in order to capture the increase in CRV recycling. Between 2010 and 2012, the number of RCs grew at a faster rate than the tons of material recycled did. As a result, the average tons handled per RC declined.

Exhibit 3-9, below, provides the average tons of aluminum, glass, and PET #1 recycled per RC for each cost survey year, 2002 through 2014. Each cost survey year's data point is the quotient determined by dividing population tons recycled by the number of RCs in the population. For 2012, we use the average tons recycled by the survey sample (reduced) population; however, 2012 average tons recycled were very similar between the reduced and full population.

Exhibit 3-9
Average Tons of Aluminum, Glass, and PET #1 Recycled per Processing Fee Recycler (2002-2014, every 2 years)



Average glass tons handled per recycler per year increased between 2002 and 2008 to a high of 437 tons. Between 2008 and 2014, average glass tons declined to 268 tons per recycler, reflected in the downward curve in Exhibit 3-9. Recycling center aluminum productivity fluctuated between 104 and 113 tons per RC between 2002 and 2008, declined to 102 tons per RC in 2010, and further declined to 81 tons per RC in 2012 and 2014. Similar to aluminum, recycling center PET #1 productivity also increased between 2002 and 2008, declined in 2010 and 2012, and stabilized between 2012 and 2014 at approximately 107 tons.

Change in Tons per RC, Costs per RC, and Cost per Ton

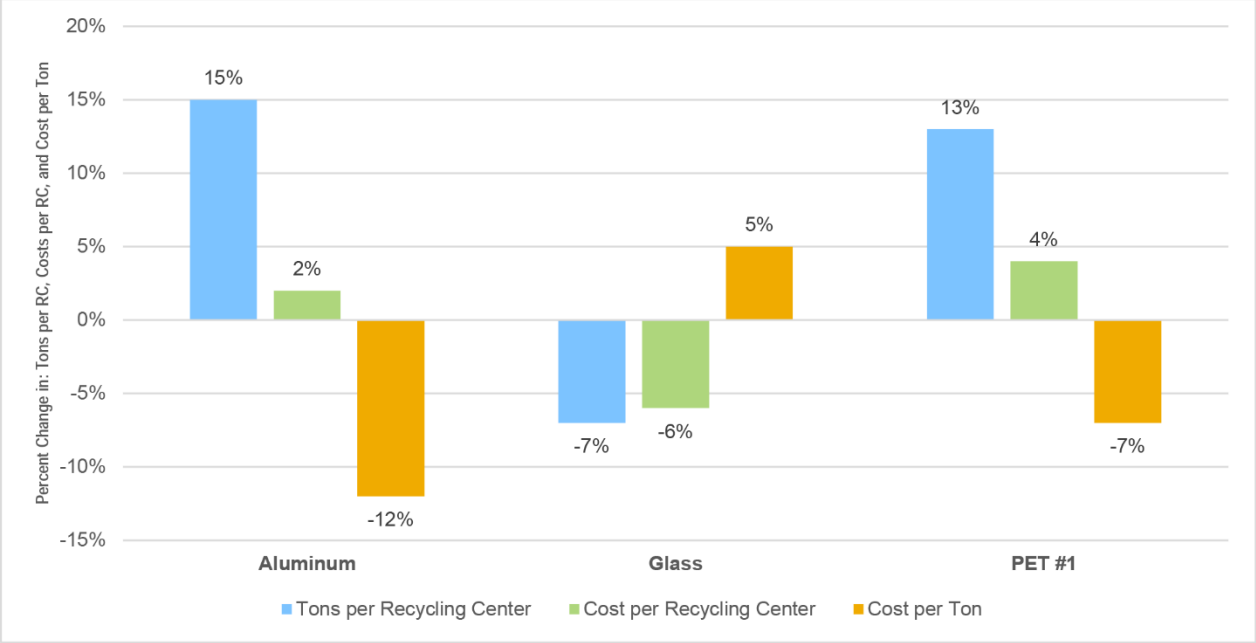
The relative changes since 2012 in the average tons handled per RC and the average costs per RC are primary drivers of the decreases in aluminum and PET cost per ton results in 2014. Average RC costs for handling aluminum, glass, and PET #1 increased in 2014, but not by nearly as much as the significant increase in average RC productivity (tons recycled per RC) for each material. As a result, the cost per ton for aluminum and PET #1 decreased from 2012 to 2014. With regard to glass, average tons per RC and average costs per RC decreased by 7 percent and 6 percent respectively. The resulting cost per ton for glass increased by 5 percent. This increase is largely explained by a shift in the proportion of RCs within each stratum. This shift is explained in section F, “Changes in Recycling Center Population Dynamics.”

Exhibit 3-10, on the next page, summarizes the relationship between RC productivity, costs, and cost per ton. The figure shows the percent change in tons per RC, costs per RC, and statewide, weighted-average cost per ton, between the 2012 and 2014, PF for PF recycler samples for aluminum, glass, and PET #1.** For aluminum and PET #1, recycling center productivity (measured as tons recycled per RC) increased much faster than average costs per RC did, resulting in a decrease in cost per ton.

The cost per ton is a simple algebraic result of the cost per ton calculation: Cost per ton equals costs divided by tons. As compared to the 2012 cost survey results, the 2014 tons (the denominator in the equation) for aluminum and PET #1, increased at a faster rate than did costs (the numerator) for each material. A larger relative denominator resulted in a smaller quotient, cost per ton. The relative percent change in tons and costs are not mirrored precisely in the percent change in each material’s cost per ton, because the change in cost per ton is based on the statewide weighted-average, and the changes in tons and costs shown in the figure are at the survey sample level.

** Exhibit 3-16 shows the change in Tons per RC and Cost per RC for the sampled populations in 2012 and 2014. These sample populations contains a significantly higher proportion of strata 1 recyclers than the full population, in order for appropriate statistical extrapolation to the full population. The proportions of strata 1, 2 and 3 recyclers between the sample populations in 2012 and 2014 were very similar.

Exhibit 3-10
2012 Sampled Processing Fee Recyclers and 2014 Sampled Processing Fee Recyclers Percent Change in Tons per Recycler, Percent Change in Costs per Recycler, and Percent Change in Statewide, Weighted-Average Processing Fee Recycler Cost per Ton



The 2014 statewide aluminum recycler cost per ton is 12 percent less than the 2012 statewide aluminum recycler cost per ton. Between the 2012 and 2014 cost surveys, average RC aluminum tons recycled (productivity) increased 15 percent, while costs increased 2 percent over the same period. These two RC operational forces are a significant driver for the entire aluminum cost per ton decrease.

The 2014 statewide glass cost per ton is 5 percent higher than the 2012 statewide recycler cost per ton. Between 2012 and 2014, average glass tons recycled per recycling center decreased 7 percent, while costs per recycling center decreased 6 percent over the same period. This was one of the factors (in addition to the population shifts discussed in the next subsection) that led to an increase in glass cost per ton.

The 2014 statewide recycler PET #1 cost per ton is 7 percent less than the 2012 statewide PET #1 cost per ton. Between 2012 and 2014, the average tons PET #1 per recycling center increased 13 percent, while costs per recycling center increased only 4 percent over the same period. The relative differences between these two operational forces are a significant driver for the 7 percent decrease in PET #1 cost per ton.

Labor Hours per Ton Recycled

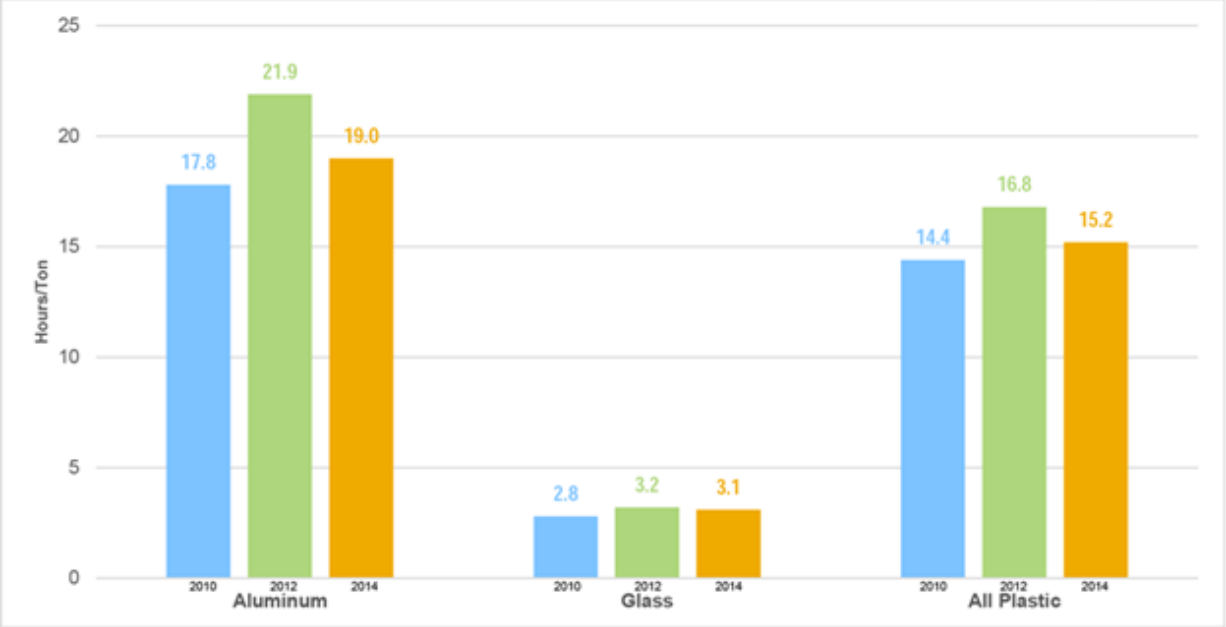
The labor hours required to handle one ton of CRV material is another measure of RC productivity and is a factor that has a direct impact on cost per ton. We calculated and

compared the average PF for PF recycler labor hours allocated per ton of aluminum, glass, and plastic†† recycled for the 2010, 2012 and 2014 surveys. **Exhibit 3-11,** below, shows the labor hours allocated per ton of material recycled. On average, the labor hours required to handle one ton of CRV aluminum, glass and plastic decreased from 2012 to 2014. As labor makes up approximately one-half of a recycler's CRV costs, a reduction in labor hours, all other factors held equal, will translate to a reduction in costs per ton.

The order of the magnitude of change in labor hours required per ton in 2014 corresponds to the order of the percent decrease in 2014 cost per ton for aluminum and plastic (PET #1). Specifically, aluminum had the greatest percent decrease in both labor hours per ton and cost per ton (-13 percent and -12 percent respectively). Plastic had a 10 percent labor hours per ton decrease and a 7 percent cost per ton decrease (essentially PET #1, which makes up approximately 94 percent of plastic costs and tons). Glass had a smaller 3 percent labor hours per ton decrease, but a 5 percent cost per ton increase. Population factors had a larger influence on glass cost per ton than the decrease in glass labor hours per ton.

†† The analysis of labor hours per ton includes data available for plastic, rather than for PET #1, because of the cost survey methodology. We combine all plastic hours in the labor allocation cost model, prior to splitting costs between plastic resins in the Indirect Cost Allocation Sub-Model for All Plastics. PET #1 comprises approximately 94 percent of all plastic tons and costs. Therefore, total plastic labor hours generally are reflective of PET #1 hours. We also use a similar allocation method, the Indirect Cost Allocation Sub-Model for aluminum/bimetal, to split costs between aluminum and bimetal, for the relatively few RCs that handle both materials. Total costs and tons of bimetal are less than 0.03 percent of aluminum costs and tons. Therefore, the hour analysis reflects time spent on aluminum.

Exhibit 3-11
2010, 2012 and 2014 Sampled Processing Fee Recyclers
Average Labor Hours per Ton of Aluminum, Glass, and All Plastic Recycled



Average Wages / Hour
2010: $14.43 / hour
2012: $13.89 / hour
2014: $13.69 / hour

While RCs may be able to reduce labor hours in response to lower tons of CRV material, RCs still must employ one, or more, employee on site during all hours of operation. To the extent that employees spend more time on site handling less material, the hours per ton will increase. Our cost survey does distinguish time spent waiting for CRV customers. All time is allocated to CRV materials, non-CRV materials, or other business.

Average labor wages per hour declined since the 2012 cost survey. The average recycler wage per hour (including owners, supervisors, and laborers) declined approximately 1.4 percent between 2012 and 2014, from $13.89 per hour to $13.69 per hour.

E. Changes in Recycling Center Population Dynamics

The statewide, weighted-average cost per ton calculation is based on the simple weighted-average cost per ton for each sample strata, and the tons of material recycled by each strata of the population. **Exhibit 3-12,** below, illustrates the cost per ton calculation for glass.

With a stratified sample and a weighted-average calculation, generally the higher-volume (and lower-cost) recyclers have a stronger influence on the statewide cost per ton. Variations in the volume of material recycled by strata can influence the statewide, weighted-average cost per ton.

Exhibit 3-12
Example Calculation of 2014 Statewide, Weighted-Average Cost per Ton for Glass

Stratum	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton
Stratum 1	55,427.95	$3,926,699.66	$70.84
Stratum 2	19,915.84	2,111,052.87	106.00
Stratum 3	2,596.20	402,719.80	155.12
Sample Total	77,939.98	$6,440,472.33	$82.63

1. Simple weighted-average cost per ton for each stratum, and simple weighted-average for the sample

2. Total costs for each stratum, calculated by multiplying sample cost per ton from above, by total glass tons, summed for entire population

Stratum	Reduced Population Glass Tons	Reduced Population Glass Cost	Reduced Population Cost per Ton
Stratum 1	106,306.11	$7,530,724.48	$70.84
Stratum 2	117,646.43	12,470,521.55	106.00
Stratum 3	31,810.31	4,934,415.45	155.12
Population Total	255,762.85	$24,935,661.48	$97.50

3. A statewide, weighted-average result of $97.50 per ton, calculated by dividing total population glass costs by total population glass tons

Exhibit 3-13
Comparison of Cost per Ton by Material Type and Strata Between 2012 and 2014

Glass

Stratum	2014	2012	% Change
1	$70.84	$73.20	-3%
2	106.00	105.77	0%
3	155.12	155.19	0%

PET #1

Stratum	2014	2012	% Change
1	$371.42	$401.42	-7%
2	447.22	500.56	-11%
3	511.06	565.95	-10%

Aluminum

Stratum	2014	2012	% Change
1	$462.78	$532.37	-13%
2	559.40	621.85	-10%
3	612.41	750.13	-18%

HDPE #2

Stratum	2014	2012	% Change
1	$457.98	$511.57	-10%
2	534.25	715.63	-25%
3	658.83	757.63	-13%

For the 2014 cost survey results, population changes in glass recycling are a primary factor in the 5 percent increase in glass costs per ton between 2012 and 2014. **Exhibit 3-13,** above, provides the weighted-average cost per ton by strata for glass, aluminum, PET #1, and HDPE #2. For aluminum, PET #1, and HDPE #2, the average cost per ton for each strata declined between 2012 and 2014, as did the statewide, weighted-average cost per ton. For glass, the average cost per ton for stratum 1 declined 3 percent, and the average cost per ton for strata 2 and 3 had essentially no change. However, the statewide, weighted-average cost per ton for glass increased 5 percent between 2012 and 2014.

Comparing recycling volumes and cost contributions by strata to the statewide, weighted-average cost per ton between 2012 and 2014 provides insight into the 5 percent increase in glass cost per ton. **Exhibits 3-14, 3-15,** and **3-16,** starting on the next page, illustrate the percent of population tons recycled by each strata and the percent of total population costs by each strata for 2012 and 2014.

Exhibit 3-14 provides the tons and cost comparisons for glass. The light blue shade at the top of each bar represents stratum 1, the middle green shade represents stratum 2, and the bottom dark blue shade represents stratum 3. When comparing tons, Exhibit 3-14 shows increases in percent of tons for strata 2 and 3, and a resulting decline for stratum 1. This shift also translates to costs, as stratum 1 makes up a smaller percentage of total statewide costs (42 percent in 2012 versus 30 percent in 2014). In 2014, lower-cost stratum 1 recyclers contributed less to the statewide, weighted-average cost per ton. Conversely, higher-cost strata 2 and strata 3 recyclers contributed more to the statewide, weighted-average cost per ton. The result is an increase in glass cost per ton between 2012 and 2014, even though the sample cost per ton declined for stratum 1, and was stable for strata 2 and 3.

Exhibits 3-15 and 3-16 illustrate the same data for aluminum and PET #1. For these two materials, the shifts in tons and costs from stratum 1 to stratum 2 and 3 also occurred, but to a lesser extent. For these two materials, the costs per ton declined between 2012 and 2014 for each strata. These consistent drops in cost per ton across strata were substantial enough that the shift toward more recycling (and more costs) contributed by smaller recyclers was not enough to drive costs up.

Exhibit 3-14
Percent of Population Glass Tons Recycled and Percent of Glass Total Costs – 2012 and 2014

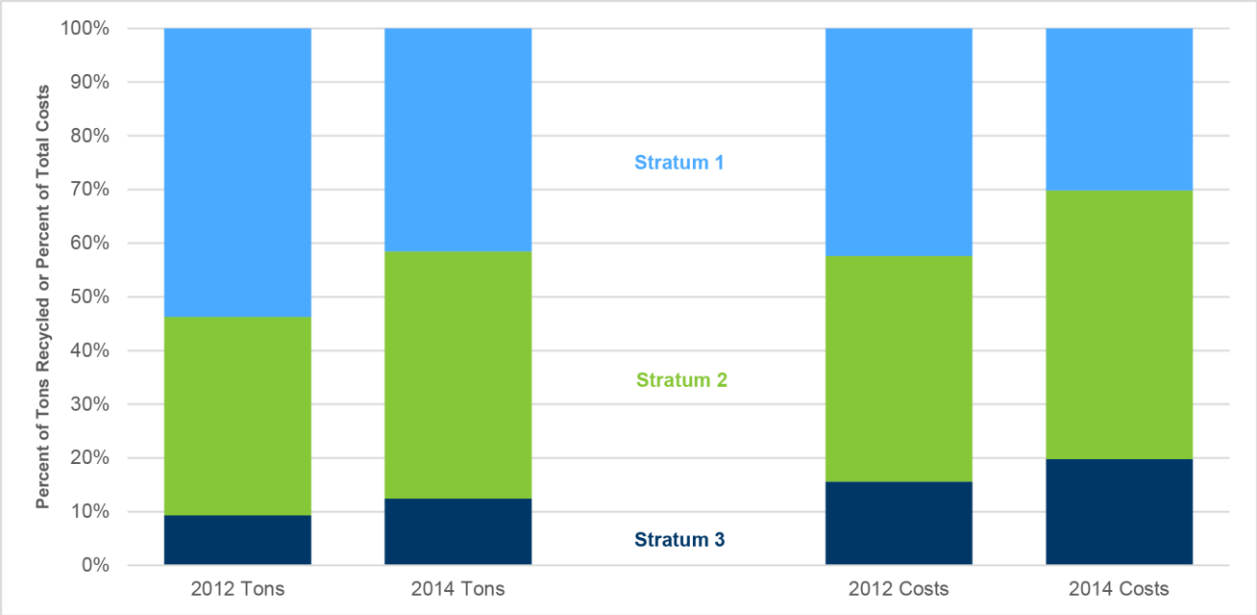


Exhibit 3-15
Percent of Population Aluminum Tons Recycled and Percent of Aluminum Total Costs – 2012 and 2014

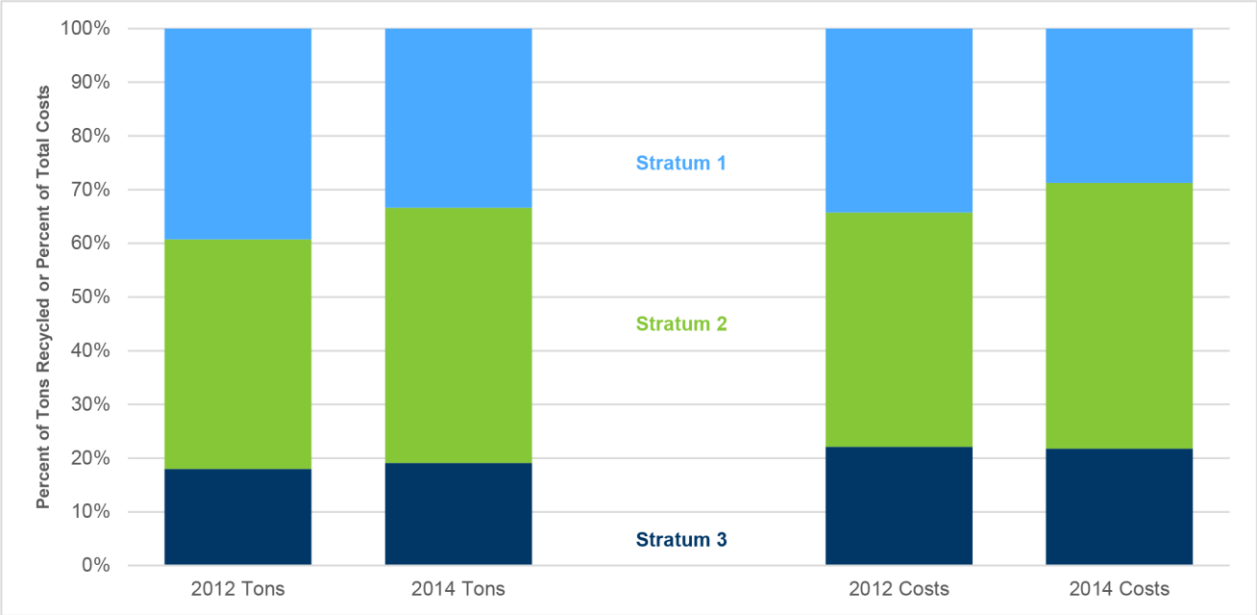
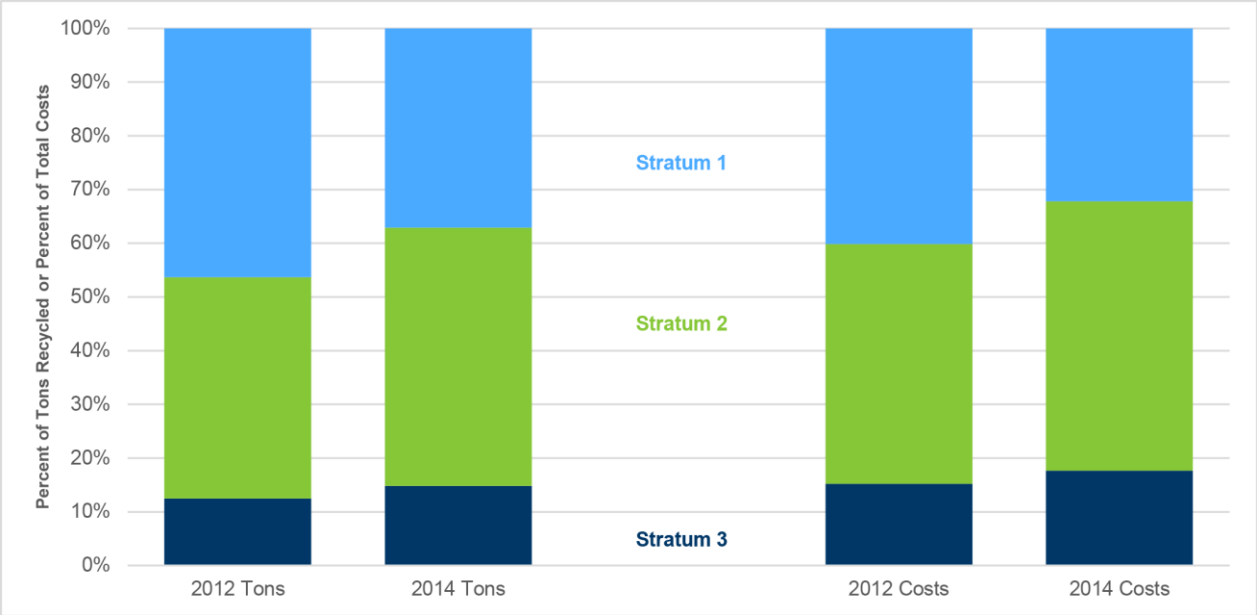


Exhibit 3-16
Percent of Population PET #1 Tons Recycled and Percent of PET #1 Total Costs – 2012 and 2014



F. Comparison of Population Size, Recycling Tons, Costs, and Payments by Strata

Exhibit 3-17, 3-18, 3-19, 3-20, and **3-21,** beginning on the next page, provide the number of sites and tons per strata, for the four major material types from 2002 to 2014 (every two years). For 2012, the tables provide data for the full population of recyclers, consistent with the prior years' data. The tables illustrate the reversal in stratum 1 trends between 2008 and 2010, with reductions in number of sites and tons of all materials for the first time since 2002, followed by a return to previous numbers of stratum 1 RCs in 2012. Between 2012 and 2014, tons recycled by stratum 1 recyclers decreased for aluminum, glass, PET #1, and HDPE #2.

The 997 traditional recyclers that made up the 2014 processing fee recycler full population represented the second-largest number of processing fee recyclers in the population over the last seven cost surveys years. However, the 2014 population represents a 3 percent decrease from 2012 (from 1,032 to 997). The makeup of recyclers within the full population maintained the shift toward smaller stratum 2 and stratum 3 recyclers that started in 2010. The number of large stratum 1 recyclers decreased by 24 percent between 2012 and 2014 and stratum 1 recyclers made up a smaller proportion (13 percent) of total recyclers. The discussions below refer to the full population of 2014 PF recyclers.

The number of stratum 2 and stratum 3 recyclers had been fairly stable over the 2002 to 2008 cost surveys. However, the number of recyclers in each of these two strata increased more than 20 percent between 2008 and 2010, and increased another 20 percent for stratum 2 and 33 percent for stratum 3 between 2010 and 2012. From 2012 to 2014 this growth slowed, and the number of stratum 2 and stratum 3 recyclers remained relatively stable, with a minor increase of 1.5 percent in stratum 2 and 0.2 percent in stratum 3 recyclers. Thus, from 2012 to 2014, the population of total recyclers remained consistent for medium and smaller recyclers, while the number of larger recyclers declined sharply.

The volume of material handled by stratum 1 recyclers decreased by 8 percent between 2008 and 2010, decreased less than 1 percent between 2010 and 2012, and decreased by 28 percent between 2012 and 2014. The sharp decrease in volume handled by stratum 1 recyclers is likely related to the decrease in stratum 1 recyclers themselves. In 2014, stratum 1 recyclers recycled 43 percent, less than half, of all tonnage, as compared to 2012, when stratum 1 recyclers handled 52 of all tonnage. In 2014, stratum 2 recyclers handled 43 percent of all tonnage recycled, as compared to 36 percent in 2012 and 34 percent in 2010. Stratum 3 recyclers handled 14 percent of the total tons recycled in 2014 and 12 percent in 2012. The trends in the volume of material handled by recyclers can be aligned with the trends in the total population of recyclers, as the decrease in stratum 1 recyclers leads to their handling less material. This material is then handled by stratum 2 and stratum 3 recyclers.

For stratum 2 recyclers, aluminum and glass volumes declined between 2004 and 2006, increased slightly in 2008, and increased significantly between 2008 and 2010.

Aluminum and glass tons recycled by stratum 2 recyclers also increased between 2010 and 2012 and increased again between 2012 and 2014. PET #1 tonnage handled by stratum 2 recyclers increased in all time periods. HDPE #2 tonnage handled by stratum 2 recyclers increased up until 2012 but declined between 2012 and 2014.‡‡

Exhibit 3-17
Population and Tons Detail for Four Major Materials, by Strata, for Processing Fee Recyclers

	Year	Population			Total Population	Tons Redeemed			Total Tons
		Stratum 1	Stratum 2	Stratum 3		Stratum 1	Stratum 2	Stratum 3	
Total	2002	106	282	296	684	166,766	136,008	33,551	336,325
	2004	112	290	272	674	187,899	155,269	30,494	373,662
	2006	135	274	268	677	226,453	142,533	31,695	400,681
	2008	173	270	286	729	316,809	152,912	38,454	508,175
	2010	165	325	352	842	290,519	176,393	45,911	513,323
	2012[a]	174	390	468	1,032	288,271	201,672	63,869	553,812
	2014[b]	132	396	469	997	208,716	210,381	65,760	484,857

[a] 2012 is the full population of processing fee recyclers. [b] 2014 is the full population of processing fee recyclers.

Exhibit 3-18
Population and Tons Detail for Aluminum, by Strata, for Processing Fee Recyclers

	Year	Population			Total Population	Tons Redeemed			Total Tons
		Stratum 1	Stratum 2	Stratum 3		Stratum 1	Stratum 2	Stratum 3	
Aluminum	2002	104	282	290	676	24,926	34,636	12,734	72,296
	2004	112	290	271	673	28,084	35,999	10,482	74,565
	2006	135	274	268	677	32,734	28,781	9,246	70,761
	2008	173	270	284	727	42,173	29,899	10,227	82,299
	2010	165	325	349	839	40,603	33,364	12,294	86,261
	2012[a]	174	389	465	1,028	36,871	35,763	16,776	89,410
	2014[b]	132	396	467	995	30,060	37,835	15,969	83,864

[a] 2012 is the full population of processing fee recyclers. [b] 2014 is the full population of processing fee recyclers.

‡‡ The significant reduction in HDPE #2 tons recycled for each strata in 2014 reflects the change in CalRecycle policy to eliminate the commingled rate. In previous years, some non-CRV HDPE #2 (or #3 to #7 plastic) was being claimed as CRV HDPE #2.

Exhibit 3-19
Population and Tons Detail for Glass, by Strata, for Processing Fee Recyclers

	Year	Population			Total Population	Tons Redeemed			Total Tons
		Stratum 1	Stratum 2	Stratum 3		Stratum 1	Stratum 2	Stratum 3	
Glass	2002	105	282	260	647	126,851	85,781	16,857	229,489
	2004	112	290	246	648	135,949	93,729	14,879	244,557
	2006	135	274	242	651	156,301	85,415	15,423	257,139
	2008	173	270	259	702	211,574	88,140	18,980	318,694
	2010	165	325	325	815	191,462	102,385	23,183	317,030
	2012[a]	174	390	446	1,010	189,465	116,798	31,133	337,396
	2014[b]	132	396	443	971	132,334	119,758	32,956	285,049

[a] 2012 is the full population of processing fee recyclers. [b] 2014 is the full population of processing fee recyclers.

Exhibit 3-20
Population and Tons Detail for PET #1, by Strata, for Processing Fee Recyclers

	Year	Population			Total Population	Tons Redeemed			Total Tons
		Stratum 1	Stratum 2	Stratum 3		Stratum 1	Stratum 2	Stratum 3	
PET #1	2002	104	282	265	651	14,220	15,323	3,920	33,463
	2004	112	290	251	653	21,123	22,878	4,819	48,820
	2006	135	274	250	659	33,545	25,383	6,528	65,456
	2008	173	270	269	712	55,633	30,992	8,614	95,239
	2010	165	325	336	826	51,821	36,493	9,601	97,915
	2012[a]	174	390	454	1,018	54,282	43,995	14,742	113,019
	2014[b]	132	394	456	982	44,079	50,064	16,099	110,243

[a] 2012 is the full population of processing fee recyclers. [b] 2014 is the full population of processing fee recyclers.

Exhibit 3-21
Population and Tons Detail for HDPE #2, by Strata, for Processing Fee Recyclers

	Year	Population			Total Population	Tons Redeemed			Total Tons
		Stratum 1	Stratum 2	Stratum 3		Stratum 1	Stratum 2	Stratum 3	
HDPE #2	2002	96	256	185	537	769	268	40	1,077
	2004	107	277	184	568	2,743	2,663	314	5,720
	2006	132	267	213	612	3,873	2,954	498	7,325
	2008	168	262	236	666	7,429	3,881	633	11,943
	2010	163	321	301	785	6,633	4,651	833	12,117
	2012[a]	173	385	420	978	7,422	4,948	1,178	13,548
	2014[b]	130	389	420	939	2,242	2,723	735	5,700

[a] 2012 is the full population of processing fee recyclers. [b] 2014 is the full population of processing fee recyclers.

Stratum 3 recyclers saw declining aluminum volumes from 2002 to 2006, followed by a slight increase between 2006 and 2008, and a greater increase between 2008 and 2010, and again between 2010 and 2012. Between 2012 and 2014, aluminum tonnage recycled by stratum 3 recyclers decreased slightly. For these small recyclers, glass volumes increased between 2002 and 2004, decreased between 2004 and 2006, then increased in 2008, 2010, 2012, and 2014. Stratum 3 recyclers saw increasing PET #1 in all time periods and increasing HDPE #2 up through 2012, as HDPE #2 declined between 2012 and 2014.

The cost to recycle varies between large, medium, and small recyclers. In the cost survey, Crowe determined the weighted-average cost per ton for each of the strata and majority materials. Comparing these strata-specific costs per ton to the statewide, weighted-average cost per ton allows one to assess the relative financial position of large, medium, and small recyclers. **Exhibits 3-22, 3-23, 3-24,** and **3-25,** starting on the next page, illustrate the 2014 costs per ton and population size by strata for aluminum, glass, PET #1, and HDPE #2. Exhibits 3-22 to 3-25 provide costs and RC numbers for the reduced population, consistent with utilizing the reduced population to determine costs. These figures illustrate the following:

- For all four materials, costs per ton were lowest for large stratum 1 sites. Stratum 2 costs per ton were always lower than stratum 3 costs per ton.
- For all four materials, the average cost per ton for stratum 2 recyclers was close to, but slightly higher than, the statewide weighted-average cost per ton.
- Glass costs per ton were significantly higher than the statewide, weighted-average for small, stratum 3 recyclers, implying that on average, processing payments do not cover the costs of recycling for this stratum of recyclers. The average cost to recycle glass for stratum 2 recyclers is only slightly higher than the statewide average.
- PET #1 costs per ton for strata 1 were below the statewide weighted average. However, PET #1 costs per ton for stratum 3 recyclers were significantly higher than the statewide weighted average, while costs per ton for stratum 2 recyclers were slightly higher than the statewide weighted average. Again, this implies that processing payments do not cover the costs of recycling PET #1 for small stratum 3 recyclers.
- Fewer recyclers handle HDPE #2 than the other major material types. Again, HDPE #2 costs per ton were significantly higher than the statewide weighted average for small, stratum 3 recyclers, implying that on average, processing payments do not cover the costs of recycling for these small recyclers. HDPE #2 costs per ton for stratum 2 recyclers were slightly higher than the statewide weighted average.

Exhibit 3-22
Aluminum Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2014)

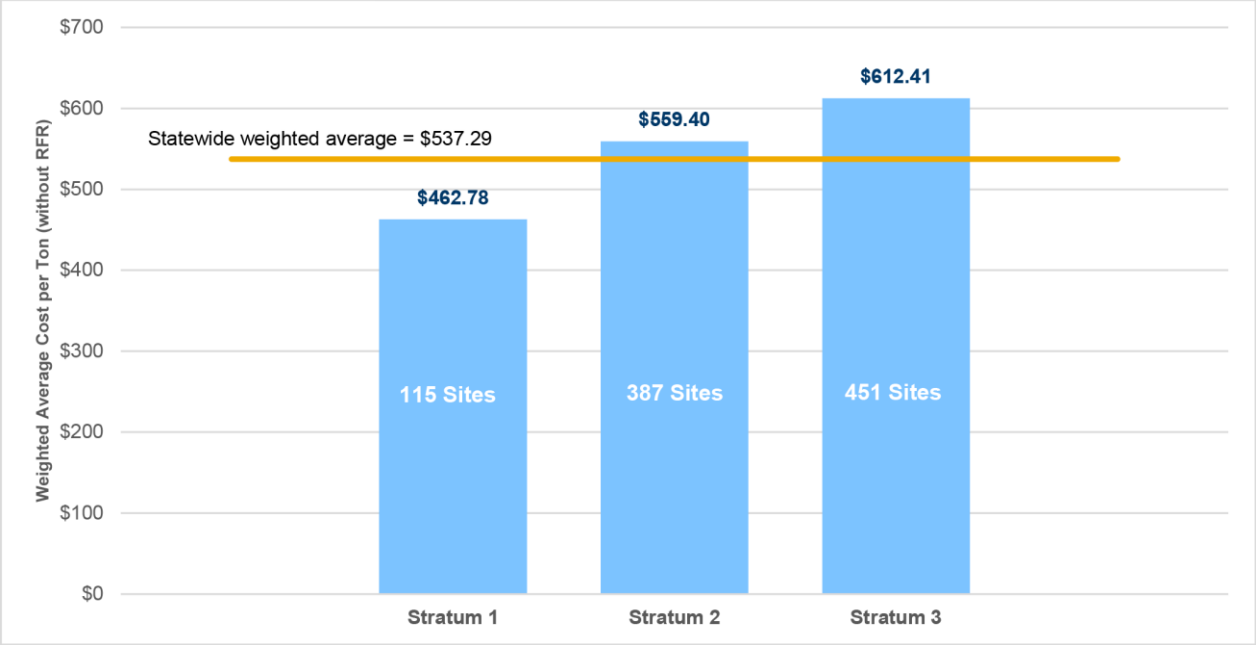


Exhibit 3-23
Glass Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2014)

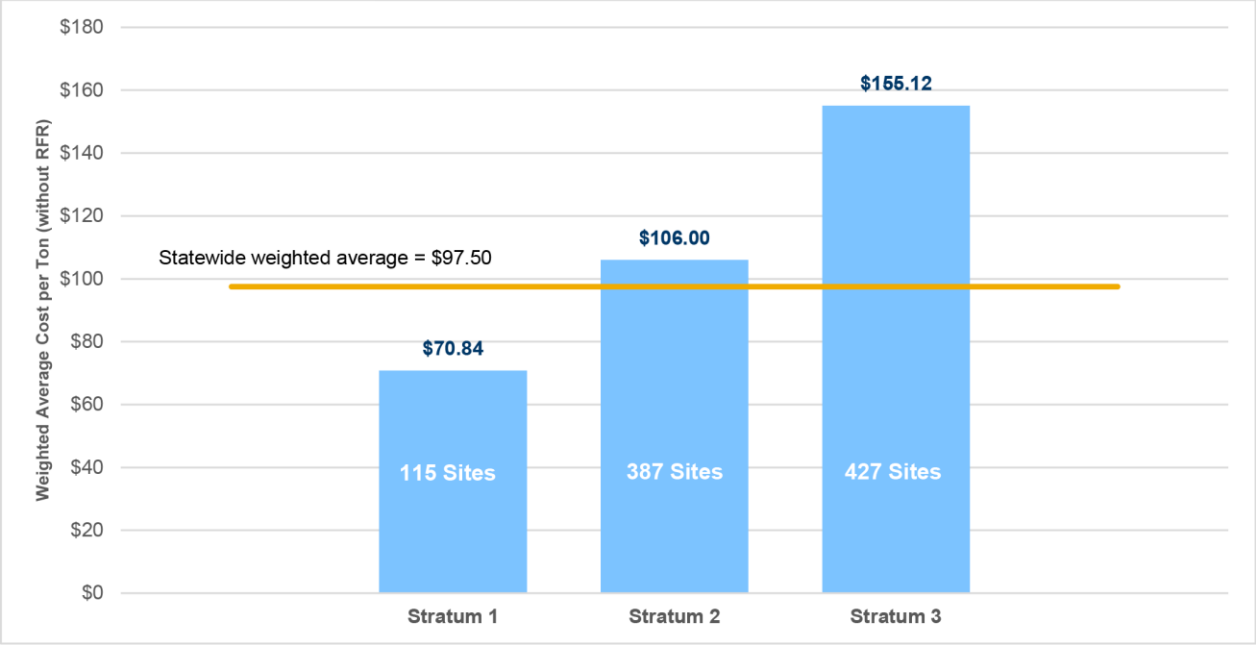


Exhibit 3-24
PET #1 Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2014)

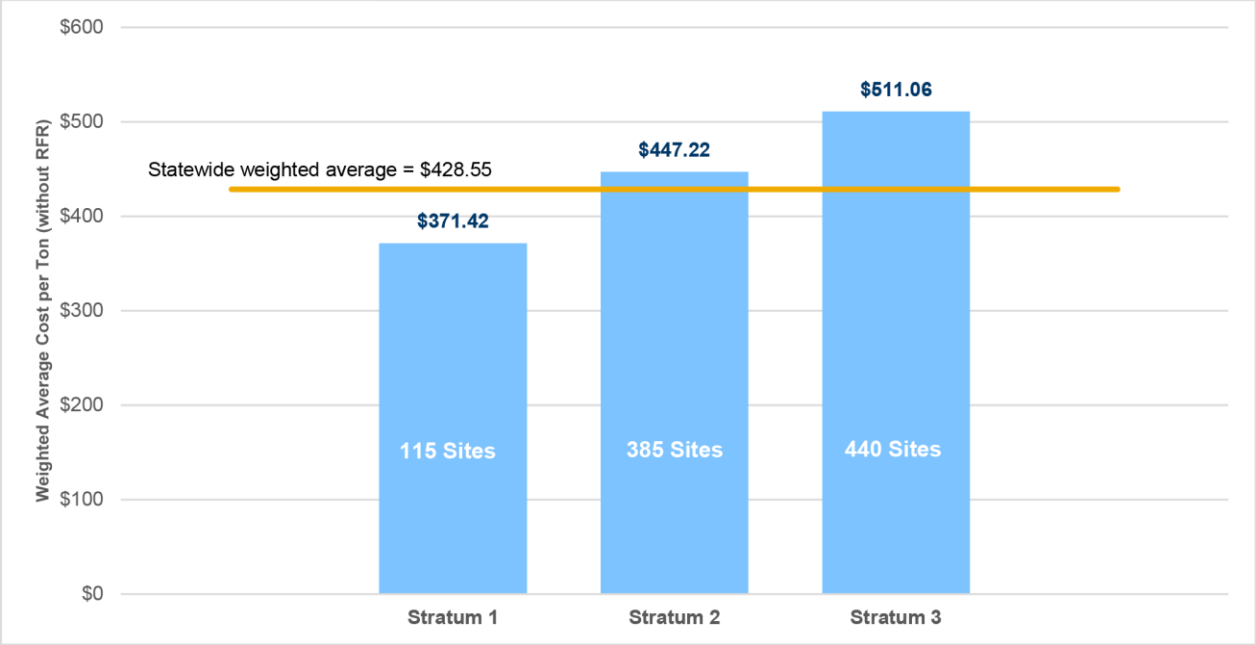
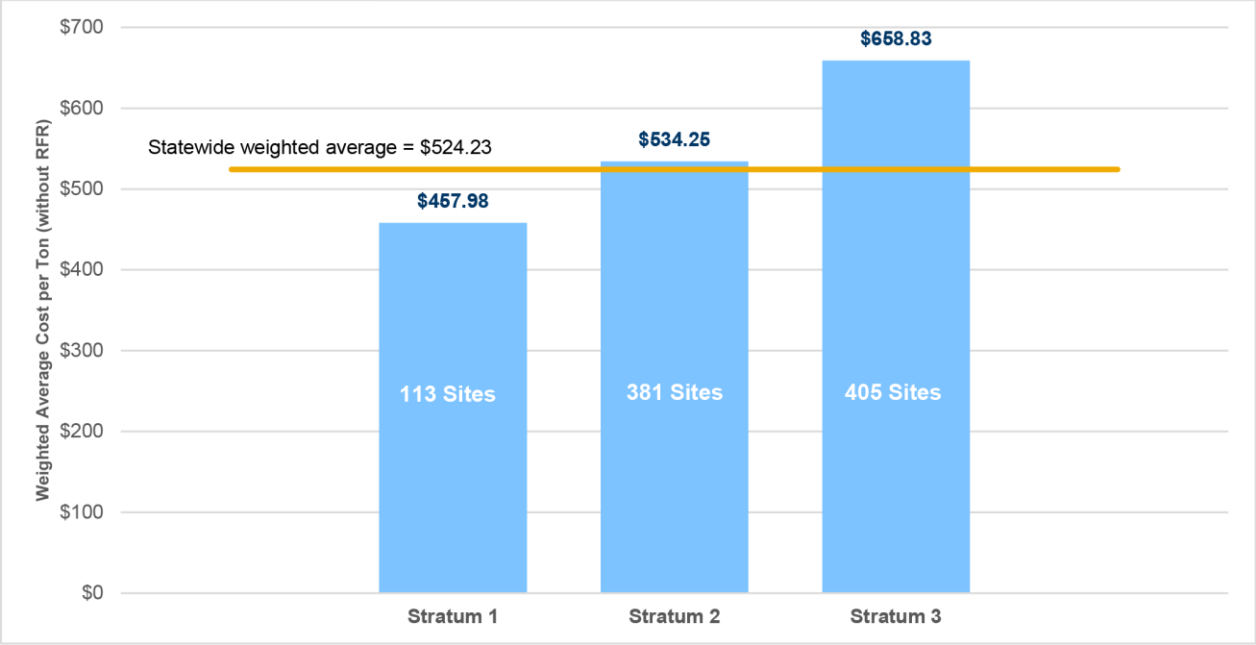


Exhibit 3-25
HDPE #2 Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2014)



G. Cost Survey Methodology Validation

Crowe conducted additional analyses to test the validity of the survey results. This subsection organizes our findings in two areas, as follows:

- Distribution of cost per ton results
- Labor and non-labor costs

Based on the analyses described below, we conclude that our methodology is consistent with prior years. We are confident that the cost per ton results consistently reflect recycler operations and costs.

Distribution of Cost per Ton Results

Crowe evaluated the distribution of 2014 cost per ton results. Our assumption was that if the cost survey was conducted without bias, we would expect a generally "right skewed" normal distribution of cost per ton results from our sample. That is, cost per ton can never be less than $0 per ton, and there is no fixed upper limit on the cost per ton. A distribution of RCs by cost per ton is expected to be concentrated toward the left, with a "tail" stretching toward the right.

Exhibits 3-26, 3-27, 3-28, and **3-29,** beginning on the next page, provide frequency histograms of the cost per ton results for aluminum, glass, PET #1, and HDPE #2. On each graph, the vertical axis is the number of RCs, and the horizontal axis is cost per ton. The horizontal axis of cost per ton is in $100 increments for aluminum, PET #1, and HDPE #2, and in $25 increments for glass.

The histograms demonstrate extremely consistent distributions among all four material types. In addition, these histograms are extremely consistent as compared to the 2012 frequency histograms, which were similarly skewed to the right. The distributions are right-skewed distributions, with a tail to the right as cost per ton increases. The consistency of the four distributions also demonstrates that the survey results are reasonably balanced between the material types.

The right-side skew represents the fact that the cost per ton cannot be below $0, as there are some actual, baseline costs required to recycle a ton of material.
At the high cost end, there are fewer constraints. For example, a recycler with low tonnage and high fixed costs could end up with a very high cost per ton.

Each of the four histograms also shows a slight "bump" to the right-hand side, with slightly more RCs with higher cost per ton values than might be expected on a pure right-skewed normal distribution curve. We evaluated whether this could be a bimodal distribution. We determined that rather than a clear pattern of two subpopulations that would explain a typical bimodal distribution, each with a distinct and somewhat equal mode (height of each curve), the slight bump reflects minor inconsistencies in recycler costs and operations, which generally do not follow a straight linear relationship between costs and tons.

Exhibit 3-26
2014 Sampled Processing Fee Recyclers, Distribution of Aluminum Cost per Ton

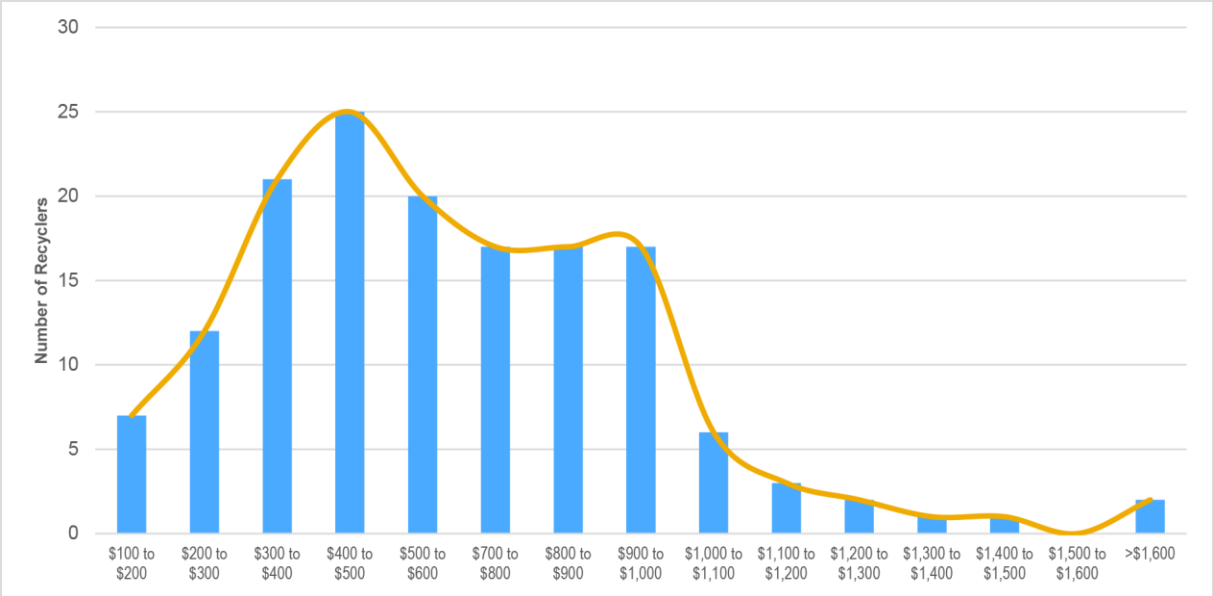


Exhibit 3-27
2014 Sampled Processing Fee Recyclers, Distribution of Glass Cost per Ton

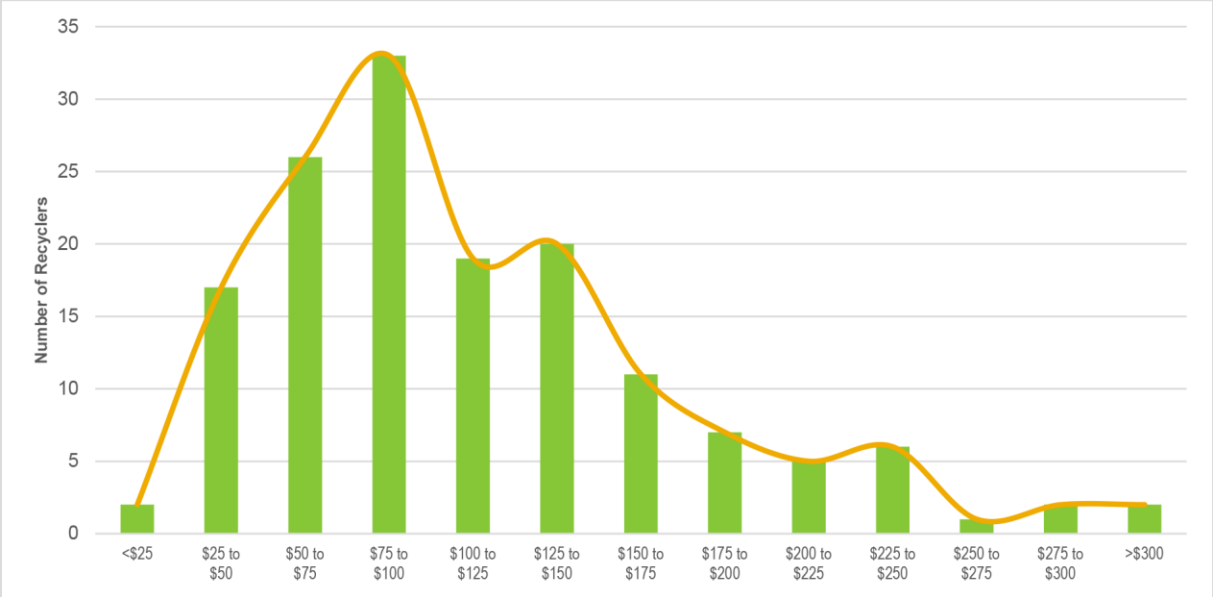


Exhibit 3-28
2014 Sampled Processing Fee Recyclers, Distribution of PET #1 Cost per Ton

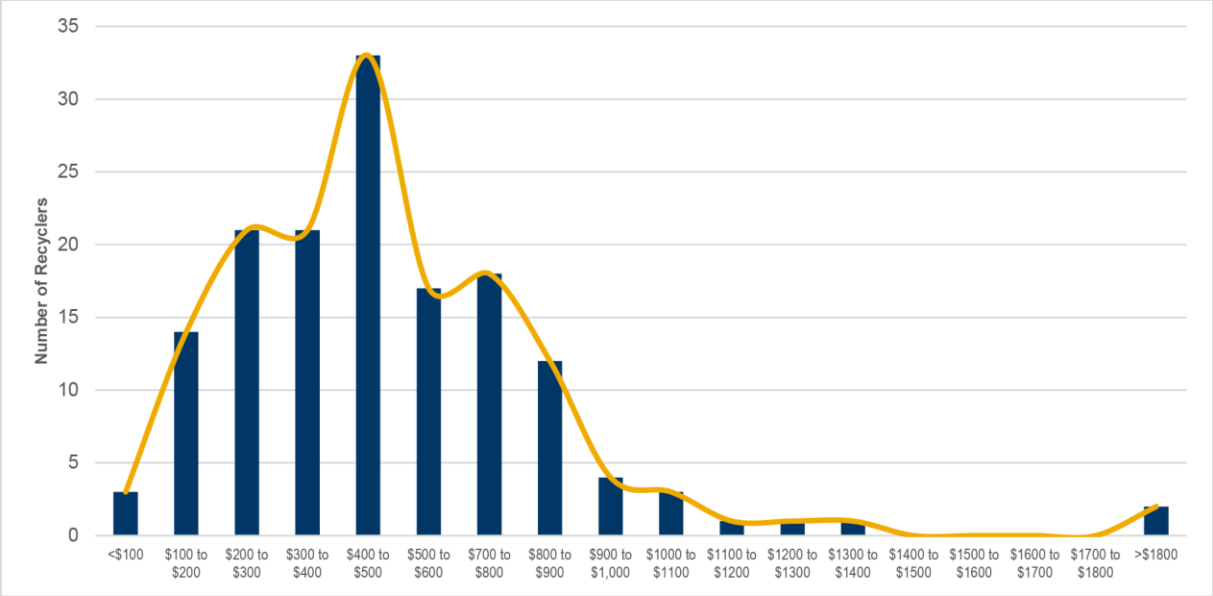


Exhibit 3-29
2014 Sampled Processing Fee Recyclers, Distribution of HDPE #2 Cost per Ton

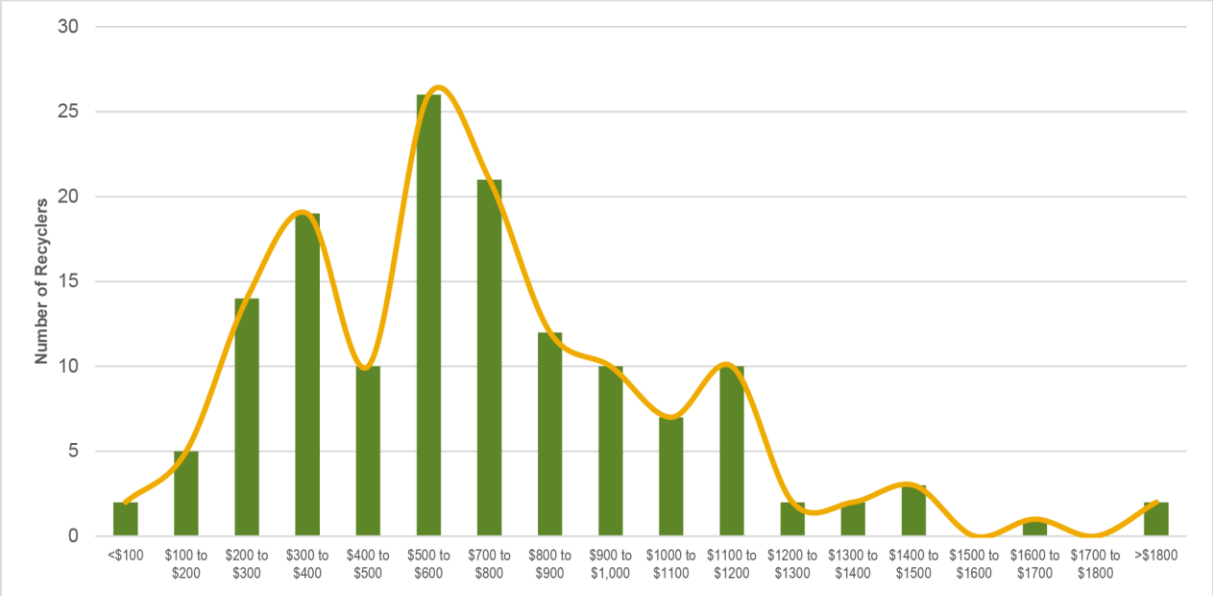
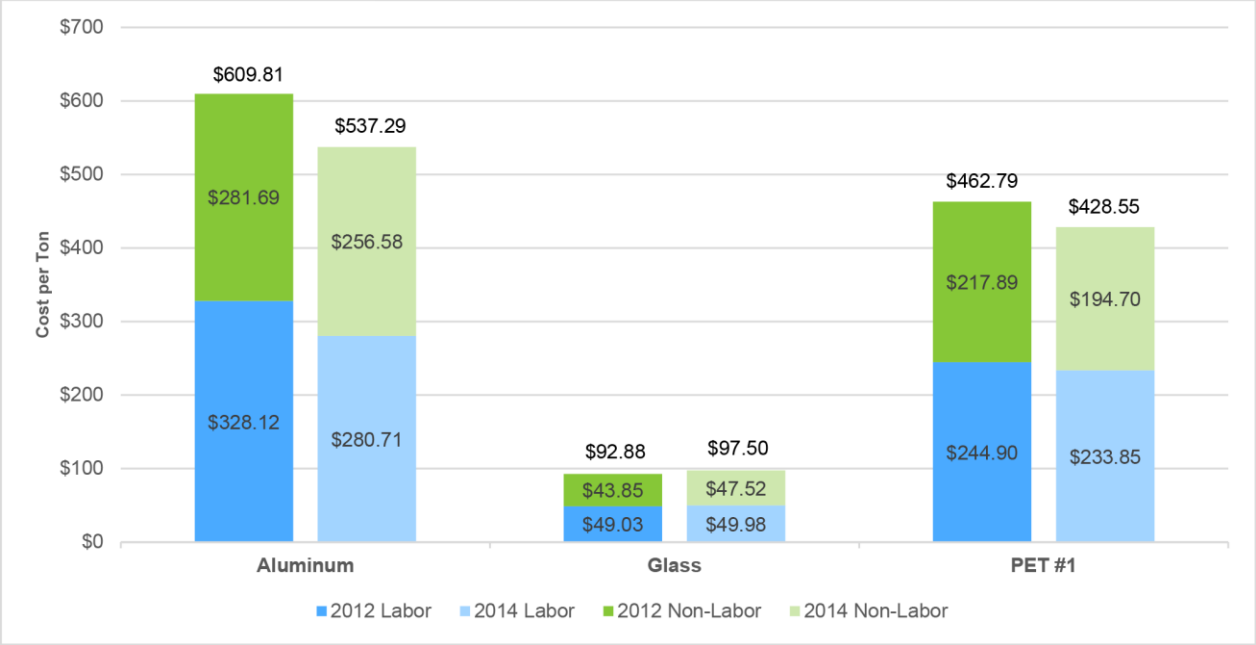


Exhibit 3-30
2012 and 2014 Sampled Processing Fee Recyclers
Labor and Non-Labor Costs per Ton



Labor and Non-Labor Costs

We also determined the labor and non-labor portions of cost per ton for the 2012 and 2014 cost survey, and compared how the two cost components changed between the two surveys. **Exhibit 3-30,** above, shows that, for each material type, labor accounts for just slightly more than one-half of the cost per ton. The shares of labor and non-labor cost per ton are generally consistent between the two survey years, further validating our survey methodology.

Labor costs decreased between 2012 and 2014 for aluminum and PET #1 and increased only slightly for glass. We showed earlier that average hourly wages declined slightly between 2012 and 2014, and that hours per ton recycled increased for glass and plastic and decreased for aluminum. Therefore, the increase in the labor cost component of cost per ton is, on average, due primarily to RCs spending more time for each ton of CRV recycled, not due to higher average hourly wages.

The two analyses presented above provide considerable confidence in our sample design and cost survey labor allocation methodologies that were the basis of the 2014 cost per ton results. The results also demonstrate a consistency in the cost survey labor allocation methodology between the 2012 and 2014 cost surveys.

H. Summary of Processing Fee Cost Analyses

Compared to 2012, the 2014 cost per ton decreased for aluminum (-12 percent), PET #1 (-7 percent) and HDPE (-14 percent) and increased for glass (5 percent). When considering historical shifts, population dynamics and changes in cost and volume, these changes are within the range of expectation.

- When comparing 2012 and 2014 full populations, volumes for have declined for the four major materials. At the same time, the number of recyclers has decreased, the first time since 2004.
- Cost per ton has decreased for aluminum and PET #1 in large part due to increases in average tons per recycler outpacing increases in average costs per recycler within the sample.
- Cost per ton has increased for glass in large part due to shifts in stratum populations between 2012 and 2014. A significantly higher proportion of volume was handled by strata 2 and 3 recyclers in 2014 when compared to 2012.
- Labor hours per ton has decreased slightly for aluminum, glass, and plastic. Sampled average wage per hour has decreased slightly when compared to 2012.
- The 2014 cost per ton methodology and results are valid. Statewide weighted averages for each material aligns appropriately to stratum averages, histograms of cost per ton distributions show normal, right-skewed distributions, and proportion of labor and non-labor costs per ton align to those of 2012.
- For all four major materials, the statewide weighted-average cost per ton is just below the stratum 2 weighted-average cost per ton, further reflecting consistency in results across material types.

4. Processing Payments and Processing Fees

This section describes how processing payments and processing fees are calculated; compares the 2004, 2006, 2008, 2010, 2012, 2014, and 2016 processing payments and processing fees; and examines historical scrap value trends. The section is organized as follows:

A. Processing Payment and Processing Fee Calculations
B. Scrap Values
C. Comparison of Historical Processing Payments and Processing Fees

A. Processing Payment and Processing Fee Calculations

Section 14575(a) of the California Beverage Container Recycling and Litter Reduction Act specifies that "if any type of empty beverage container with a refund value established pursuant to Section 14560 has a scrap value less than the cost of recycling, the Department shall, on January 1, 2000, and on or before January 1 annually thereafter, establish a processing fee and a processing payment for the container, by the type of the material of the container."

The original intent of the processing payments and processing fees was that each container type should cover its own cost of recycling. For example, if the scrap value for glass was not enough to cover the cost of recycling glass, then the processing fee, paid by beverage manufacturers and passed through to recyclers, would cover that additional cost. Thus, the processing fee would, in theory, create an incentive for beverage manufacturers to use material types that were less costly to recycle, and/or that did not have a processing fee. At the same time, the recycler, who was required to accept these materials because of the beverage container program, would not suffer a loss.

The processing payment is defined as the difference between the statewide, weighted-average cost of recycling (as determined by this cost to recycle survey), multiplied by a reasonable financial return and a cost of living adjustment (COLA), and the average scrap value paid to recyclers (for the period October through September of the previous year). The equation is as follows:

$$\text{Processing Payment} = (\text{Cost of Recycling} \times \text{Reasonable Financial Return} \times \text{COLA}) - (\text{Scrap Value})$$

The processing payment is paid by CalRecycle to processors, who then pass the payment on to recyclers, based on the weight of material redeemed.

The processing fee, earlier in the history of the beverage recycling program, was equal to the processing payment, and was paid to CalRecycle by beverage manufacturers on

every container sold. Over time, the processing fee has been modified, and currently, when adequate funds are available in the Beverage Container Recycling Fund, the amount of processing fee paid by manufacturers is reduced, depending on the recycling rate of the material. When funds are available, the difference between the processing fee paid to the Department, and the processing payment paid to recyclers, is made up with funds from the California Beverage Container Recycling Fund, essentially from CRV paid on unredeemed containers.

In 2003, AB 28 established the current system whereby unredeemed funds, when available, are used to subsidize the processing fee by a minimum of 35 percent, up to 90 percent, depending on the recycling rate (and availability of funds).

Under current statutory requirements, the processing fee for a given container type is equal to a specified percentage of the processing payment, depending on the recycling rate in the previous fiscal year, as shown in **Exhibit 4-1,** below. The fiscal year 2014/2015 recycling rates were used to determine the maximum processing fee reduction factors for glass, bimetal, and plastic resins. **Exhibit 4-2,** below, shows the actual percent of processing payment for each material type. The percent of processing payment is multiplied by the processing payment for each material to determine the amount of processing fee paid by beverage manufacturers.

Exhibit 4-1
Processing Fee Reduction Factors with Adequate Funds

Recycling Rate	Percent of Processing Payment	Recycling Rate	Percent of Processing Payment
75 percent or above	10 percent	45 to 49 percent	15 percent
65 to 74 percent	11 percent	40 to 44 percent	18 percent
60 to 64 percent	12 percent	30 to 39 percent	20 percent
55 to 59 percent	13 percent	Less than 30 percent	65 percent
50 to 54 percent	14 percent		

Exhibit 4-2
Processing Fee Reduction Factors for January 1, 2016, Processing Fees

Material	Percent of Processing Payment	Material	Percent of Processing Payment
Glass	11 Percent	PP #5	65 Percent
PET #1	11 Percent	PS #6	65 Percent
HDPE #2	11 Percent	Other #7	65 Percent
PVC #3	20 Percent	Bimetal	65 Percent
LDPE #4	65 Percent		

Exhibit 4-3
Processing Fees Public Notice (December 15, 2015)

Table I 2016 Processing Fees Effective January 1, 2016 Glass, Bimetal and Plastic									
		Plastic							
	Glass	PET	HDPE	Vinyl	LDPE	PP	PS	Other	Bimetal
Cost of Recycling per Ton with Reasonable Financial Return & COLA	$99.97	$439.41	$537.52	$845.55	$1,206.25	$1,082.16	$670.31	$734.43	$677.40
Scrap Value per Ton	-$1.10	$273.45	$354.51	$0.31	$26.61	$17.78	$107.55	$28.20	$53.37
Processing Payments to All Participant Types									
Processing Payment Per Ton Redeemed	$101.07	$165.96	$183.01	$845.24	$1,179.64	$1,064.38	$562.76	$706.23	$624.03
Processing Payment Per Pound Redeemed (To be used on DR6)	$0.05054	$0.08298	$0.09151	$0.42262	$0.58982	$0.53219	$0.28138	$0.35312	$0.31202
Processing Fees to be Paid by Beverage Manufacturers									
Manufacturers' Percentage of Processing Payment	11%	11%	11%	20%	65%	65%	65%	65%	65%
Processing Fee Pursuant to Section 14575(f)	$0.00293	$0.00043	$0.00140	$0.00755	$0.00924	$0.05765	$0.00166	$0.07173	$0.03027
Section 14575(j) Processing Fee Reduction	$0.00061	$0.00019	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Processing Fee to be Paid by Beverage Manufacturers	**$0.00232**	**$0.00024**	**$0.00140**	**$0.00755**	**$0.00924**	**$0.05765**	**$0.00166**	**$0.07173**	**$0.03027**

Exhibit 4-3, above, is a copy of the 2016 Processing Fees notice, published by CalRecycle on December 15, 2015. The exhibit provides components of the processing payment calculations, as well as the processing payments per ton and per pound; and the processing fees per container. Exhibit 4-3 also documents the Section 14575(f) reduction in the processing fee for glass and PET #1.

B. Scrap Values

CalRecycle is required to calculate the average scrap values paid to recyclers for the 12 months between October 1 and September 30 directly preceding the year for which processing payments and fees are calculated. For example, for the January 1, 2016, processing payments and fees, the average scrap value used for the calculation covers the time period from October 1, 2014, to September 30, 2015.

Section 2955 of the California Code of Regulations specifies how CalRecycle shall conduct the scrap value survey. CalRecycle surveys all certified processors each month using a standard form, the Scrap Value Purchases Survey Form. Processors are required to complete the form and submit it to CalRecycle by the tenth day of the following month. CalRecycle publishes average scrap values monthly and reports the final annual (October through September) average scrap value for use in the processing payment and processing fee calculations, by December 1.

Exhibit 4-4
Statewide Average Scrap Values for the January 1, 2016, Processing Payment and Processing Fee Calculations

Material	Scrap Value (per Ton)	Material	Scrap Value (per Ton)
1. Aluminum	$1,450.42	6. PVC #3	0.31
2. Glass	(1.10)	7. LDPE #4	26.61
3. PET #1	273.45	8. PP #5	17.78
4. HDPE #2	354.51	9. PS #6	107.55
5. Bimetal	53.37	10. Other #7	28.20

The annual average scrap values for the 10 beverage container material types from October 1, 2014, through September 30, 2015, are shown in **Exhibit 4-4,** above. These were the values used for the January 1, 2016, processing payment and processing fee calculations.

C. Comparison of 2004, 2006, 2008, 2010, 2012, 2014, and 2016 Processing Payments and Processing Fees

In any given year, processing payments and processing fees reflect the combined results of the cost survey and scrap value survey. **Exhibit 4-5,** below, compares the processing payments for the nine relevant material types for the years following the seven most recent cost surveys, i.e., for the January 1, 2004, 2006, 2008, 2010, 2012, 2014, and 2016 processing payments to recyclers. **Exhibit 4-6,** on the next page, compares the percent change in the processing payment per ton between each succeeding cost survey.

Exhibit 4-5
Comparison of Processing Payments (per Ton)
(2004-2016, every 2 years)

Material	Processing Payment per Ton						
	2004	2006	2008	2010[a]	2012	2014	2016
1. Glass	$74.52	$83.68	$94.52	$66.87	$88.26	$94.72	$101.07
2. PET #1	330.41	226.39	197.68	249.44	0.00	117.26	165.96
3. HDPE #2	510.62	402.65	216.33	207.77	289.94	317.56	183.01
4. Bimetal	519.70	629.54	920.47	654.52	797.66	801.93	624.03
5. PVC #3	1,079.05	1,658.89	755.49	834.62	980.95	1,066.50	845.24
6. LDPE #4	3,395.76	1,511.58	1,919.68	1,189.57	1,248.65	1,263.96	1,179.64
7. PP #5	1,516.52	686.77	831.95	1,068.99	1,294.45	1,219.73	1,064.38
8. PS #6	6,293.42	3,085.51	871.41	650.27	786.51	772.55	562.76
9. Other #7	770.83	1,273.97	687.68	724.4	837.07	852.64	706.23

[a] Includes the proportional reduction required due to insufficient funds.

Exhibit 4-6
Comparison of the Percent Change in Processing Payments (per Ton)
(2004-2016, every 2 years)

Material	Percent Change					
	2004 to 2006	2006 to 2008	2008 to 2010	2010 to 2012	2012 to 2014	2014 to 2016
1. Glass	12%	13%	-29%	32%	7%	7%
2. PET #1	-31%	-13%	26%	-100%	n/a	42%
3. HDPE #2	-21%	-46%	-4%	40%	10%	-42%
4. Bimetal	21%	46%	-29%	22%	1%	-22%
5. PVC #3	54%	-54%	10%	18%	9%	-21%
6. LDPE #4	-55%	27%	-38%	5%	1%	-7%
7. PP #5	-55%	21%	28%	21%	-6%	-13%
8. PS #6	-51%	-72%	-25%	21%	-2%	-27%
9. Other #7	65%	-46%	5%	16%	2%	-17%

The 2010 processing payments reflect the proportional reductions implemented in November 2009. In 2012 for the first time in the history of the program there was no processing payment or processing fee for PET #1. PET #1 scrap values have since declined, and a PET #1 processing fee and processing payment was reinstated in 2013. January 1, 2016, processing payments to recyclers for glass and PET #1, increased while processing payments to recyclers for all other materials decreased between 2014 and 2016.

Processing fees are paid by beverage manufacturers on each beverage container sold. **Exhibit 4-7,** on the next page, compares the per container processing fees from 2004 to 2016 (every two years). **Exhibit 4-8,** on the next page, compares the percent change in the per container processing fees between each succeeding cost survey.

The 2010 processing fees reflect the proportional reduction in processing fee subsidies, resulting in the several-fold increase in processing fees for glass, PET #1, and HDPE #2, as compared to 2008. The January 1, 2016, processing fees also includes the Section 14575(f) reduction in processing fees for glass and PET #1. The variability in processing fees for the minority materials is due to variations in the cost to recycle and scrap values.

Exhibit 4-7
Comparison of Processing Fees (per Container)
(2004-2016, every 2 years)

Material	Processing Fee per Container						
	2004	2006	2008	2010[b]	2012	2014	2016
1. Glass	$0.00181	$0.00229	$0.00240	$0.01373	$0.00237	$0.00182	$0.00232
2. PET #1	0.00167	0.00159	0.00072	0.00569	0.00000	0.00016	0.00024
3. HDPE #2	0.01042	0.00503	0.00216	0.01821	0.00213	0.00215	0.00140
4. Bimetal	0.02194	0.02557	0.04825	0.04526	0.04470	0.03671	0.03027
5. PVC #3	0.03578	0.05501	0.02525	0.02768	0.01194	0.03895	0.00755
6. LDPE #4	0.03153	0.01181	0.01691	0.00982	0.01082	0.01017	0.00924
7. PP #5	0.07468	0.0248	0.09013	0.10857	0.04727	0.04505	0.05765
8. PS #6	0.0293	0.01437	0.00507	0.00176	0.00227	0.00223	0.00166
9. Other #7	0.0216	0.03664	0.04217	0.05009	0.07353	0.08660	0.07173

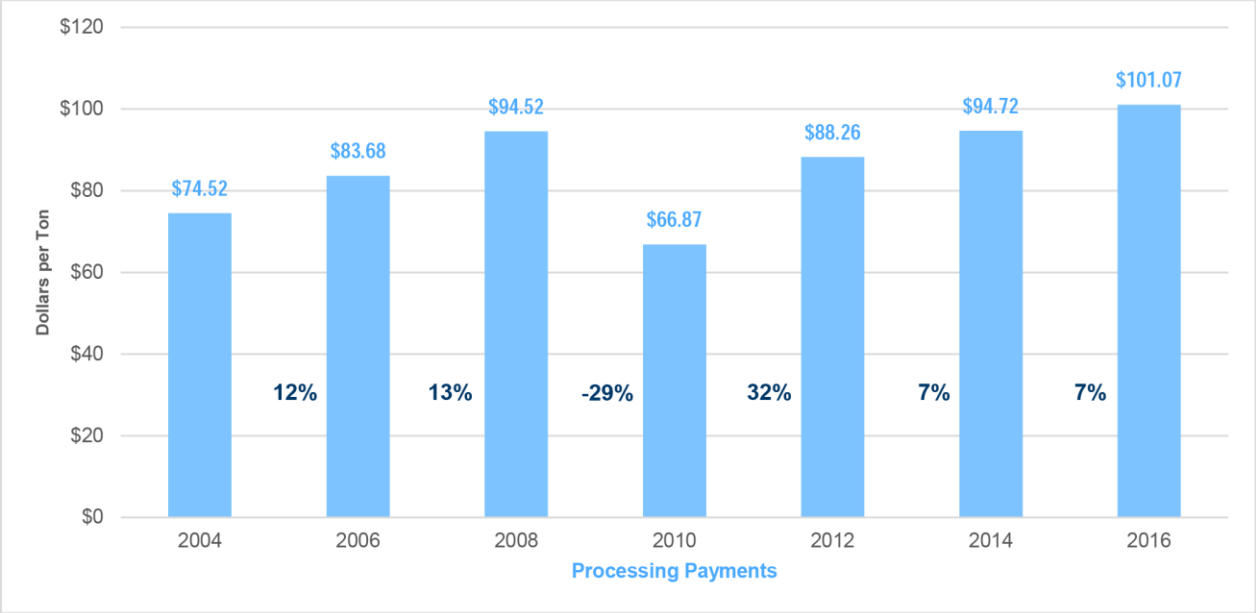
[b] Includes an increased manufacturer's percentage share as a result of the proportional reduction required due to insufficient funds.

Exhibit 4-8
Comparison of the Percent Change in Processing Fees (per Container)
(2004-2016, every 2 years)

Material	Percent Change					
	2004 to 2006	2006 to 2008	2008 to 2010	2010 to 2012	2012 to 2014	2014 to 2016
1. Glass	27%	5%	472%	-83%	-23%	27%
2. PET #1	-5%	-55%	690%	-100%	n/a	50%
3. HDPE #2	-52%	-57%	743%	-88%	1%	-35%
4. Bimetal	17%	89%	-6%	-1%	-18%	-18%
5. PVC #3	54%	-54%	10%	-57%	226%	-81%
6. LDPE #4	-63%	43%	-42%	10%	-6%	-9%
7. PP #5	-67%	263%	20%	-56%	-5%	28%
8. PS #6	-51%	-65%	-65%	29%	-2%	-26%
9. Other #7	70%	15%	19%	47%	18%	-17%

Exhibits 4-9, 4-10, and **4-11,** beginning on the next page, compare the processing payments and processing fees for 2004, 2006, 2008, 2010, 2012, 2014, and 2016 for the three majority material types, glass, PET #1, and HDPE #2. The percentage label next to the bars represents the percent change from two years prior.

Exhibit 4-9
Comparison of Glass Processing Payments and Processing Fees
(2004-2016, every 2 years)



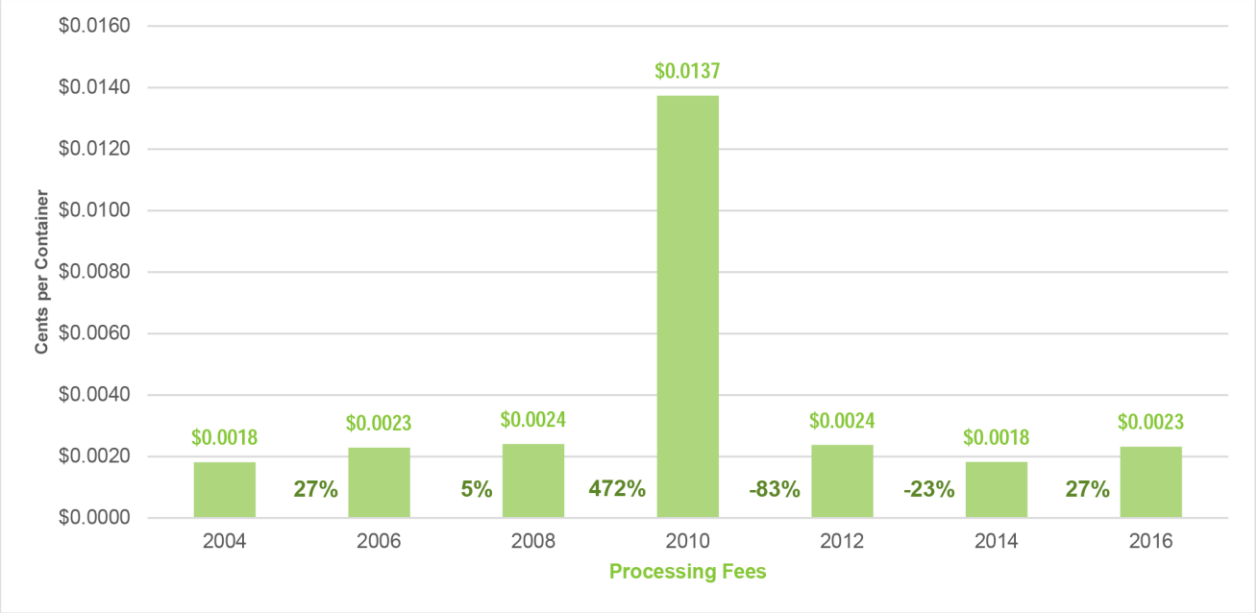
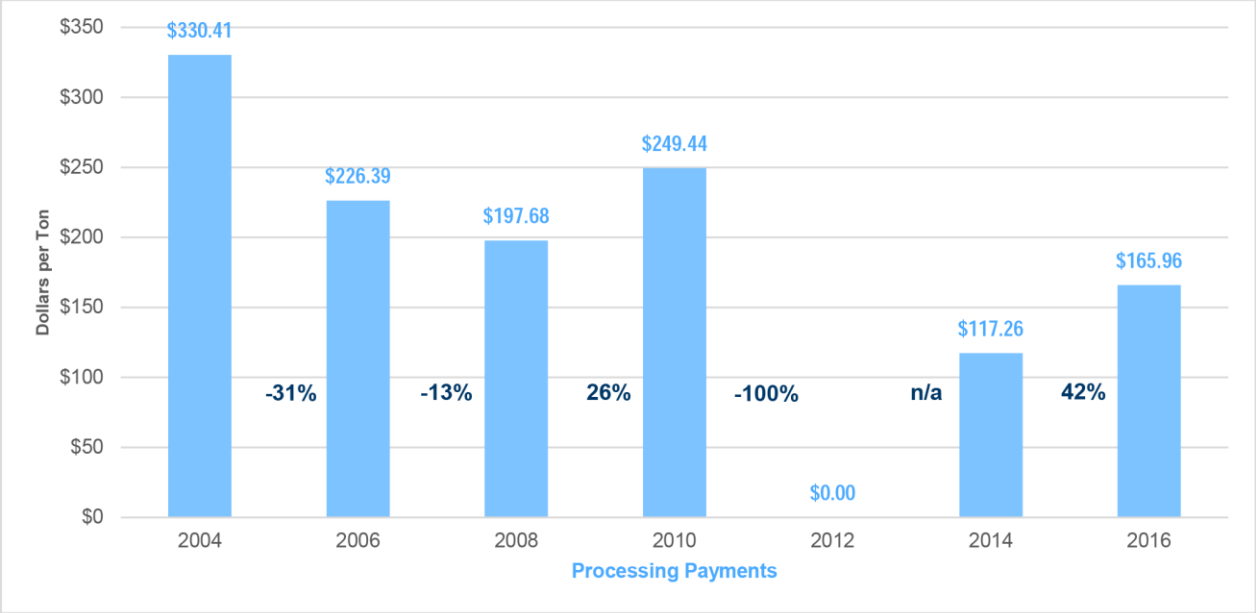


Exhibit 4-10
Comparison of PET #1 Processing Payments and Processing Fees
(2004-2016, every 2 years)



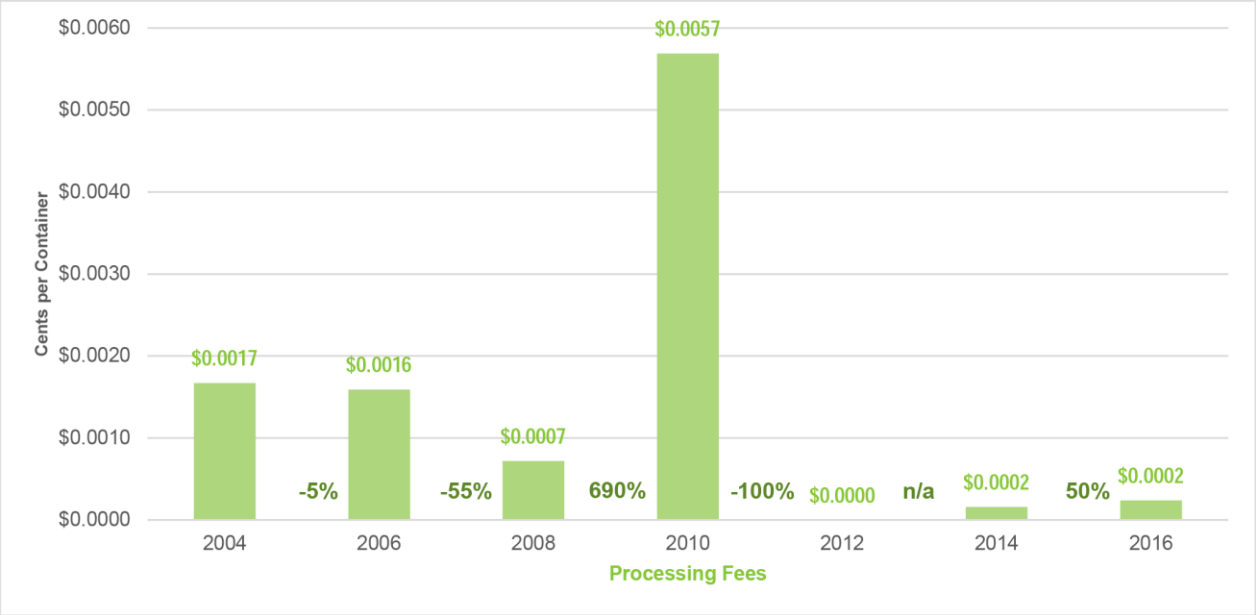


Exhibit 4-11
Comparison of HDPE #2 Processing Payments and Processing Fees
(2004-2016, every 2 years)