2018 Processing Fee Cost Survey: Final Report

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Produced Under Contract by Crowe

CalRecycle

California Department of Resources Recycling and Recovery

2018 Processing Fee Cost Survey

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Acknowledgments

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Executive Summary

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

This executive summary is organized as follows:

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A. Processing Fee Cost Survey Background

In 1986, the California State Legislature enacted the California Beverage Container Recycling and Litter Reduction Act (AB 2020, Margolin, Chapter 1290). This “bottle bill” program is the only one of its kind in the nation in terms of this unique program structure.

A major subprogram 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 Beverage Container Recycling Program (BCRP) are required to redeem all beverage container material types. Scrap values of glass, plastics, and bi-metal 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 program, including a reasonable financial return (RFR), a cost of living adjustment (COLA), 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 a material scrap value is high enough to cover recycling costs, including a reasonable financial return and COLA, no processing fee is imposed. If a material scrap value is less than the statewide, weighted-average recycling costs, including a reasonable financial return and COLA, then a processing fee is supposed to make up this difference, or net cost.

Since their inception, processing fees, and calculated recycler costs, have been controversial. Processing fees have been the subject of numerous studies, task forces, and legislation. Originally, processing fees were to be automatically equal to the net cost of recycling the subject beverage containers, as measured by studies. Instead, processing fees have fluctuated from year-to-year, depending on legislative, legal, and regulatory policy decisions.

The study approach to calculating the cost of recycling has evolved significantly since inception of the program, as the Department of Conservation (now CalRecycle) continually improved recycler costing methodologies over the first seventeen years of the program. The current labor allocation cost survey methodology was last formally refined in approximately 1995.

Formulating the cost of recycling to determine processing payments and fees is a large cost accounting and statistical challenge, rivaling technical requirements of state-of-the-art, activity-based costing and statistical survey techniques used by private industry. CalRecycle has been innovative in meeting the intent of AB 2020, measuring recycler costs for a system that does not systematically track and measure these costs.

Between 1992 and 2001, processing fees and processing payments were based on legislatively set costs of recycling. Senate Bill 332 (Sher, Chapter 815, Statutes of 1999) required CalRecycle to conduct cost surveys every third year (starting in year 2000, for the 2001 processing fees). The statute requires CalRecycle to measure actual 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.

CalRecycle conducted a processing fee cost survey in year 2000, using 1999 calendar year costs, for the January 1, 2001 processing fees. This was the first of the “every three 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 (Jackson, Chapter 753, 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 CalRecycle to determine the actual costs for certified recycling centers on and after January 1, 2004, every second year. CalRecycle has been conducting processing fee cost surveys every two years since 2002. The next cost survey after this report will have recycler center costs surveyed in 2021 (using 2020 financial statements), for a processing fee effective January 1, 2022.

Assembly Bill 3056 (Committee on Natural Resources, Chapter 907, 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 [PF] recyclers), and recycling centers that do receive handling fees (handling fee [HF] recyclers). Results of the handling fee cost survey will be discussed in a separate report.

B. Processing Fee Cost Survey Objectives

This processing fee cost survey was used to estimate California statewide, weighted-average, 2018 certified recycler costs per ton for four beverage container material types, and the percent change in HDPE #2 cost per ton between 2016 and 2018. Recycler center costs were surveyed and analyzed in 2019 (mid-April through mid-November), using recycler center calendar year 2018 financial statements. Recycler center costs measured by this survey will be used for the processing fee calculation, effective January 1, 2020.

This overall 2018 processing fee cost survey had a slightly higher sample size as compared to the previous three processing fee cost surveys (154 unique sites). The Crowe team completed 154 recycler cost surveys during 27 weeks of field work (May 2, 2019 to October 31, 2019) 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. Finally, this cost survey generally achieved the same high level of accuracy as prior cost surveys undertaken by CalRecycle.

Historically, processing fees have been imposed on bi-metal, glass, and PET (# 1 resin type) plastic materials. When additional plastic resin types were incorporated into the AB 2020 program in year 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** identifies plastic beverage container resin types.

Exhibit ES-1
Plastic Resin Types

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

C. Processing Fee Cost Survey Results

The statewide recycler costs per ton for the ten material types in the beverage container recycling program are presented in **Exhibit ES-2.** Exhibit ES-2 compares 2018 costs per ton to the eight prior cost surveys in which CalRecycle measured recycler costs (even years 2002 through 2016). Note that costs per ton in Exhibit E-2 are not adjusted for inflation or reasonable financial return (RFR). **Exhibit ES-3** provides the two-year percent change in cost per ton between cost surveys. The 2018 cost per ton results are higher than 2016 results and are also higher than costs per ton from prior survey years. However, the increased costs per ton are less dramatic if we compare annual cost per ton adjusted by Consumer Price Index (CPI).* **Exhibit E-4** provides a comparison of CPI-adjusted costs per ton for aluminum, glass, PET #1, and HDPE #2 using the U.S. Department of Labor, Bureau of Labor Statistics, West Urban CPI. While 2018 costs are still relatively high, they are not as high as several prior years when adjusted by CPI.

* Source: http://www.dof.ca.gov/Forecasting/Economics/ Indicators/Inflation/

Exhibit ES-2
Summary Comparison of Statewide Costs per Ton Survey Results for Processing Fee Recyclers (2002–2018)

Material Type	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**$626.61**	$539.11	$537.29	$609.81	$537.06	$559.23	$516.13	$465.90	$418.95
2. Glass	**132.68**	101.04	97.50	92.88	89.76	81.60	94.98	82.45	79.81
3. PET #1	**502.44**	421.30	428.55	462.79	440.61	426.76	477.73	493.31	479.63
4. HDPE #2	**838.00**	547.11	524.23	612.50	611.62	501.67	500.64	671.73	645.91
5. Bi-Metal	**1,056.35**	689.66	660.65	771.88	770.80	632.22	883.55	607.03	508.18
6. PVC #3	**1,318.18**	860.60	824.65	963.49	962.14	789.16	731.37	1,583.72	1,064.52
7. LDPE #4	**1,880.50**	1,227.72	1,176.43	1,374.50	1,372.58	1,125.80	1,858.09	1,889.50	3,324.89
8. PP #5	**1,687.06**	1,101.43	1,055.41	1,233.10	1,231.38	1,009.99	787.83	809.42	1,478.77
9. PS #6	**1,044.99**	682.24	653.74	763.80	762.73	625.60	623.11	3,051.82	6,137.30
10. Other #7	**1,144.95**	747.50	716.27	836.86	835.69	685.44	741.93	1,264.47	759.32

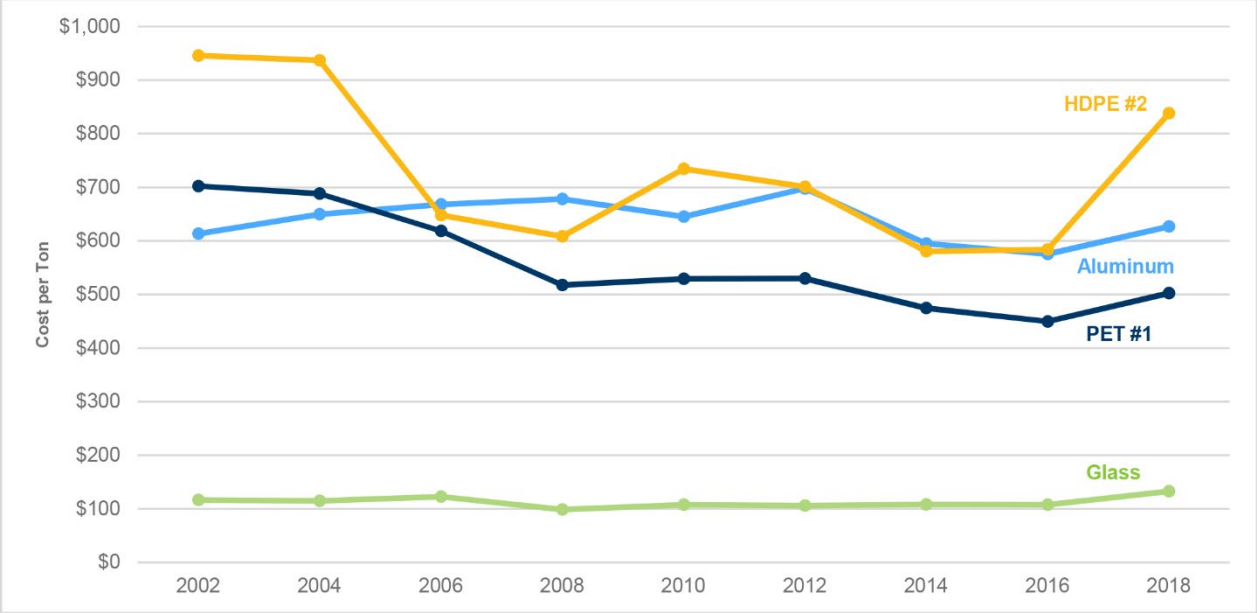
Note: Without reasonable financial return (RFR).

Exhibit ES-3
Two-Year Percent Change in Statewide Recycler Cost per Ton, by Material Type (2012–2018)

Material Type	2016 to 2018	2014 to 2016	2012 to 2014	2010 to 2012	2008 to 2010	2006 to 2008	2004 to 2006	2002 to 2004
1. Aluminum	**16%**	0.3%	-12%	+14%	-4%	+8%	+11%	+11%
2. Glass	**31%**	3.6%	+5%	+3%	+10%	-14%	+15%	+3%
3. PET #1	**19%**	-1.7%	-7%	+5%	+3%	-11%	-3%	+3%
4. HDPE #2	**53%** [a]	4.4%[a]	-14%[a]	0%[a]	+22%[a]	0%	-25%	+4%
5. Bi-Metal	**53%**	4.4%	-14%	0%	+22%	-28%	+46%	+19%
6. PVC #3	**53%**	4.4%	-14%	0%	+22%	+8%	-54%	+49%
7. LDPE #4	**53%**	4.4%	-14%	0%	+22%	-39%	-2%	-43%
8. PP #5	**53%**	4.4%	-14%	0%	+22%	+28%	-3%	-45%
9. PS #6	**53%**	4.4%	-14%	0%	+22%	0%	-80%	-50%
10. Other #7	**53%**	4.4%	-14%	0%	+22%	-8%	-41%	+67%

[a] The 53 percent change from 2016 to 2018, 4.4 percent change from 2014 to 2016, the -14 percent change from 2012 to 2014, the 0 percent change from 2010 to 2012, and the 22 percent from 2008 to 2010 are rounded. Between 2016 and 2018, the actual HDPE percent change was 53.17 percent. Between 2014 and 2016, the actual HDPE percent change, which was used to calculate bi-metal, and plastics #3 to #7, cost per ton was 4.36 percent. Between 2012 and 2014 the actual percent change was -14.44percent. Between 2010 and 2012 the actual percent change was 0.14 percent. Between 2008 and 2010, the actual HDPE percent change for the same calculation was 21.92 percent.

Exhibit ES-4
CPI Adjusted Statewide Recycler Costs per Ton, by Material Type



Aluminum

The increase in aluminum cost per ton to $626.61 is higher than each of the prior eight surveys. Total tons of aluminum recycled by the processing fee recycler survey population has continued to decline, and at 66,714 tons is lower than all cost survey years. This continued decline in aluminum likely reflects the ongoing market shift from aluminum to PET beverage containers and CalRecycle's ongoing enforcement activity. On a per-recycler basis, average tons of aluminum recycled per year increased in 2018 to the highest level since 2010. The increase was a result of the smaller number of recycling centers, rather than an increase in aluminum recycling. In general, the increased quantity of aluminum per recycler would tend to improve recycler profitability as compared to 2012, 2014, and 2016. However, average tons of aluminum per recycler are still 8 percent lower than between the 2002 and 2010 average. In 2018, aluminum made up over 16 percent of tons of CRV material recycled by the population, a decline from 2016.

Glass

The glass cost per ton to recycle increased 31 percent from 2016 to 2018 to $132.68. This continues a trend of increased glass costs since 2008, resulting in a cost per ton over $100 for the second time. Glass volumes continued to decline between 2016 and 2018, compared to the stabilized levels between 2014 and 2016, following a large decrease between 2012 and 2014. Total glass volumes in 2018 were lower than all but 2002 levels. The average tons of glass recycled per year on a per-recycler basis

increased from 268 tons to 342 tons, reversing the decline between 2012 and 2014. In 2018 glass made up its lowest historical percent share of CRV material recycled. In 2018, glass made up 56 percent of tons of CRV material recycled, compared to a high of 67.8 percent in 2002.

PET #1

The 19 percent increase in the cost per ton to recycle PET #1, $502.44, is higher than the PET #1 cost per ton determined by the prior eight surveys. For PET #1, the costs have generally fluctuated year to year within a relatively narrow band (now $421 to $502 per ton). Tons of PET #1 recycled decreased 2 percent from 2016 to 2018, almost as high as 2016 and the peak in 2012. However, on a per-recycler basis, average tons recycled per year increased to the highest level yet, from approximately 107 tons in 2012 and 2014 to 160 tons in 2018. In 2018, PET #1 made up its greatest share of CRV materials recycled, at 26 percent.

HDPE #2

HDPE #2 cost per ton increased 53 percent, to a level above the prior eight surveys, and significantly above the aluminum cost per ton. HDPE #2 costs per ton is based on the sub model and relative costs compared to PET and to a lesser extent other plastics. The requirement to redeem separated CRV-only material continued to have an impact on HDPE #2 recycling in 2018. HDPE #2 is the only beverage container material to have a commingled rate significantly lower than 100 percent because recyclers continue to receive (and separate) large volumes of non-CRV HDPE #2. This results in a low commingled rate. The decreased HDPE #2 commingled rate (approximately 70 percent) was far lower than all other minority plastics, impacting the allocation of costs across plastics. In addition, the PET commingled rate increased to almost 100 percent. These changes increase costs for HDPE, reflecting the additional cost of sorting non-CRV HDPE from HDPE beverage containers. Another factor driving up HDPE costs per ton is that HDPE overall volumes and tons per recycler both decreased. Tons of HDPE #2 declined 21 percent between 2016 and 2018, the lowest level since 2002. These two factors, commingled rates and lowered volumes, are likely the primary reasons for the big percent increase for HDPE, relative to the 16 percent to 31 percent increases among aluminum, glass, and PET #1.

Bi-Metal and Plastics #3 to #7

This is the fifth processing fee cost survey that the cost per ton for bi-metal 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 five 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 five percent of total containers recycled).

In calendar year 2018, HDPE #2 made up only 0.9 percent of all beverage containers recycled. Bi-metal and plastics #3 through #7 made up between 0.04 percent and 0.08 percent of containers 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 bi-metal and plastics #3 to #7 was based on the calculated 53 percent increase in HDPE #2 between 2016 and 2018. Thus, for the 2018 cost per ton for each of these six minority materials (bi-metal, PVC #3, LDPE #4, PP #5, PS #6, and Other #7), cost per ton increased by 53 percent.

Error Rates

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 eighth consecutive survey, the 2018 sampling plan was based on a more accurate 90 percent confidence interval, and a 10 percent error rate.

Exhibit ES-5 provides the 2018 sample error rates for each relevant material type. In 2018, 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 below the 10 percent error rate at the 90 percent confidence level threshold.

The error rates in 2018 were consistent with the low error rates for each of the four materials over the prior eight cost surveys. Because bi-metal 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
Sample Error Rates for Processing Fee Recyclers, by Material Type (90% Confidence Interval) (2002–2018)

Material Type	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**7.52%**	6.71%	5.86%	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass	**6.88%**	7.80%	6.49%	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1	**7.40%**	6.11%	6.23%	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2	**8.62%**	6.68%	6.86%	7.63%	7.33%	8.27%	8.97%	7.47%	9.78%
5. Bi-Metal	N/A	N/A	N/A	N/A	N/A	6.89%	8.31%	9.83%	7.57%
6. PVC #3	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
7. LDPE #4	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
8. PP #5	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
9. PS #6	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
10. Other #7	N/A	N/A	N/A	N/A	N/A	9.53%	9.95%	100% Sample	100% Sample

Exhibit ES-6 provides the sample size and method for each of the ten material types. The statewide weighted-average for the major materials—aluminum, glass, PET #1, and HDPE #2—were calculated from a stratified random sample. The sample sizes for glass, PET#1, and HDPE #2 were lower than 154 because a small number of recycling centers in the stratified random sample did not report all four material types.

Exhibit ES-6
Sample Sizes and Sample Method by Material Type (2018)

Material Type	2018 Sample Size	2018 Sample Method
1. Aluminum	**154**	Stratified Random Sample
2. Glass	**152**	Stratified Random Sample
3. PET #1	**153**	Stratified Random Sample
4. HDPE #2	**150**	Stratified Random Sample
5. Bi-Metal	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

Below we summarize eight of the major tasks accomplished over a nine-month time period to complete this processing fee cost survey.

- Developed and documented the sample design framework, and randomly selected recycling centers for the cost survey. We 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.
- Revised and updated the Cost Survey Training Manual and training materials. We continued to update the evolving training manual, based on the heavily streamlined 2016 Cost Survey Training Manual. The manual consists of ten chapters, each emphasizing actions for survey team members to take in the field and when completing site files. The training manual focuses on key areas of learning necessary to successfully conduct cost surveys. In addition, Crowe updated PowerPoint presentations covering topics in the Training

Manual. The presentations include videos of a cost survey site visit, quizzes, and activities specific to each training module.

- Revised and conducted cost survey training consisting of three days of interactive training sessions, training site visits, and a follow-up classroom session. Activities during the first three days included conducting cost survey interview role playing activities, mentoring from experienced survey team members, and completing a site visit cost model and associated documentation. Following the three days of classroom training, each new survey team member conducted at least two cost survey site visits with a highly experienced team member to provide “real-world” experience. The experienced survey team member guided the new team member, with increasing levels of responsibility for the on-site and post-site visit procedures over the course of the visits. Following the field visits, new survey members spent two days working together to complete the site files. The entire survey team reconvened after the training site visits to present and discuss the site visits and review the remainder of the training materials. For this 2018 Cost Survey, Crowe also conducted a two-hour training for Quality Control reviewers, and a two-hour training specific to rePlanet operations.
- Updated and calibrated the Labor Allocation Cost Survey Model, a 14-worksheet, Excel-based computer model that was used to allocate recycling center costs to beverage container material types based on labor allocations. Crowe updated the cost survey model to reflect 2018 container per pound and CRV payment information, as well as procedural changes to the cost survey. In addition, we calibrated the Indirect Cost Allocation Sub-Models for aluminum/bi-metal and all plastics with 2018 survey information. These sub-models, now incorporated into the Labor Allocation Cost Survey Model, ensure rational allocation of costs and labor to bi-metal 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 bi-metal and plastics #3 to #7, the sub-model is still utilized to help determine aluminum, PET #1, and HDPE #2 costs per ton.
- Created a secure SharePoint site for the project team and developed a secure on-line file review system for team members to upload and review survey files. The survey files maintain the functional components of former hard copy documentation (site procedure checklist, site memorandum, site equipment sheet, Excel cost model, signed affidavit, and supporting site labor and financial information), but eliminate the paper-intensive file development and review process of prior cost surveys.
- Scheduled, conducted, and completed 154 recycling center on-site visits during 26 weeks between May 2, 2019, and October 31, 2019, using the statistical sample frame developed by Crowe. Throughout the scheduling and site visits, the Crowe team built upon the field working relationships

established with the program's recyclers in prior years. These on-site working relationships were important to the success of this cost survey and should carry over into future cost surveys. All the cost surveys were conducted by a team of one or two auditors, including accountants and/or recycling experts. It typically took between one to three hours to complete the on-site survey. In addition to the on-site time, usually over 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.

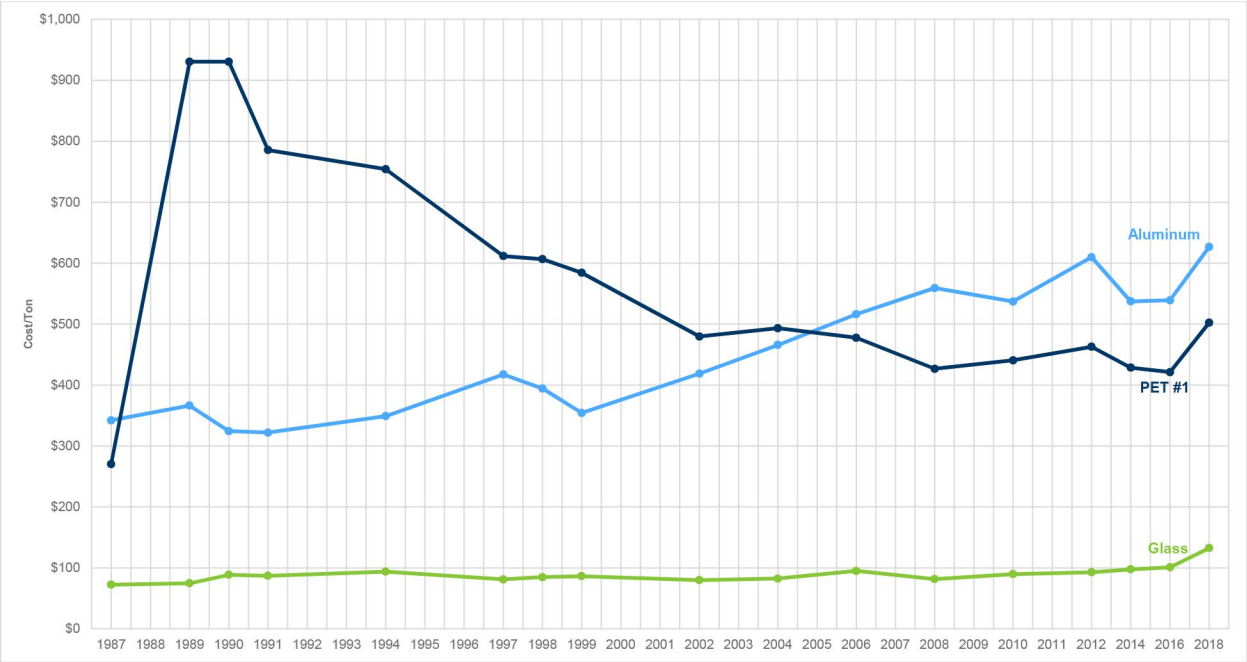
- Developed and implemented an intensive quality control procedure that included thirteen hours, and five different levels of review (site team review, independent first level review, manager review, CPA partner review, and project director review), for each site file. This review took place before the site files were released for data processing and data analysis. These quality assurance steps ensured that each site file was complete and accurate, and ensured that all results from the labor allocation model and the indirect cost allocation sub-models were accurate. In total, over 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 154 completed labor hour allocation cost models. Crowe developed an Excel workbook to calculate total costs by material type, total tons by material type, and for each of the four beverage container material types. Crowe also calculated the percent change in HDPE #2 cost per ton between 2016 and 2018. 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 2018 cost per ton on the percent change in HDPE #2 cost per ton between 2016 and 2018 (bi-metal 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 cost survey. Much of our analyses focused on trying to identify and better understand likely reasons for the changes in costs per ton for aluminum, glass, and PET #1, as compared to the 2016 processing fee cost survey. These analyses included: (1) an examination of historical cost survey results; (2) analysis of changes in recycler population and tonnage; (3) analysis of recycler strata population, tonnage, and cost per ton; (4) analysis of proportional tons and costs by material; and (5) confirmation of our cost survey methodology. These analyses are summarized below:

- Examined historical processing fee cost survey results. This cost survey represented the seventeenth 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-7.**

Exhibit ES-7
Historical Processing Fee Recycler Cost per Ton (without RFR) (1987–2018)



- Evaluated changes in recycling center productivity between 2012, 2014, 2016, and 2018. Between 2016 and 2018, the number of RCs decreased while for many materials the total tons of material recycled also decreased at varying levels. Productivity improved for RCs that recycle aluminum, glass, and PET #1, but costs per ton for these materials and average cost per RC increased from 2016 to 2018.
- Analyzed recycler strata population, tonnage, and cost per ton. It appears that a majority of the recycling center closures in 2018 were small recyclers. The number of PF recyclers in 2018 was consistent with the number of PF recyclers in the mid-2000s. 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, stratum 3 recycling costs for the four primary materials 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 one 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. In addition, in 2018, medium stratum two recyclers also have lower costs than the statewide, weighted-average.

- Confirmed cost survey methodology, including validation of strata definitions, CRV versus Non-CRV labor allocations, and material allocations. The cost per ton results from this 2018 processing fee cost survey are consistent with historical results. 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.
- Performed a cost category comparison between 2016 and 2018 RC costs, including adjusting 2016 RC costs using the CPI of 6.7 percent. Average CRV costs per RC increased by over one-third (35 percent) between 2016 and 2018. Cost categories that account for 95 percent of the increase between 2016 (CPI adjusted) and 2018 costs, were: direct labor, general business overhead, transportation, rent, and maintenance.
- For labor costs, we analyzed 2016 and 2018 CRV hourly wages. We concluded that average CRV hourly wages increased nearly 10 percent between 2016 (adjusted) and 2018. This increase in average CRV wages is in alignment with California's minimum wage increase of $10.00 per hour to $11.00 per hour from 2016 to 2018. We provide additional analyses related to labor in Section 3 of this report.
- For transportation costs, we analyzed 2016 and 2018 average transportation costs per RC. We researched diesel retail prices per gallon† and compared this data with the average transportation costs per recycler center from 2010 to 2018. In 2016, California averaged $2.65 per gallon of diesel, whereas, in 2018, the average price increased to $3.87 per gallon, or an increase of 46 percent. From 2016 to 2018, average transportation costs per recycling center increased roughly 90 percent or nearly double the percentage increase in diesel cost per gallon. We provide additional analyses related to transportation in Section 3 of this report.

† Source: U.S. Energy Information Administration, Annual Retail Gasoline and Diesel Prices: https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_sca_w.htm

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 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 (Fund), essentially from CRV paid on unredeemed containers.

Exhibit ES-8 illustrates the January 1, 2020, per ton processing payments, and per container processing fees.

Exhibit ES-8
Processing Payments and Processing Fees
January 1, 2020

Material Type	Processing Payment (per Ton)	Processing Fee (per Container)
1. Aluminum	None	None
2. Glass	$153.00	$0.00375
3. PET #1	376.14	0.00066
4. HDPE #2	755.38	0.00602
5. PVC #3	1,496.40	0.05014
6. LDPE #4	2,128.76	0.01696
7. PP #5	1,886.32	0.05573
8. PS #6	1,173.60	0.00348
9. Other #7	1,298.23	0.13610
10. Bi-metal	1,196.10	0.04799

G. Summary of Results

As compared to 2016, the 2018 cost per ton to recycle aluminum increased by 16 percent, glass increased by 31 percent, PET #1 increased 19 percent, and HDPE #2 increased 53 percent. These are the most significant cost increases across recent cost surveys. Increased CPI between 2016 and 2018 could account for a 6.7 percent increase, but clearly there are other factors contributing to the higher cost per ton. The survey population recycling volumes decreased for all material types, as did the number of recyclers in the survey population. The relative mix of material types continued to shift to PET #1, which accounted for 26 percent of survey population tons, the highest percentage over the last nine cost surveys.

Between 2016 and 2018 there was a reduction in the overall survey population of PF recycling centers, and a decrease in the total tons of CRV material recycled. The combination of fewer recyclers and fewer tons recycled could suggest an increase in cost per ton between 2016 and 2018. Another change between the 2016 and 2018 cost surveys was the strata definition. Prior to the start of the cost survey, Crowe and CalRecycle analyzed a range of strata definitions and selected a PET-based strata definition that is more reflective of the current recycling marketplace than the historical glass strata definitions and the 2016 PET #1 strata definitions. Based on an analysis of 2016 survey results using 2018 survey strata definitions and vice-versa, the increase in costs per ton was not a result of the new strata definitions. Our analysis of 2016 and 2018 cost survey data identifies six key factors that contributed to higher costs per ton:

1. Higher average CRV hourly wages, reflective in part of increases in California and Los Angeles County minimum wage between 2016 and 2018
2. A reduction in the number of surveyed recycling centers with average hourly wages below minimum wage, potentially due to ongoing recycling center closures
3. Increased transportation costs between 2016 and 2018 driven in large part by increased fuel and diesel prices between 2016 and 2018
4. By random selection, there were fewer very high-volume and low-cost RCs selected for the 2018 survey
5. The survey population volume and average tons of HDPE per site declined, and percent of non-CRV HDPE increased, as compared to 2016, all upward factors on cost per ton for HDPE
6. Factoring in cost of living increases, the Consumer Price Index (CPI) increased 6.7 percent between 2016 and 2018, likely accounting for a portion of the cost per ton increases.

1. Processing Fee Cost Survey Methodologies

This section describes the cost survey methodologies, from establishing the survey sample frame, to the quality control procedures, and all the supporting tasks in between. 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 LLP (Crowe) personnel, for the ninth 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 eight prior cost surveys. While Crowe further revised the training approach for this 2018 cost survey and updated strata parameters, the fundamentals of conducting the cost survey remain consistent. Overall, costs per ton for aluminum, glass, PET #1, and HDPE #2 in 2018 increased from 2016, but the results are consistent, and show low error rates (6 to 8 percent).

This processing fee cost survey was used to estimate California statewide, weighted-average, 2018 certified recycler cost per ton, for four beverage container material types, and the percent change in HDPE #2 cost per ton between 2016 and 2018. Recycler center costs were surveyed and analyzed in 2019 (early May through mid-November), using recycler center calendar year 2018 financial statements. Recycler center costs measured by this survey will be used for the processing fee calculation, effective January 1, 2020.

The population of processing fee (PF) recycling centers eligible for the cost survey was defined as all recycling centers: (1) not receiving handling fees between January 2018 and December 2018; (2) certified and operational on or before March 1, 2018; (3) reported redemption volume between January 2018 and December 2018; (4) not subsidized by the Department of Rehabilitation; and (5) not subject to CalRecycle investigation for major infractions. There were 31 sites removed from the population due

to investigations, leaving 674 recycling centers in this total traditional recycling center population.

This overall 2018 processing fee cost survey had a slightly larger sample size than the previous processing fee cost survey (154 versus 143 unique sites). The Crowe team completed 154 recycler cost surveys during May 2019 through October 2019 to obtain these cost survey results. These 154 recycling centers are referred to in this report as "PF for PF recycling centers."

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.

All 154 recyclers were treated equally in terms of scheduling, site visits, and quality control. This survey was the fifth consecutive survey in recent years that the state has not determined costs per ton for all ten beverage container material types. Senate Bill 1357 (Padilla, Chapter 697, Statutes of 2008) states that the department shall adjust the costs of recycling for material types that make up less than five 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 five percent of total containers recycled). In calendar year 2018, HDPE #2 made up approximately half of one percent of all beverage containers recycled. Bi-metal and plastics #3 through #7 made up between 0.03 percent and 0.25 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 bi-metal 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 PET volume, as shown in **Exhibit 1-1.**

Exhibit 1-1
Stratum Definitions for Processing Fee Recyclers (2018)

Stratum	Annual PET Volume
1	Greater than, or equal to, 400 tons
2	Greater than, or equal to 200 tons, up to 399 tons
3	Less than 200 tons

Prior to the start of the cost survey, Crowe and CalRecycle analyzed a range of strata definitions and selected a PET-based strata definition that is more reflective of the current recycling marketplace than the prior 2016 survey plastic strata definition. Prior to revising the strata, and to test the potential impact of the change, we recalculated the 2016 survey costs per ton using the 2018 strata definitions, shifting from 75 tons PET cutoff from strata 3 to strata 2, to 200 tons PET. Similarly shifting from 200 tons PET cutoff from strata 2 to strata 1, to 400 tons.

Costs per ton using 2016 survey data and 2018 definitions were essentially equal to 2016 survey data using 2016 strata definitions. The changes in cost per ton for aluminum, glass, and PET #1 was at, or less than, one percent. This comparison illustrated that changing PET strata definitions did not have an impact in the results.

Sample Design Results

Exhibit 1-2 provides the 2018 sample error rates for each relevant material type. In 2018, 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 below the 10 percent error rate at the 90 percent confidence level threshold.

The error rates in 2018 were consistent with the low error rates for each of the four materials over the last eight cost surveys. Because costs per ton for bi-metal and plastics #3 to #7 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 provides the sample size and method for each of the ten 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, by Material Type (90% Confidence Interval) (2002–2018)

Material Type	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**7.52%**	6.71%	5.86%	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass	**6.88%**	7.80%	6.49%	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1	**7.40%**	6.11%	6.23%	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2	**8.62%**	6.68%	6.86%	7.63%	7.33%	8.27%	8.97%	7.47%	9.78%
5. Bi-Metal	N/A	N/A	N/A	N/A	N/A	6.89%	8.31%	9.83%	7.57%
6. PVC #3	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
7. LDPE #4	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
8. PP #5	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
9. PS #6	N/A	N/A	N/A	N/A	N/A	100% Sample	100% Sample	100% Sample	100% Sample
10. Other #7	N/A	N/A	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 (2018)

Material Type	2018 Sample Size	2018 Sample Method
1. Aluminum	**154**	Stratified Random Sample
2. Glass	**152**	Stratified Random Sample
3. PET #1	**153**	Stratified Random Sample
4. HDPE #2	**150**	Stratified Random Sample
5. Bi-Metal	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

The sample design 233 unique processing fee sites originally selected among the random PET stratified sample (plus the processing fee container strata sample). When the cost survey was underway, several issues arose that required a site to be dropped, and an alternate site appropriately and randomly chosen, to replace it. Reasons for dropped sites included: (1) CalRecycle may have initiated a new site investigation or CalRecycle may have again subsequently decertified a site; (2) sites were closed or sold, and the owner was not available; (3) sites were found to be subsidized by the Department of Rehabilitation; or (4) the site owners were non-cooperative.

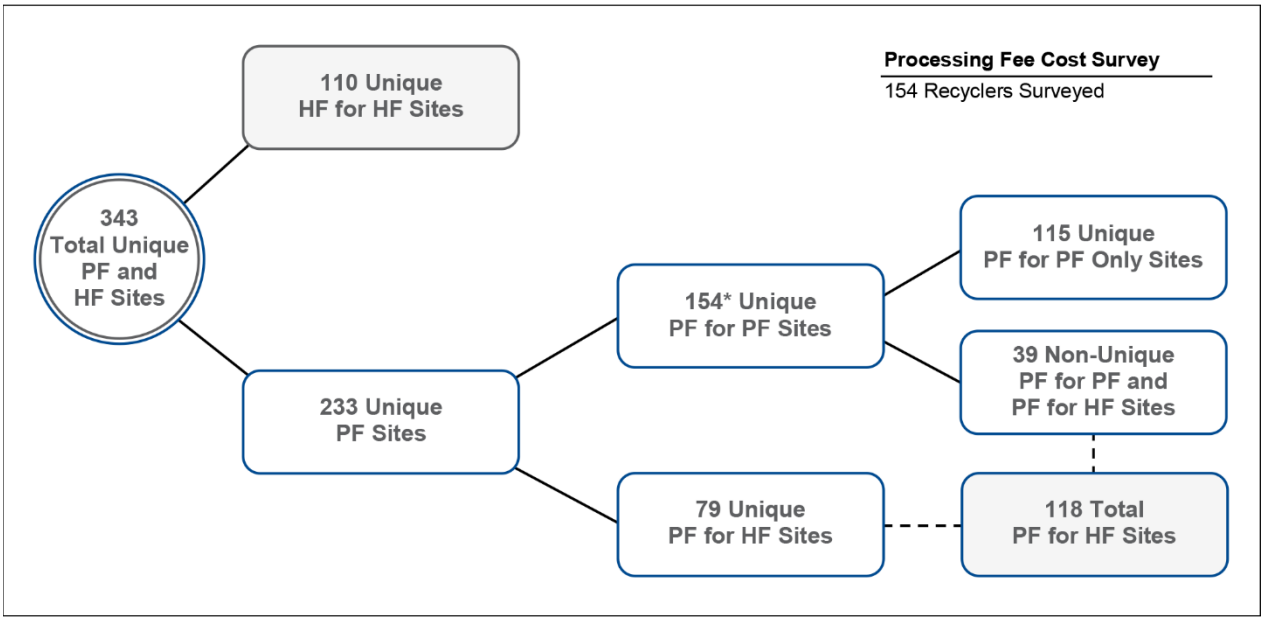
For this 2018 cost survey, there were a significant number of processing fee recycling centers that closed during 2018 or in 2019 prior to our survey site visit. When possible, Crowe surveyed sites that had closed, meeting with the site owner to obtain the required financial and labor information. However, there were many instances where the owner was not available, or not willing to cooperate.

Crowe selected alternative sites for these initially dropped sites. Crowe replaced each dropped site with the next site in random selection order to maintain the integrity of the survey sample. The alternative sites were carefully chosen from the respective appropriate lists of available sites by strata. The lists of available sites to choose from were randomly generated and there was a strict sequential protocol ordering established in order to ensure survey randomness integrity.

Sample Reconciliation

This processing fee cost survey was part of a broader combined processing fee and handling fee cost survey that included 233 processing fee and 110 handling fee recyclers. The final 233 processing fee recyclers included 154 unique sites for the processing fee cost survey. **Exhibit 1-4** 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 (2018)



* 39 PF sites within the 154 also were within the handling fee (HF) cost survey (PF for HF sites), for a total 118 (79 + 39) 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 staff members at Crowe were employed during the project start-up and survey months (April 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 early April 2019. 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 recycling experts. Each survey team typically 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 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, matching the varying schedules of over 20 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 efficient review of sites via a check-out workflow, and tracked the status of each site. 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 warranting that they would not disclose any information made available by each certified recycler. Also, the following company contractors signed company confidentiality agreements: Crowe LLP (Prime Contractor); Richardson & Company (Subcontractor); Geiss Consulting (Subcontractor); Encina Advisors, LLC (Subcontractor); Boisson Consulting (Subcontractor), CalRecovery, Inc. (Subcontractor); and Bohica Advisors LLC (Disabled Veteran Business Enterprise Subcontractor).

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) CalRecycle 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 2015 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. For the current cost survey, Crowe continued to update and revise the training manual and materials.

Crowe streamlined the manual to consist of ten chapters, each emphasizing actions for survey team members to take in the field and when completing site files. The new training manual focuses on key areas of learning necessary to successfully conduct cost surveys. In addition, Crowe developed new PowerPoint presentations covering topics in the training manual. The presentations include videos of a cost survey site visit, quizzes, and activities specific to each training module.

Crowe created new work assignments and interactive exercises as part of the 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 still 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.

Over half of the individuals who conducted site visits for this survey had experience in the previous processing fee cost surveys (every other year beginning in 2002) and had completed one or more training sessions 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 the full 32-hour, in-house training course in 2019.The new survey team members completed the full 32-hour, in-house training program and participated in field training.

Following the first three days of classroom training, each new survey team member conducted at least two cost survey site visits with a highly experienced team member in order to provide “real-world” experience. The experienced survey team member guided new team members, with increasing levels of responsibility for the on-site and post-site visit procedures over the course of the visits. Following the field visits, new survey members spent two days working together to complete the site files. The entire survey team reconvened after the training site visits to present and discuss the site visits and review the remainder of the training materials. For this 2018 Cost Survey, Crowe also conducted a two-hour training for quality control reviewers and two-hour training specific to rePlanet.

For the classroom component of the training, Crowe prepared and presented PowerPoint presentations for each training module. A significant segment of the training sessions was spent on hands-on activities and preparing three site files (simple, moderate, complex) using data from the 2016 cost survey. 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 role-playing interviews, and on-line quizzes. 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 2002–2016 cost surveys. Prior to conducting the current cost survey, Crowe reviewed and updated the cost model to reflect 2018 container per pound and CRV payment information, as well as procedural changes to the cost survey. Crowe updated fields in the model review sheet for surveyors to enter information about site transportation.

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 included calculating cost per ton for ten different material types: six plastic resins, in addition to PET #1, glass, aluminum, and bi-metal. A key task of the 2002 cost survey project was to develop a costing methodology for plastics #2 to #7 and bi-metal. For this 2018 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 2004-2016. In addition, we calibrated the Indirect Cost Allocation Sub-Models for Aluminum/Bi-Metal and All-Plastics with 2018 survey information. These sub-models, now incorporated into the Labor Allocation Cost Survey Model, ensure rational allocation of costs and labor to bi-metal 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 bi-metal 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/Bi-Metal—was to separate the individual majority and minority material costs from the larger indirect cost categories: all plastics and aluminum/bi-metal. 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 and material handling factors (weight of containers, number of containers, volume [size] 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

Consistent with the 2016 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 Excel 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, illustrated in **Exhibit 1-5:**

- **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

Exhibit 1-5
Three Phases of the Cost Survey (2018)

Phases	1. Pre-Site Visit	2. Site Visit	3. Post-Site Visit
Activities	• Scheduling team sends notification letter • Survey team confirms site visit • Survey team reviews information on the site, including prior site files and current cost model • Scheduling team sends follow-up notification letter, as necessary	• Survey team conducts site visit	• Survey team completes site files and uploads files to SharePoint site • Reviewers begin reviewing site files • Survey team responds to comments • Review process ends in final approval
Participants	• Scheduling Team • Survey Team	• Survey Team	• Survey Team • Reviewers

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 2018 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 one to three 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. Team members classified costs into one of the following categories:

- Direct labor
- Other labor
- General business overhead
- Transportation
- Rent
- Depreciation
- Property taxes
- Utilities
- Supplies
- Fuel
- Insurance
- Interest
- Maintenance/repairs
- Not allowable

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. 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 ten 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 workpapers, and conducted a reasonableness check of 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 securely 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 encryption 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 authorized 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 ten 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 2018 processing fee cost survey, Crowe 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 (bi-metal and plastics #3 to #7) based on the percent change in HDPE #2 costs per ton between the 2016 and 2018 cost surveys. **Exhibit 2-1** illustrates the two calculation approaches we used for determining processing fee recycler costs per ton for ten beverage container material types.

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 154 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 2018 tons data for both the sample and 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

‡ 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).

§ 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.

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** provides an example of the actual step-by-step calculation for glass cost per ton.

Approach B: Bi-Metal and Plastics #3 to #7

This 2018 cost survey was the fifth time since 2002 (the first was the 2010 cost survey) that the state did not calculate material-specific costs per ton for bi-metal and plastics #3 to #7. Senate Bill 1357 (Padilla, Chapter 697, Statutes of 2008) states that the department shall adjust the costs of recycling for material types that make up less than five 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 five percent of total containers recycled). Thus, the cost per ton to recycle bi-metal and plastics #3 to #7 was based on the calculated 53 percent change in HDPE #2 costs per ton between 2016 and 2018. For the 2018 cost per ton for each of these six minority materials (bi-metal, PVC #3, LDPE #4, PP #5, PS #6, and Other #7), cost per ton decreased by calculating 1.53 times the respective minority material cost per ton measured in 2016. The approach is illustrated in *Exhibit 2-1B*.

Financial Return

The Beverage Container Recycling and Litter Reduction Act, Section 14575(b)(2) specifies “a reasonable financial return for recyclers” should be included in the processing payment calculation. The RFR is multiplied by the cost of recycling to determine a cost of recycling, with financial return. Based on amendments to California Code of Regulations, Section 2975, the RFR applied to the cost of recycling for the January 1, 2020 processing payment and processing fee calculations was ten percent.

The cost to recycle used to determine processing fees and processing payments for January 1, 2020 included a cost of living adjustment (COLA) of 3.2 percent. This was the fifth 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 2018 cost data was already over a year old when the processing fees and processing payments go into effect on January 1, 2020.

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

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

$$\left(\frac{\text{Glass Stratum 1 Sample Costs}}{\text{Glass Stratum 1 Sample Volumes}} \times \text{Glass Stratum 1 Population Volumes} = \text{Glass Stratum 1 Total Population Costs}\right) +$$

$$\left(\frac{\text{Glass Stratum 2 Sample Costs}}{\text{Glass Stratum 2 Sample Volumes}} \times \text{Glass Stratum 2 Population Volumes} = \text{Glass Stratum 2 Total Population Costs}\right) +$$

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

$$\frac{\text{Glass Stratum 1 Total Population Costs} + \text{Glass Stratum 2 Total Population Costs} + \text{Glass Stratum 3 Total Population Costs}}{\text{Total Population Volumes}} = \text{Statewide Stratified Weighted-Average Cost Per Ton}$$

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

1. Determine HDPE percent change in cost per ton between 2016 ($547.11) and 2018 ($838.00):

$$\text{Percent change} = \frac{\$838.00 - \$547.11}{\$547.11} = \frac{\$290.89}{\$547.11} = +53.17\%$$

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

2016 cost per ton + (2016 cost per ton × +53.17%)

Exhibit 2-2
Weighted-Average by Strata Calculation Example for Processing Fee Recycler Glass Cost per Ton (2018)

Stratum	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton
Stratum 1	30,637.30	$3,066,633.82	$100.09[a]
Stratum 2	27,676.98	2,806,167.60	101.39[a]
Stratum 3	17,240.36	3,033,797.97	175.97[a]
Sample Total	75,554.64	$8,906,599.39	$117.88[a]

Stratum	Population Glass Tons	Population Glass Cost	Population Cost per Ton
Stratum 1[b]	56,176.83	$5,622,739.08	
Stratum 2[b]	76,727.79	7,779,430.90	
Stratum 3[b]	97,766.66	17,203,999.16	
Population Total[b]	230,671.28	$30,606,169.14	$132.68[c]

[a] Simple weighted-average cost per ton for each stratum, and simple weighted-average for the sample

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

[c] A statewide, weighted-average result of $132.68 per ton, calculated by dividing total population glass costs by total population glass tons

B. Cost Results

The costs per ton to recycle for each of the ten material types with and without the reasonable financial return and COLA are summarized in **Exhibit 2-3.** Exhibit 2-3 also shows the 2018 survey sample size for each of the four relevant material types.

Exhibit 2-4 illustrates 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 bi-metal and plastics #3 to #7.

Exhibit 2-3
Statewide Costs per Ton to Recycle for Processing Fee Recyclers (2018)

Material	Cost per Ton without Financial Return	Cost per Ton with Financial Return and COLA[a]	N = Sample Number of Sites[b]
1. Aluminum	$626.61	$711.34	154
2. Glass	132.68	150.62	152
3. PET #1	502.44	570.37	153
4. HDPE #2	838.00	951.30	150
5. Bi-Metal	1,056.35	1,199.17	NA
6. PVC #3	1,318.18	1,496.40	NA
7. LDPE #4	1,880.50	2,134.75	NA
8. PP #5	1,687.06	1,915.16	NA
9. PS #6	1,044.99	1,186.27	NA
10. Other #7	1,144.95	1,299.75	NA

[a] The reasonable financial return (RFR) is 10% and the COLA is 3.2%.

[b] Overall, 154 sites were completed to obtain these results. The cost per ton for bi-metal and plastics #3 to #7 was determined by the percent change in HDPE cost per ton.

Exhibit 2-4
Strata and Population Costs and Tons for Processing Fee Recyclers (2018)

Stratum 1 – High PET #1 Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 1 Total Costs
Aluminum	$4,544,759.39	9,030.74350	17,200.04410	$8,655,922.19
Glass	3,066,633.82	30,637.29905	56,176.83165	5,622,739.08
PET #1	6,415,792.67	15,869.48855	29,785.67770	12,041,753.78
HDPE #2	301,659.64	422.95560	722.01430	514,955.04

Stratum 2 – Medium PET #1 Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 2 Total Costs
Aluminum	$3,457,314.50	6,400.00835	20,023.39010	$10,816,635.33
Glass	2,806,167.60	27,676.97635	76,727.79270	7,779,430.90
PET #1	5,016,554.86	11,885.70650	35,144.95360	14,833,630.57
HDPE #2	342,811.83	518.31995	1,498.24595	990,924.89

Stratum 3 – Low PET #1 Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 3 Total Costs
Aluminum	$4,123,732.84	5,445.82180	29,490.59445	$22,331,162.84
Glass	3,033,797.97	17,240.36000	97,766.66000	17,203,999.16
PET #1	5,114,869.57	8,036.01005	42,884.75825	27,295,719.78
HDPE #2	305,974.93	287.30435	1,562.61245	1,664,166.63

Combined Population Strata

Material Type	Population Costs	Population Tons	Statewide Cost per Ton
Aluminum	$41,803,720.36	66,714.02865	**$626.61**
Glass	30,606,169.14	230,671.28435	**132.68**
PET #1	54,171,104.13	107,815.38955	**502.44**
HDPE #2	3,170,046.56	3,782.87270	**838.00**

Minority Materials

Material Type	2016 Cost/Ton	53.17% Increase	2018 Cost/Ton
PVC #3	$860.60	$457.58	$1,318.18
LDPE #4	1,227.72	652.78	1,880.50
PP #5	1,101.43	585.63	1,687.06
PS #6	682.24	362.75	1,044.99
Other #7	747.50	397.45	1,144.95
Bi-Metal	689.66	366.69	1,056.35

Error Rates and Confidence Intervals for Costs per Ton

The California Beverage Container Recycling and Litter Reduction Act, §14575, requires CalRecycle to conduct "a survey of a statistically significant sample of certified recycling centers, excluding those receiving a handling fee." In the California Code of Regulations, a "statistical sample" is defined as an estimate with an 85 percent confidence level (§2000 (a) (47)). 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 add oversample, it would be more statistically accurate to set the confidence interval higher, at 90 percent. The sample size was developed, based on 2016 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 ninth time, the processing fee cost survey met and exceeded all prior statistical requirements (the 2002–2016 surveys of recycler 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 1-2.** For comparison, Exhibit 1-2 also provides the error rates at the 90 percent confidence interval for each of the four (or five) relevant material types from the 2002–2016 processing fee cost surveys.[**]

The 2018 cost survey generally achieved a similar high degree of statistical confidence as the seven 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. Crowe conducted five levels of review for each site and some site files were sent back to the original survey team for additional investigation and revisions before they were approved.

[**] The bi-metal error rate at the 90 percent confidence interval is slightly higher in 2004, as compared to 2002. However, for the first time, the 2004 bi-metal sample was a statistically valid random sample drawn specifically for bi-metal, as opposed to the "hybrid" sample of available sites that was used in 2002 to determine bi-metal costs per ton. In 2004, 2006, and 2008, the bi-metal sample consisted of a statistically valid random sample drawn specifically for bi-metal. 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 resin. We again utilized a random sample for Other #7 in the 2008 cost survey. For the 2010, 2012, 2014, 2016, and 2018 cost surveys, costs per ton for plastics #3 to #7 and bi-metal were based on the percent change in HDPE #2 cost per ton between the prior processing fee cost survey.

Exhibit 2-5 provides a summary comparison of the cost per ton results for the cost surveys from 2002–2018. As compared to 2016, the 2018 cost per ton results for aluminum increased 16 percent, glass increased 31 percent, and PET #1 increased 19 percent. As compared to 2016 recycling volumes, the 2018 recycling volumes for aluminum decreased 10 percent, glass decreased 10 percent, and PET #1 decreased 2 percent. The ongoing shift of recycling volume from aluminum to PET #1 was apparent in recycling center labor allocations, with an increasing share of recycling center activity dedicated to handling plastic.

Costs per ton for bi-metal and plastics #3 to #7 were variable between 2002 and 2008. Since 2010, 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 2014, HDPE #2 cost per ton decreased 14.41 percent, to slightly above the 2008 level. In 2016, HDPE #2 cost per ton increased 4.36 percent. In 2018, HDPE #2 cost per ton increased 53.17 percent.

Exhibit 2-6 provides a summary comparison of the number of surveyed sites for each material type for the cost surveys from 2002–2018. The stratified random sample for this 2018 processing fee cost survey was slightly larger than the prior cost survey.

Exhibit 2-5
Summary Comparison of Statewide Costs per Ton Survey Results for Processing Fee Recyclers (2002–2018)

Material Type	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**$626.61**	$539.11	$537.29	$609.81	$537.06	$559.23	$516.13	$465.90	$418.95
2. Glass	**132.68**	101.04	97.50	92.88	89.76	81.60	94.98	82.45	79.81
3. PET #1	**502.44**	421.30	428.55	462.79	440.61	426.76	477.73	493.31	479.63
4. HDPE #2	**838.00**	547.11	524.23	612.50	611.62	501.67	500.64	671.73	645.91
5. Bi-Metal	**1,056.35**	689.66	660.65	771.88	770.80	632.22	883.55	607.03	508.18
6. PVC #3	**1,318.18**	860.60	824.65	963.49	962.14	789.16	731.37	1,583.72	1,064.52
7. LDPE #4	**1,880.50**	1,227.72	1,176.43	1,374.50	1,372.58	1,125.80	1,858.09	1,889.50	3,324.89
8. PP #5	**1,687.06**	1,101.43	1,055.41	1,233.10	1,231.38	1,009.99	787.83	809.42	1,478.77
9. PS #6	**1,044.99**	682.24	653.74	763.80	762.73	625.60	623.11	3,051.82	6,137.30
10. Other #7	**1,144.95**	747.50	716.27	836.86	835.69	685.44	741.93	1,264.47	759.32

Exhibit 2-6
Summary Comparison of Number of Surveyed Sites for Processing Fee Recyclers (2002–2018)

Material Type	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	154	143	151	151	129	116	123	117	136
2. Glass	152	137	151	147	128	112	121	115	131
3. PET #1	153	140	151	148	129	115	122	115	132
4. HDPE #2	150	136	146	144	127	110	118	108	119
5. Bi-Metal	N/A	N/A	N/A	N/A	N/A	40	40	52	65
6. PVC #3	N/A	N/A	N/A	N/A	N/A	11	12	14	23
7. LDPE #4	N/A	N/A	N/A	N/A	N/A	20	13	10	11
8. PP #5	N/A	N/A	N/A	N/A	N/A	21	14	12	11
9. PS #6	N/A	N/A	N/A	N/A	N/A	32	15	11	12
10. Other #7	N/A	N/A	N/A	N/A	N/A	40	40	67	49

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 2002–2018 Cost per Ton Results for Aluminum, Glass, PET #1, and HDPE #2*
C. *Cost per Ton Results for Six Minority Material Types*
D. *Changes in Number of Recyclers and Recycled Tons*
E. *Cost Category Comparison*
F. *Changes in Labor Costs*
G. *Changes in Transportation Costs*
H. *Changes in Recycling Center Population Dynamics*
I. *Comparison of Total Costs, Total Tons, and Total Containers Recycled*
J. *Comparison of Population Size, Recycling Tons, Costs, and Payments by Strata*
K. *Cost Survey Methodology Validation*
L. *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 cost of recycling survey for 50 recyclers represented the first time that such costs had been measured and calculated.

Over the last 32 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.

Exhibit 3-1 provides the historical cost per ton results for all seventeen years in which recycler cost surveys were conducted. **Exhibit 3-2** provides a comparison of CPI-adjusted costs per ton from 2002 to 2018 for aluminum, glass, PET #1, and HDPE #2 using the U.S. Department of Labor, Bureau of Labor Statistics, and West Urban Consumer Price Index (CPI).†† While 2018 costs are still relatively high, they are not as high as several prior years when adjusted by CPI. **Exhibit 3-3** provides the cost per ton results from 2002 to 2018. These costs per ton reflect actual dollar values for the years in which they were determined and thus have not been adjusted for inflation.

†† Source: http://www.dof.ca.gov/Forecasting/Economics/ Indicators/Inflation/

Exhibit 3-1
Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton (1987–2018)

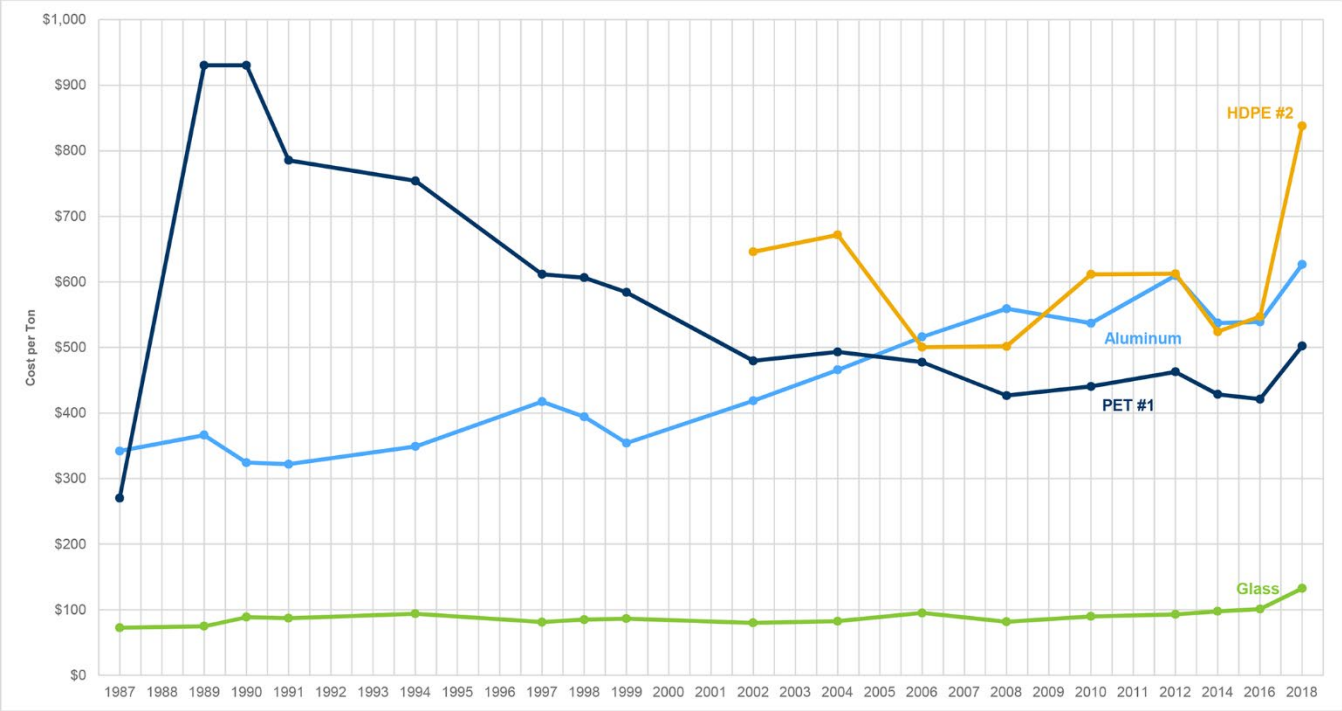


Exhibit 3-2
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002–2018)

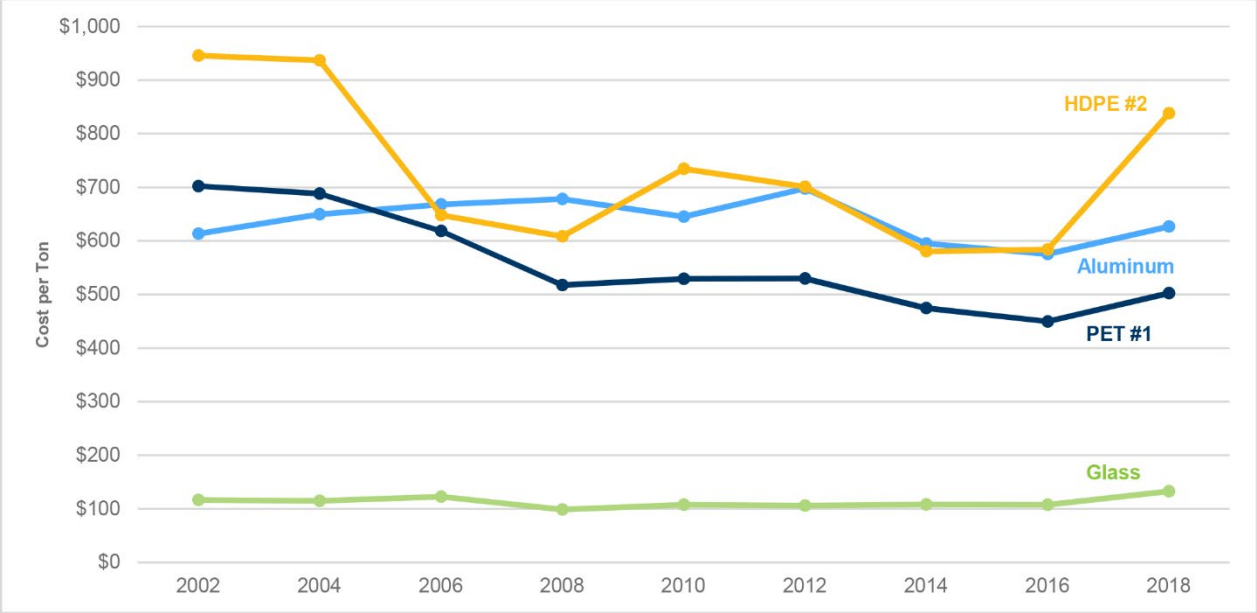


Exhibit 3-3
Historical Statewide Costs per Ton (Without Reasonable Financial Return) (2002–2018)

Material Type	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**$626.61**	$539.11	$537.29	$609.81	$537.06	$559.23	$516.13	$465.90	$418.95
2. Glass	**132.68**	101.04	97.50	92.88	89.76	81.60	94.98	82.45	79.81
3. PET #1	**502.44**	421.30	428.55	462.79	440.61	426.76	477.73	493.31	479.63
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9. PS #6	**1,044.99**	682.24	653.74	763.80	762.73	625.60	623.11	3,051.82	6,137.30
10. Other #7	**1,144.95**	747.50	716.27	836.86	835.69	685.44	741.93	1,264.47	759.32

Aluminum

The increase in aluminum cost per ton to $626.61 is higher than each of the prior eight surveys. Total tons of aluminum recycled by the processing fee recycler population has continued to decline, and at 66,714 tons is lower than all cost survey years. This continued decline in aluminum likely reflects the ongoing market shift from aluminum to PET beverage containers and CalRecycle's ongoing enforcement activity. On a per-recycler basis, average tons of aluminum recycled per year increased in 2018 to the highest level since 2010. The increase was a result of the smaller number of recycling centers, rather than an increase in aluminum recycling. In general, the increased quantity of aluminum per recycler would tend to improve recycler profitability as compared to 2012, 2014, and 2016. However, average tons of aluminum per recycler are still 8 percent lower than between the 2002 and 2010 average. In 2018, aluminum made up over 16 percent of tons of CRV material recycled by the population, a decline from 2016.

Glass

From 2016 to 2018, the glass cost per ton to recycle increased 31 percent to $132.68. This continues a trend of increased glass costs since 2008, resulting in a cost per ton over $100 for the second time. Glass volumes continued to decline between 2016 and 2018, compared to the stabilized levels between 2014 and 2016, following a large decrease between 2012 and 2014. Total glass volumes in 2018 were lower than all but 2002 levels. Between 2014 and 2018, the average tons of glass recycled per year on a per-recycler basis increased from 268 tons to 342 tons, reversing the decline between 2012 and 2014. In 2018, glass made up its lowest historical percent share of CRV material recycled. In 2018, glass made up 56 percent of tons of CRV material recycled, compared to a high of 67.8 percent in 2002.

PET #1

The 19 percent increase in the cost per ton to recycle PET #1, $502.44, is higher than the PET #1 cost per ton determined by the prior eight surveys. For PET #1, the costs have generally fluctuated year to year within a relatively narrow band (now $421 to $502 per ton). Tons of PET #1 recycled decreased 2 percent from 2016 to 2018, and decreased almost 5 percent as compared to 2012, which was an all-time high. However, on a per-recycler basis, average tons recycled per year increased to the highest level yet, from approximately 107 tons in 2012 and 2014 to 160 tons in 2018. In 2018, PET #1 made up its greatest share of CRV materials recycled, at 26 percent.

Between 1990 and 2002, the cost per ton for PET #1 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 decline of 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. In 2016, the cost per ton for PET #1 decreased 1.7 percent to $421.30. The recycling volume of PET #1 increased 8 percent between 2014 and 2016. Had PET #1 recycling volumes not increased so significantly in 2016, it is likely that the PET #1 cost per ton would have increased, not decreased, in 2016. Both the increase in 2018 PET #1 costs per ton and the decrease in PET #1 recycling volume represents a reversal of recent trends.

HDPE #2

HDPE #2 cost per ton increased 53 percent, to a level above the prior eight surveys, and significantly above the aluminum cost per ton. HDPE #2 costs per ton is based on the submodel and relative costs compared to PET and to a lesser extent other plastics. The requirement to redeem separated CRV-only material continued to have an impact on HDPE #2 recycling in 2018. HDPE #2 is the only beverage container material to have a commingled rate significantly lower than 100 percent because recyclers continue to receive (and separate) large volumes of non-CRV HDPE #2. This results in a low commingled rate. The decreased HDPE #2 commingled rate (approximately 70 percent) was far lower than all other minority plastics, impacting the allocation of costs across plastics. In addition, the PET commingled rate increased to almost 100 percent. These changes increase costs for HDPE, reflecting the additional cost of sorting non-CRV HDPE from HDPE beverage containers. Another factor driving up HDPE costs per ton is that HDPE overall volumes and tons per recycler both decreased. Tons of HDPE #2 declined 21 percent between 2016 and 2018, the lowest level since 2002. These two factors, commingled rates and lowered volumes, are likely the primary reasons for the big percent increase for HDPE, relative to the 16 to 31 percent increases among aluminum, glass, and PET #1.

Bi-Metal and Plastics #3 to #7

This is the fifth cost survey that the costs per ton for bi-metal and plastics #3 to #7 were indexed to the percentage change in HDPE #2 cost per ton. Senate Bill (SB) 1357 (Statutes of 2008) provides that CalRecycle shall adjust the costs of recycling for material types that make up less than five 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 five percent of total containers recycled).

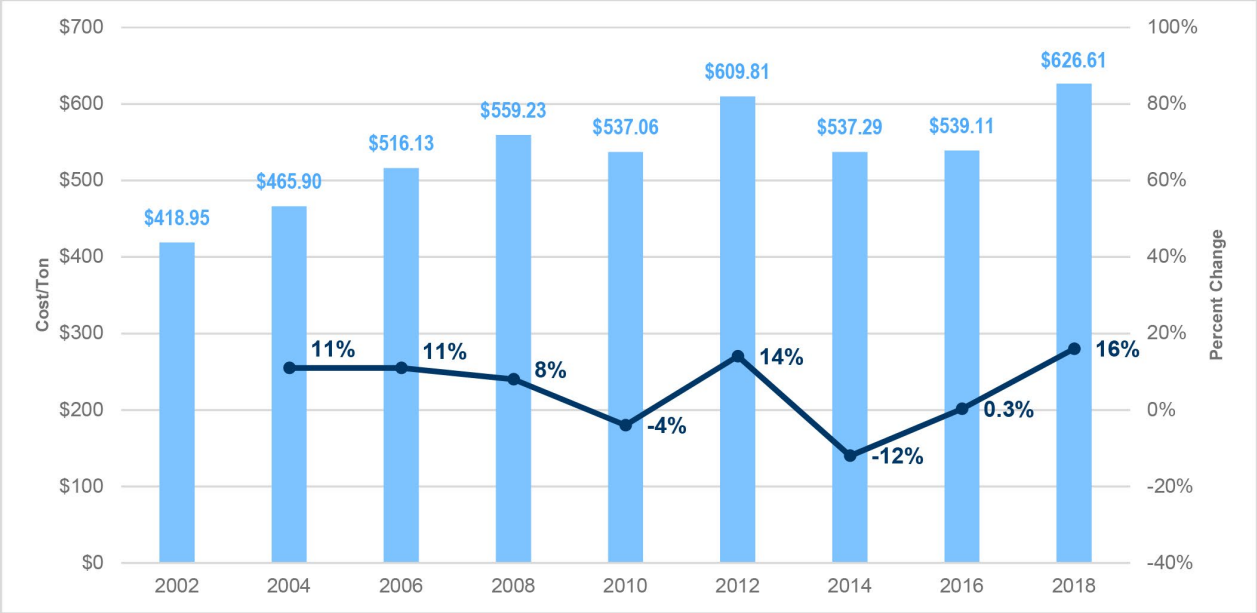
In calendar year 2018, HDPE #2 made up only 0.9 percent of all beverage containers recycled. Bi-metal and plastics #3 through #7 made up between 0.04 percent and 0.08 percent of containers recycled. Thus, while HDPE #2 recycling is minimal as compared to aluminum, glass, and PET #1, it is still substantial as compared to the other six minority material types. The cost per ton to recycle bi-metal and plastics #3 to #7 was

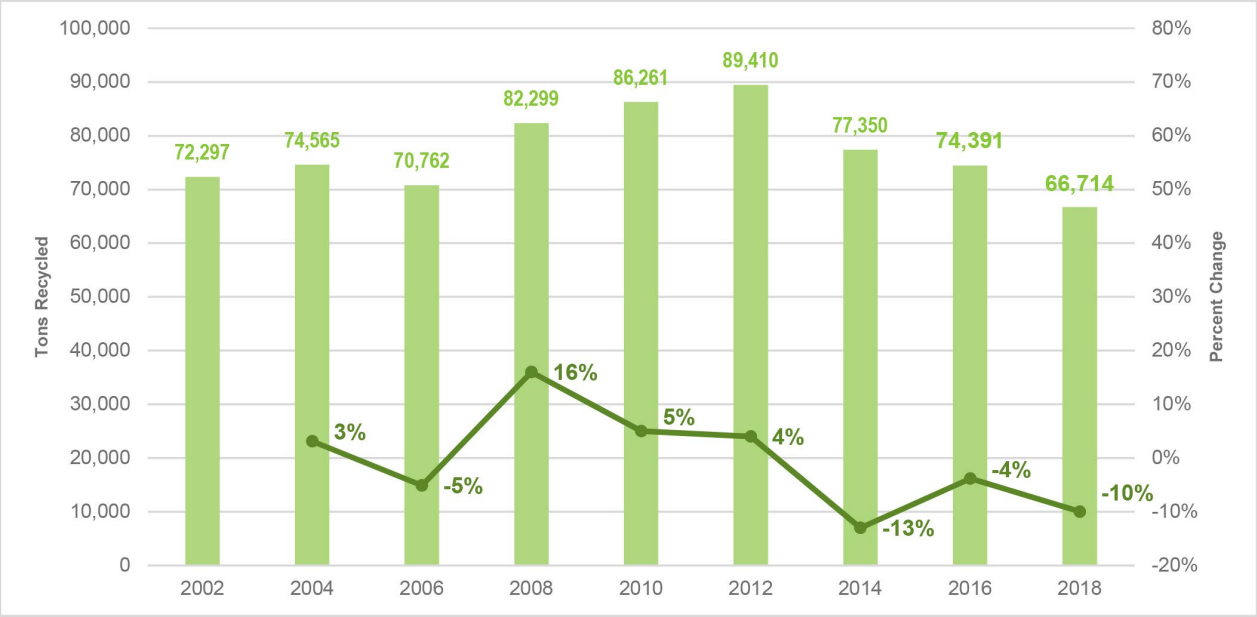
based on the calculated 53 percent increase in HDPE #2 between 2016 and 2018. Thus, for the 2018 cost per ton for each of these six minority materials (bi-metal, PVC #3, LDPE #4, PP #5, PS #6, and Other #7), cost per ton increased by 53 percent.

B. Comparison of 2002–2018 Cost per Ton Results for Aluminum, Glass, PET #1, and HDPE #2

Exhibits 3-4, 3-5, 3-6, and **3-7** provide comparisons of the processing fee recycler costs per ton and recycling tons over the last nine cost surveys, for the four majority material types. The percent figures, secondary axis, next to each column show the percentage change from the previous two years.

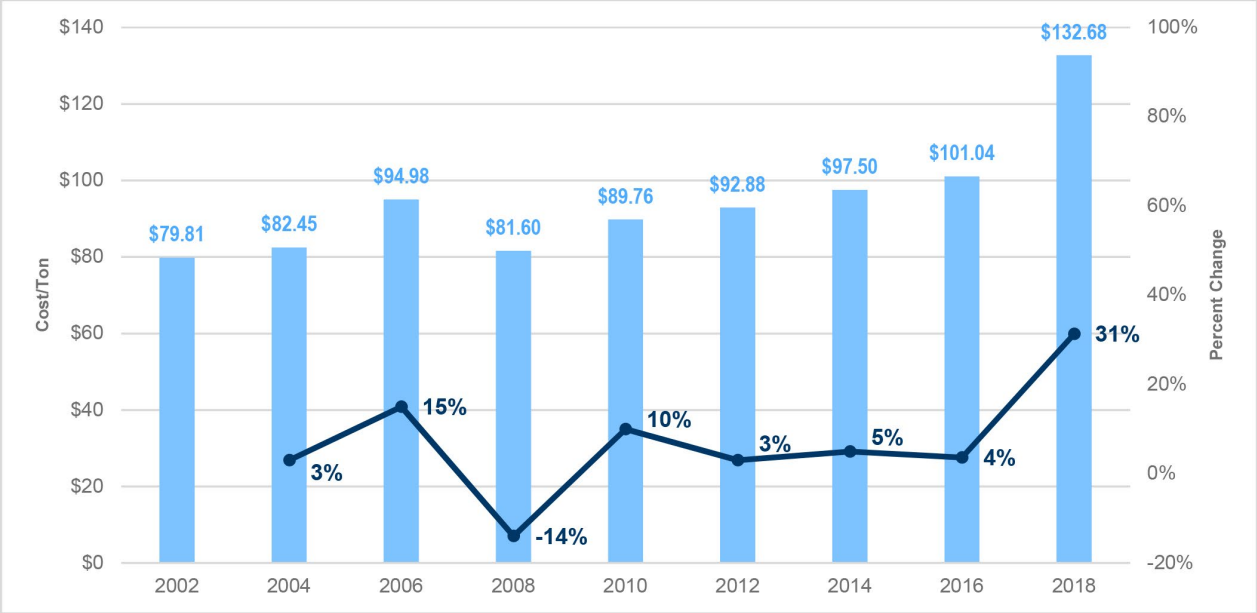
Exhibit 3-4
Aluminum Processing Fee Recycler Cost per Ton and Tons Recycled (2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018)[a]

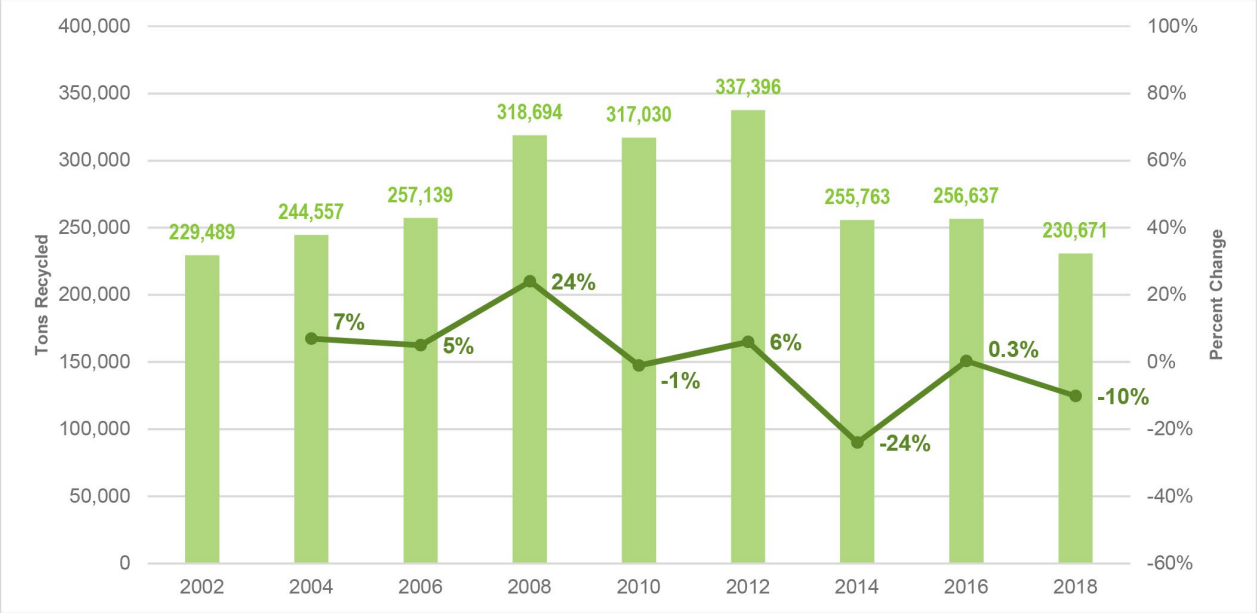




[a] For the 2012 cost survey, 269 processing fee recyclers that were being investigated by CalRecycle were removed from the full population prior to selecting the cost survey sample. The cost per ton calculation is based on a reduced population. The 2012 bar on the tons recycled graph shows the full population tons with investigated RCs, which is a better representation of the level of recycling in 2012.

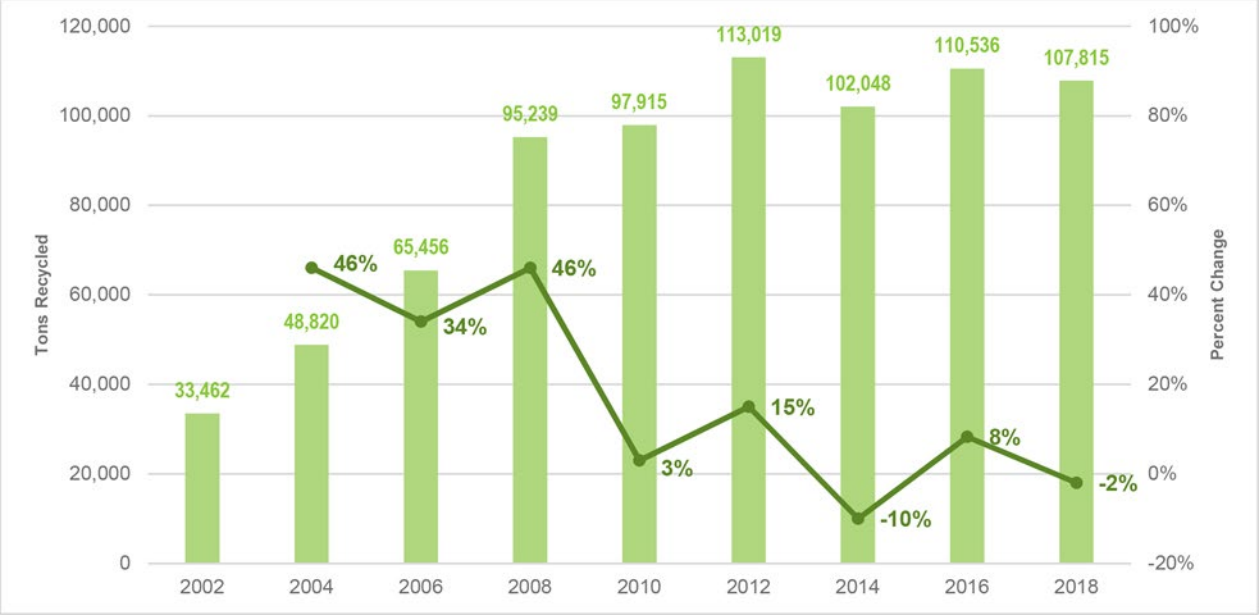
Exhibit 3-5
Glass Processing Fee Recycler Cost per Ton and Tons Recycled (2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018)[b]





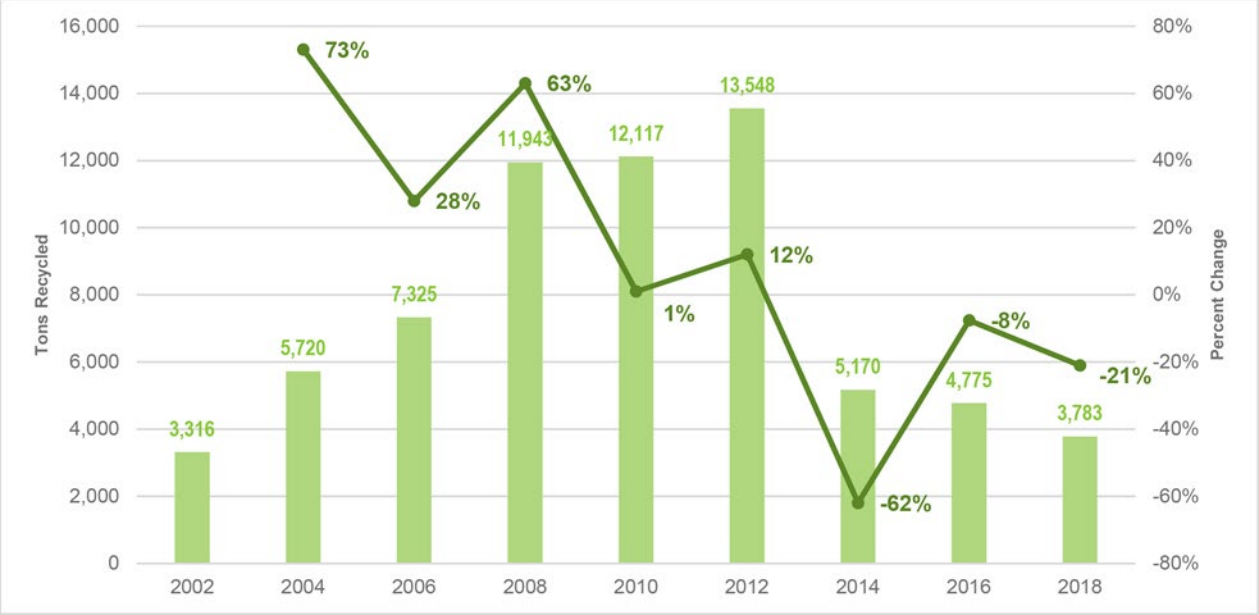
[b] For the 2012 cost survey, 269 processing fee recyclers that were being investigated by CalRecycle were removed from the full population prior to selecting the cost survey sample. The cost per ton calculation is based on a reduced population. The 2012 bar on the tons recycled graph shows the full population tons with investigated RCs, which is a better representation of the level of recycling in 2012.

Exhibit 3-6
PET #1 Processing Fee Recycler Cost per Ton and Tons Recycled (2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018)[c]



[c] For the 2012 cost survey, 269 processing fee recyclers that were being investigated by CalRecycle were removed from the full population prior to selecting the cost survey sample. The cost per ton calculation is based on a reduced population. The 2012 bar 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.

Exhibit 3-7
HDPE #2 Processing Fee Recycler Cost per Ton and Tons Recycled (2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016 and 2018)[d]



[d] For the 2012 cost survey, 269 processing fee recyclers that were being investigated by CalRecycle were removed from the full population prior to selecting the cost survey sample. The cost per ton calculation is based on a reduced population. The 2012 bar 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.

C. Cost per Ton Results for Six Minority Material Types

Exhibit 3-8 illustrates the processing fee recycler costs per ton for each of the six minority material types, bi-metal, and the five plastic resin types: PVC #3, LDPE #4, PP #5, PS #6, and Other #7. As noted previously, for the past five surveys the cost per ton for these minority materials is based on the change in cost per ton for HDPE #2. Based on the 2018 survey results, costs per ton for each of these materials increased 53 percent as compared to their 2016 cost per ton.

Exhibit 3-8
Processing Fee Recycler 2018 Costs per Ton for Bi-Metal 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 population CRV 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.

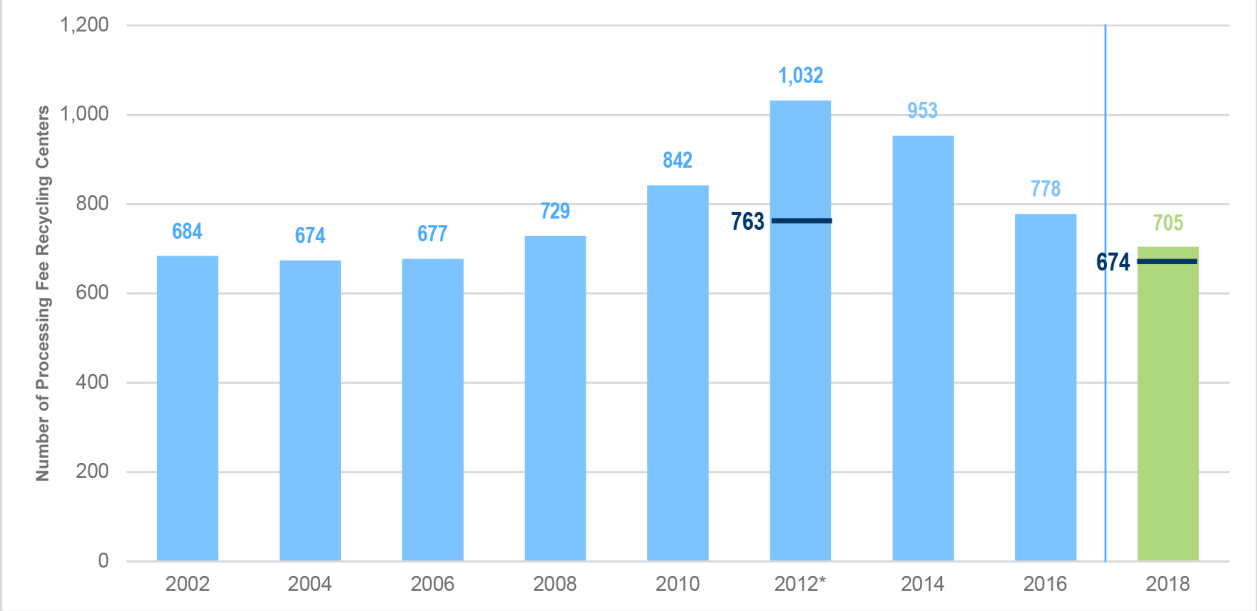
Historical Trends in Population Number of Recyclers

The population 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 3-9 provides the number of PF recyclers in the population for each of the eight prior, and current, cost surveys. The number of PF recyclers had been increasing over time, particularly between 2004 and 2012. Between 2012 and 2014, the number of recycling centers declined by 8 percent. Between 2014 and 2016, the number of recycling centers in the population declined by 18 percent. Between 2016 and 2018, the number of recycling centers continued to decline, down 9 percent. This highly publicized decline in recycling centers is commonly believed to be directly related to poor recycling markets and the market shift from high-value aluminum to lower-value PET #1. The substantially lower 674 PF survey population recyclers is still about the same number of recyclers as between 2002 to 2008.

The continuing decrease in number of processing fee recyclers from the full population in 2012 to 2014 to 2018 is also, in part, a correction from the significant growth in population between 2010 and 2012. The continuation of poor recycling markets impacted the 2018 population. When the number of RCs increases faster than the tons of CRV material recycled increases, the amount of recycled material available to each RC, on average, decreases. This, in turn, reduces recycler profitability.

Exhibit 3-9
2002–2018 Number of Processing Fee Recycling Centers



* 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. In 2018, Crowe removed 31 RCs that were under investigation by CalRecycle for major violations, reducing the total population from 705 to the survey population of 674 RCs.

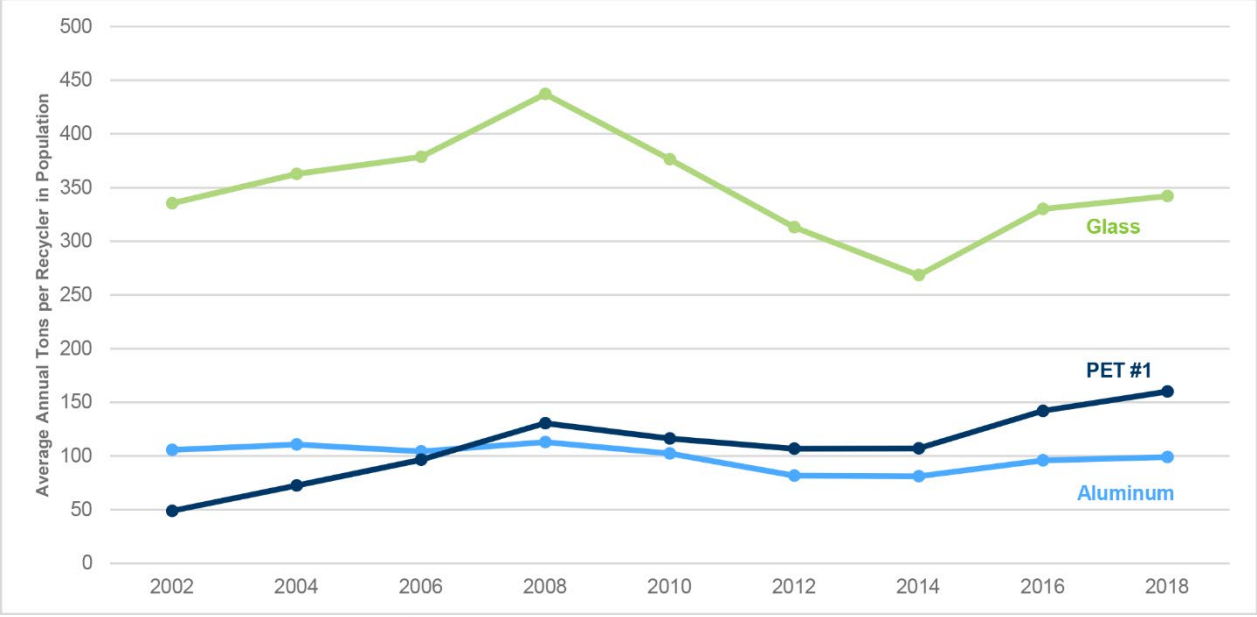
Average Tons Recycled per Recycling Center

Between 2016 and 2018, recycler productivity (average tons recycled by RC) increased for the second time since 2008. Average site volume went up, as did site costs per ton. Recycler productivity increases generally result in lower costs per ton, as efficiencies are gained. Other factors are involved in the resulting 2018 cost increases, as discussed later in this section.

There had been a significant decline in recycling center productivity starting in 2008 through 2014. The decline in productivity reflected the significant increase in the number of RCs in the population since 2008. Starting with the economic downturn in 2008, and continuing at least 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 did the tons of material recycled. As a result, the average tons handled per RC declined. Between 2014 and 2016, total tons of material recycled increased slightly and the number of RCs declined. Between 2016 and 2018, total tons of material recycled by the survey population decreased by 8 percent, and the number of RCs declined, to a greater degree, by 13 percent. The result is more tons of material recycled per RC, on average.

Exhibit 3-10 provides the average tons of aluminum, glass, and PET #1 recycled per RC for each cost survey year, 2002 through 2018. 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 3-10
2002–2018 (every 2 years) Average Tons of Aluminum, Glass, and PET #1 Recycled per Processing Fee Recycler



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 line since 2008 in Exhibit 3-10. Between 2016 and 2018, average glass tons increased to 330 and 342 per recycler, similar to the 2012 average.

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. While total aluminum recycling decreased between 2014 and 2016, the number of RCs decreased even more, resulting in an increase to 96 tons of aluminum per recycler. Between 2016 and 2018 there was a small increase to 99 tons. While an improvement, the average tons of aluminum per recycler is still lower than it was between 2002 and 2010. The reduction in aluminum recycling significantly impacts recycler profitability.

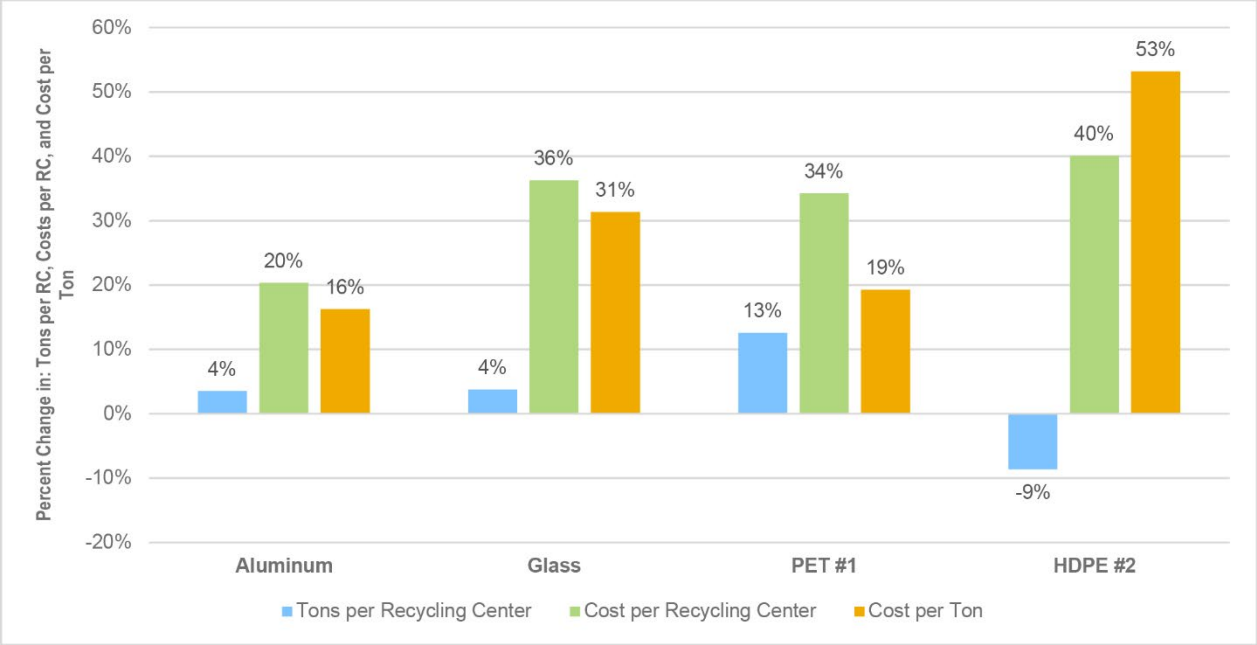
Similar to aluminum, recycling center PET #1 productivity also increased between 2002 and 2008, declined in 2010 and 2012, and stabilized between 2012 and 2014 at approximately 107 tons. Between 2016 and 2018, PET #1 increased to 160 tons. The combination of a slight decrease in PET #1 total recycling volumes and, to a greater degree, reduced number of recyclers between 2016 and 2018 led to an increase in average tons of PET #1 recycled per RC to 160.

In total, between 2016 and 2018, the average tons per RC of aluminum and glass increased 4 percent, PET #1 increased 13 percent, and HDPE #2 decreased 9 percent.

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

Exhibit 3-11 summarizes the relationship between RC productivity, costs, and cost per ton. The figure shows the percent change in average tons per RC, average costs per RC, and statewide, weighted-average cost per ton, between the 2016 and 2018, PF for PF recycler population for aluminum, glass, and PET #1. For aluminum, glass, and PET #1, average recycling center productivity (measured as tons recycled per RC) increased. For HDPE #2, average recycling center productivity decreased due to a decrease in volumes and increase in costs as compared to 2016, resulting in a significant increase in cost per ton. Recycling center costs and cost per ton increased for all four material types.

Exhibit 3-11
Percent Change in Tons per Recycler, Costs per Recycler, and Statewide, Weighted-Average Processing Fee Recycler Cost per Ton (2016 to 2018)



The cost per ton is a simple algebraic result of the cost per ton calculation: cost per ton = costs ÷ tons. As compared to the 2016 cost survey results, the 2018 tons (the denominator in the equation) for aluminum, PET #1, and glass was less than the numerator (costs). 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 a simple weighted-average.

The 2018 statewide aluminum cost per ton is 16 percent higher than the 2016 statewide recycler cost per ton. Between 2016 and 2018, average aluminum tons recycled per recycling center increased 4 percent, while costs per recycling center increased 20 percent over the same period. This was one of the factors that led to the increase in aluminum cost per ton.

The 2018 statewide glass cost per ton is 31 percent higher than the 2016 statewide recycler cost per ton. Between 2016 and 2018, average glass tons recycled per recycling center increased 4 percent, while costs per recycling center increased 36 percent over the same period. This was one of the factors that led to an increase in glass cost per ton.

The 2018 statewide recycler PET #1 cost per ton is 19 percent higher than the 2016 statewide PET #1 cost per ton. Between 2016 and 2018, the average tons PET #1 per recycling center increased 13 percent, while costs per recycling center increased 34

percent over the same period. This was one of the factors that led to an increase in PET #1 cost per ton.

The 2018 statewide recycler HDPE #2 cost per ton is 53 percent higher than the 2016 statewide HDPE #2 cost per ton. Between 2016 and 2018, the average tons HDPE #2 per recycling center decreased 9 percent, while costs per recycling center increased 40 percent, over the same period. This was one of the factors that led to an increase in HDPE #2 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, 2014, 2016, and 2018 surveys. **Exhibit 3-12** shows the labor hours allocated per ton of material recycled. On average, the labor hours required to handle one ton of CRV Glass and Plastic slightly increased from 2016 to 2018. Aluminum, however, slightly decreased from 17.9 hours per ton in 2016 to 17.7 hours per ton in 2018, essentially the same as in 2010.

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.

Exhibit 3-13 provides PF for PF recycler average hourly CRV wage since 2010 and compares these results with minimum wage and inflation-adjusted average hourly CRV wages. 2018 average labor wages per hour increased since the 2016 cost survey but were nearly the same as inflation adjusted average hourly CRV wages in 2010. The average recycler wage per hour (including owners, supervisors, and laborers) increased 17 percent between 2016 and 2018, from $15.09 per hour to $17.65 per hour. The change in average recycler wage per hour from 2016 to 2018 is roughly 10 percent after adjusting by the CPI, which is the same percentage increase as minimum wage from 2016 to 2018.

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‡‡ 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/bi-metal, to split costs between aluminum and bi-metal, for the relatively few RCs that handle both materials. Total costs and tons of bi-metal are less than 0.03 percent of aluminum costs and tons. Therefore, the hour analysis reflects time spent on aluminum.

Exhibit 3-12
2010, 2012 2014, 2016, and 2018 Sampled Processing Fee Recyclers
Average Labor Hours per Ton of Aluminum, Glass, and All Plastic Recycled

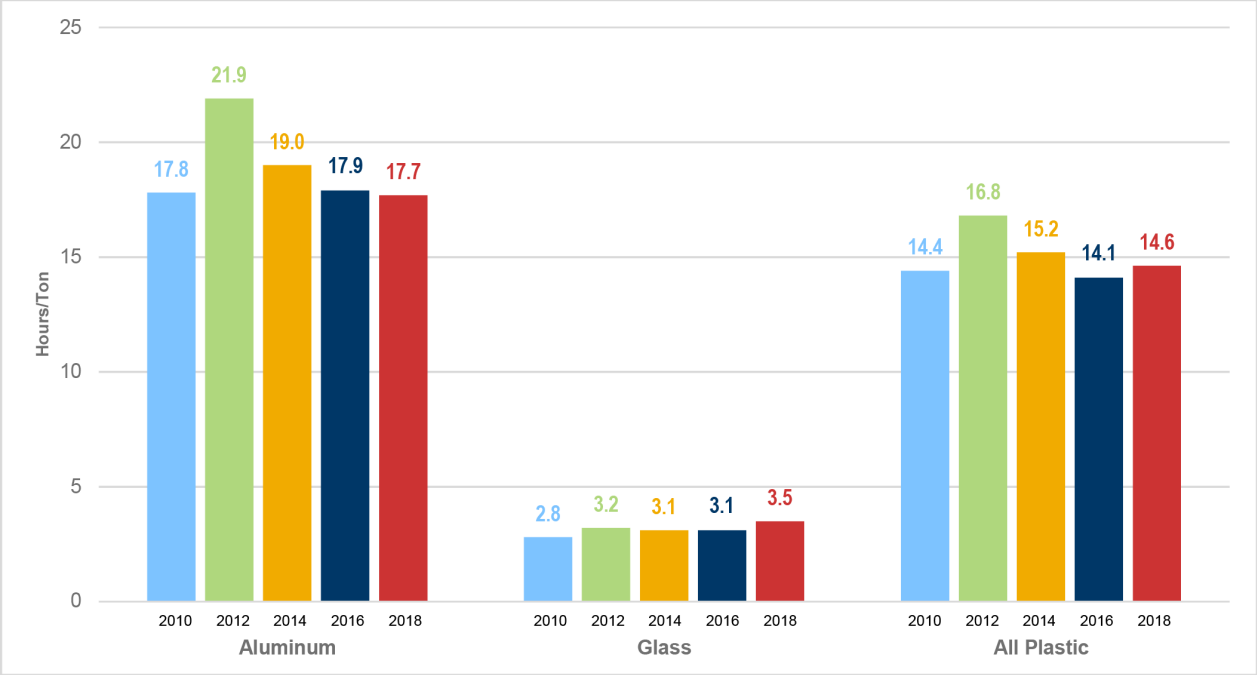
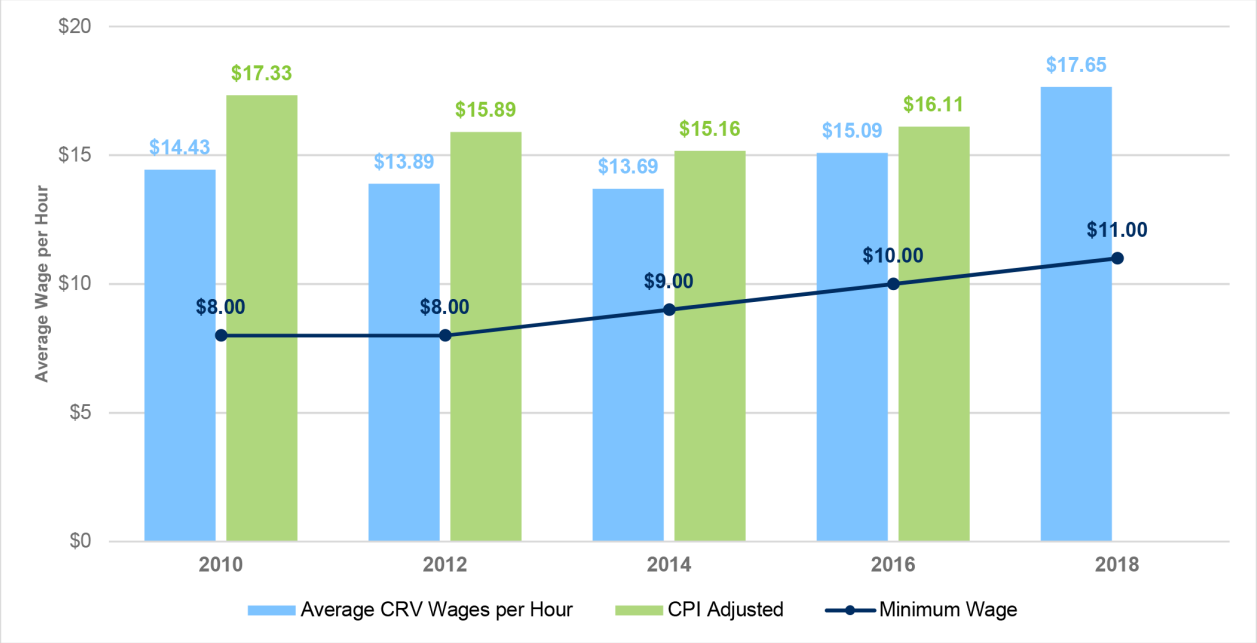


Exhibit 3-13
2010, 2012, 2014, 2016, and 2018 Sampled Processing Fee Recyclers
Average CRV Wages per Hour



E. Cost Category Comparison

In conducting the cost surveys, Crowe assigns each recycler cost line item to one of thirteen categories. To help evaluate potential reasons for the cost per ton increase between 2016 and 2018, we compared the average CRV category costs for the two survey samples. These data reflect the total costs in a particular category divided by the number of RCs in the survey population. They do not consider costs by strata or recycling tons per site, they simply reflect an average category cost per RC for the 143 RCs surveyed for the 2016 cost survey and the 154 RCs surveyed for the 2018 cost survey. As illustrated below, the per site average costs increased more than the weighted-average cost per ton, which consider recycling volumes and are weighted across the population.

Exhibit 3-14 provides a comparison of the 2018 average category costs per RC, the percent of CRV costs by category for 2018, the 2016 average category costs per RC, the percent of CRV costs by category for 2016, and CPI adjusted 2016 category costs per RC, and the percent change between the 2018 and CPI adjusted 2018 category costs. The CPI adjustment between 2016 and 2018 was 6.7 percent.[§§] Exhibit 3-14 illustrates several key points:

- Average CRV costs per RC increased by over one-third (35%) between 2016 and 2018
- The percent of CRV costs, by category, did not change significantly between 2016 and 2018. For example, direct labor represented 51.9 percent of CRV costs in 2018 and 50.1 percent in 2016, even though direct labor itself increased by 40 percent
- Consistent with prior cost surveys, the cost categories that make up the largest share of RC costs are:
  - Direct labor (~50 percent)
  - Rent (~10 to 12 percent)
  - Indirect labor (~8 to 11 percent)
  - Transportation (~5 to 7 percent)
  - General business overhead (GBO) (administrative costs, fees, etc.) (~5 to 7 percent)
- The cost categories with the greatest dollar increase between 2016 (adjusted) and 2018, accounting for 92 percent of the increase, were:
  - Direct labor
  - General business overhead
  - Transportation
  - Rent
  - Maintenance

[§§] U.S. Department of Labor, Bureau of Labor Statistics, West Urban Consumer Price Index: https://www.dof.ca.gov/Forecasting/Economics/Indicators/Inflation/

- The increase in direct labor was the largest single factor, accounting for 56 percent of increased per site costs between 2016 and 2018
- Transportation and GBO had the next largest dollar increases, each accounting for roughly 11 percent of the increased per site costs between 2016 and 2018.

Exhibit 3-14
Comparison of Average Processing Fee Recycler Category Costs (2016 and 2018)

Cost Category	2018 (n=154)	% of CRV Costs	2016 (n=143)	% of CRV Costs	CPI Adjusted 2016	% Change 2016 (adj.) to 2018
Direct Labor	$134,989	51.9%	$90,265	50.1%	$96,349	40%
Indirect Labor	$20,745	8.0%	$19,184	10.7%	$20,477	1%
General Business Overhead	$18,248	7.0%	$9,741	5.4%	$10,398	76%
Transportation	$17,171	6.6%	$8,993	5.0%	$9,599	79%
Rent	$27,634	10.6%	$20,826	11.6%	$22,230	24%
Depreciation	$4,931	1.9%	$4,902	2.7%	$5,232	-6%
Property Tax	$1,220	0.5%	$988	0.5%	$1,055	16%
Utilities	$7,734	3.0%	$6,169	3.4%	$6,585	17%
Supplies	$6,365	2.4%	$5,822	3.2%	$6,214	2%
Fuel	$2,027	0.8%	$2,157	1.2%	$2,302	-12%
Insurance	$5,530	2.1%	$4,023	2.2%	$4,294	29%
Interest	$1,388	0.5%	$567	0.3%	$605	129%
Maintenance	$11,902	4.6%	$6,411	3.6%	$6,843	74%
Total CRV Costs per Site	$259,884	100.0%	$180,048	100.0%	$192,183	35%

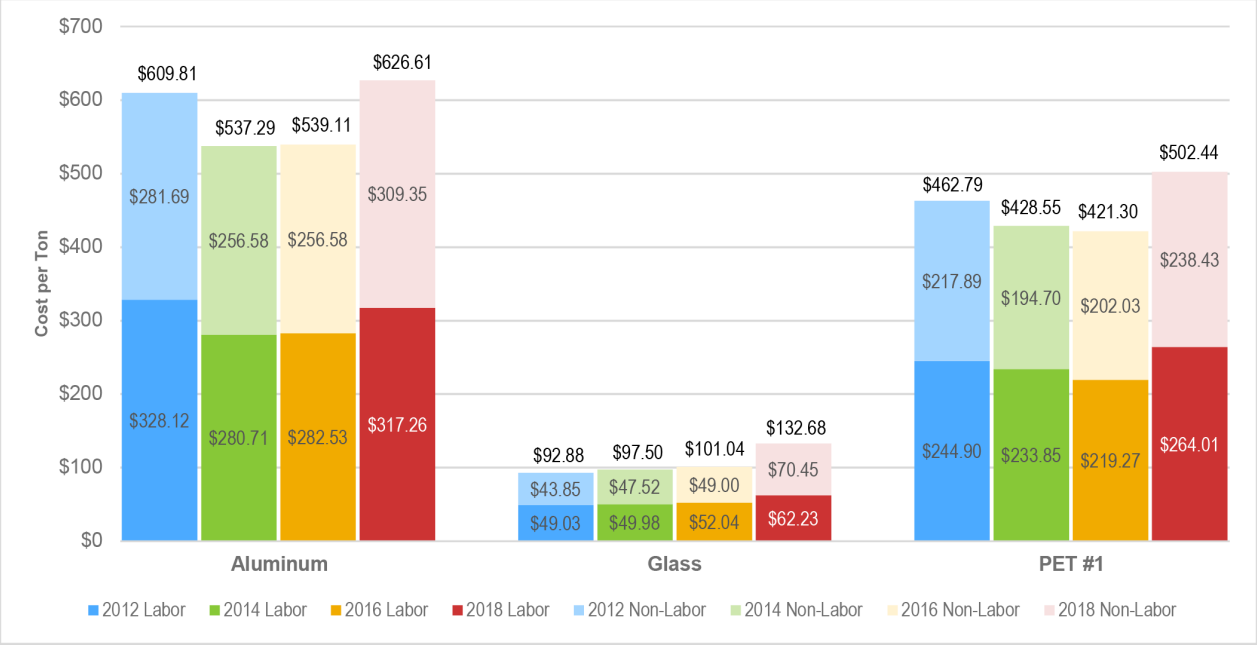
Labor and Non-Labor Costs

We also determined the labor and non-labor portions of cost per ton for the 2012, 2014, 2016, and 2018 cost surveys, and compared how the two cost components changed between the four surveys. **Exhibit 3-15** shows that, for each material type, labor accounts for 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 four survey years and across the three material types, further validating our survey methodology.

Labor costs increased between 2016 and 2018 for all three material types. We showed earlier that average hourly wages increased between 2016 and 2018, and that hours per ton recycled increased for glass (~13%) and plastic (~3.5%), and decreased slightly for aluminum (~1%). The combination of the slightly increased labor hours per ton along with increased average hourly wages contributed to the increase in the labor cost component.

Exhibit 3-15
2012, 2014, 2016, and 2018 Sampled Processing Fee Recyclers
Labor and Non-Labor Costs per Ton



The two analyses presented above provide considerable confidence in our sample design and cost survey labor allocation methodologies that were the basis of the 2018 cost per ton results. The results also demonstrate a consistency in the cost survey labor allocation methodology between the 2012, 2014, 2016, and 2018 cost surveys.

In the next two sections we look more closely at the data and potential reasons behind the increases in direct labor and transportation. Each of these two cost categories are made up of distinct components that can be readily compared from year to year. Direct labor consists of actual employee wages and owner/partner income (i.e. owner wages). Transportation consists of costs associated with transporting CRV material from recyclers to processors. By comparison, GBO consists of a wide range of line items (accounting, advertising (excluding coupons), bank charges, dues/subscriptions, payroll processing, safety, security, licenses and permits, etc.) that are less suitable for direct comparison.

F. Changes in Labor Costs

Crowe analyzed CRV labor costs and labor hours to better understand how labor influenced the increase in cost per ton between 2016 and 2018. In the analyses below, 2016 labor costs are not adjusted by CPI, rather they are a straight dollar comparison across the two survey years. A CPI adjustment would increase 2016 costs by 6.7 percent.

To evaluate the potential influence and impact of labor costs on costs per ton, as well as the potential influence of high-wage sites or labor allocations, we conducted evaluations of several potential factors related to labor hours, labor allocations, hourly yard wages, hourly administrative wages, and minimum wage. The cost survey labor allocation methodology assigns labor hours for each employee or owner at the site based on whether the time was associated with: 1) the recycler or other business, 2) CRV or non-CRV, 3) Direct yard labor (DYL) or all other labor (AOL), and by aluminum/bi-metal, glass, and plastic. DYL labor includes yard employees that sort, weigh, handle, bale, or cashier. AOL labor includes administration, management, and driver time, all of which are typically higher-wage activities.

- Factors that did lead to higher labor costs:
  - Higher CRV hourly wages. Weighted-average CRV hourly wages increased overall and by strata between 2016 and 2018
  - Higher simple average overall wages per hour, DYL wages per hour, and AOL wages per hour
  - Significant increases in hourly wages for Los Angeles County RCs as compared to the remainder of the state, likely driven by the 26 percent increase in LA county minimum wage between 2016 and 2018
  - A reduction in low-wage RCs in the survey samples between 2016 and 2018, potentially due to the closure of low profit stratum 3 RCs between 2016 and 2018

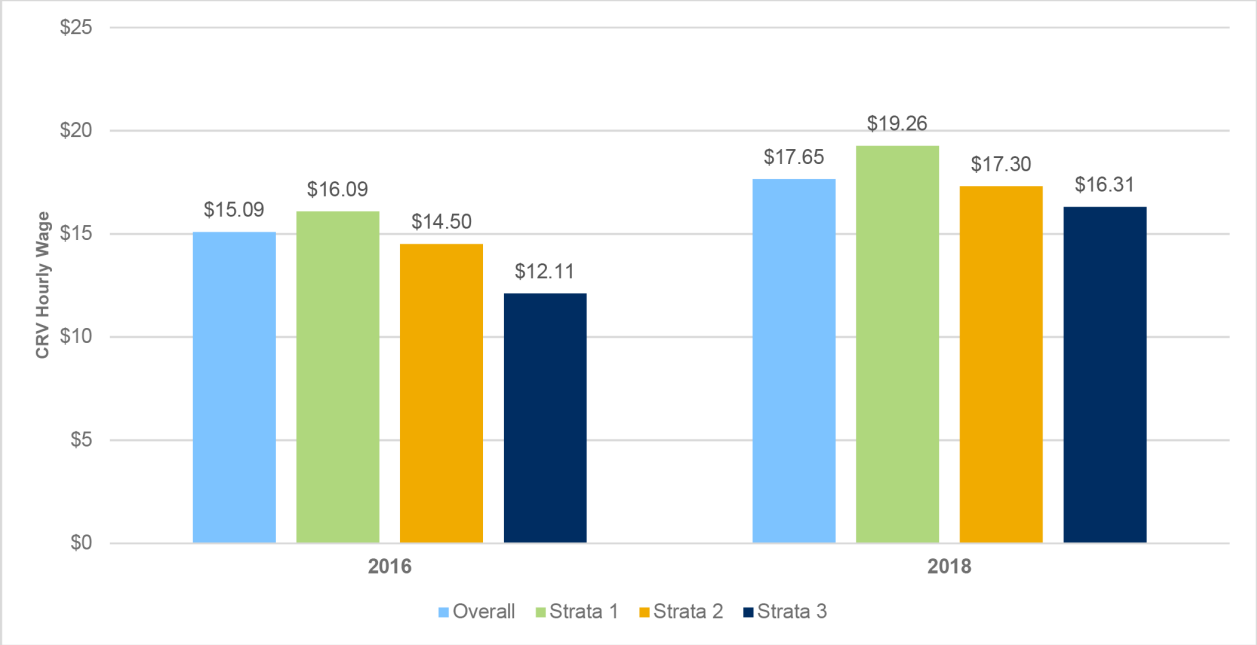
- Factors that did not lead to higher labor costs:
  - Labor allocations – there were not significant changes in the allocation of CRV hours between material types or hours per ton by material type. There was an increase in CRV all other labor (AOL), which accounted for 8 percent of CRV hours in 2016 and 10 percent of CRV hours in 2018. However, this 2-percentage point increase is not enough to explain the increased labor costs
  - Increased hours handling CRV materials – There were no significant changes in percent of CRV hours, CRV hours per ton, percentage of DYL hours by material type, DYL hours per ton by material type, and AOL hours per ton by material type. There was a slight increase in percent of AOL hours as a percent of RC hours between 2016 and 2018, noted above
  - High wage sites – there were a small number of sites with relatively high owner wages (profits); however, this did not differ significantly between 2016 and 2018, and only contributed to a minor share of total costs.

CRV Hourly Wages

Crowe calculated CRV hourly wages by summing CRV labor costs across all RCs in each survey sample and dividing by the sum of CRV labor hours. **Exhibit 3-16** provides a summary of CRV hourly wages. Thus, this calculation reflects a weighted average hourly wage across the survey samples. It does not consider tons of CRV material. As seen above, labor reflects approximately 50 percent of the cost of CRV recycling.

CRV hourly wages increased 17 percent between 2016 and 2018. If we consider that California minimum wage increased 10 percent between 2016 and 2018, and CPI could account for a 6.7 percent increase, the 17 percent seems reasonable. Across strata, the greatest increase was in strata 3, with a 35 percent increase. This is consistent with the reduction in strata 3 low-wage sites, discussed below. The increase in hourly wages likely explains a significant portion of the increased costs per ton.

Exhibit 3-16
Comparison of CRV Hourly Wages Overall and by Strata (2016 and 2018)



To provide context, at 2,080 hours annually, $17.65 per hour is equivalent to $36,712 gross annual income. In 2017, the median household income in California was $71,805. The 2017 per capita income was $35,046.*** The California Poverty Measure for a family of four, slightly higher than the federal poverty level, was about $32,500 in 2017.†††

*** U.S. Census, American Community Survey: https://www.census.gov/programs-surveys/acs/.

††† Public Policy Institute of California (https://www.ppic.org/publication/poverty-in-california/.

Increases in DYL, AOL, and Overall Wage per Hour

Consistent with the weighted-average increase in CRV hourly wage, the simple average DYL, AOL, and overall hourly wages increased across all surveyed sites and by strata. These wages include all labor: other business, RC, non-CRV, and CRV. They reflect a simple average of the average hourly wage for each site in the survey sample. They do not reflect the number of hours per site, or volumes of material handled. **Exhibit 3-17** provides a comparison of average hourly wages by strata and overall.

Exhibit 3-17
Comparison of DYL, AOL, and Overall Wage per Hour (2016 and 2018)

Average DYL per hour

Strata	2016	2018	% Change
1	$15.01	$15.63	4%
2	13.64	16.43	20%
3	13.14	14.67	12%
Average	**$13.89**	**$15.30**	**10%**

Average AOL per hour

Strata	2016	2018	% Change
1	$30.69	$54.18	77%
2	21.58	32.83	52%
3	20.59	29.98	46%
Average	**$24.16**	**$35.06**	**45%**

Average Overall Wage per Hour

Strata	2016	2018	% Change
1	$18.26	$21.44	17%
2	15.32	19.05	24%
3	14.57	17.56	21%
Average	**$15.97**	**$18.66**	**17%**

On average, CRV and non-CRV direct yard labor (DYL) hours make up over 80 percent of RC hours. The remaining less than 20 percent of RC hours are all other labor (AOL). In 2016, there was a greater percentage of "other business" hours among surveyed sites, primarily due to the fact that there were two large transfer stations/MRFs (with RCs) in the 2016 survey sample. These sites accounted for one-third of the other business hours.

The increase in overall DYL between 2016 and 2018 is the same as the increase in statewide minimum wage. This is likely a coincidence but may also reflect anecdotal feedback provided during this and prior cost surveys. Anecdotally, we hear that low wage businesses such as recycling centers must respond to increases in minimum wage, even if they provide wages that are slightly above. To compete for workers in a tight labor market, employers must provide competitive wages. Furthermore, to attract workers to physically demanding work at recycling centers, employers tell us they need to provide a premium above minimum wage.

The increase in average AOL per hour was significantly more than the increase in DYL per hour, and the overall wage per hour. While higher AOL wages contributed to the increased labor costs, they are not a driving factor in overall costs per ton. AOL hours represent only 10 percent of CRV hours.

Minimum Wage Increases

Changes in DYL are most likely to be impacted by changes in minimum wage. Because DYL accounts for over 80 percent of CRV labor, increases in DYL have a greater impact on CRV recycling costs than increases in AOL. California minimum wage increased 10 percent, from $10 per hour in 2016 to $11 per hour in 2018. Los Angeles County's minimum wage increased 26 percent between 2016 and 2018. This change in LA County is reflected in DYL, AOL, and overall hourly wage changes between surveyed recyclers in LA County and the rest of the state. Approximately one-third of surveyed processing fee recyclers in 2016 and 2018 were located in LA County. As a result, increases in hourly wages in LA County sites has a significant impact on overall labor costs.

As **Exhibit 3-18** illustrates, LA County DYL increased 24 percent between 2016 and 2018, while non-LA County DYL increased 5 percent. Average DYL in non-LA County sites was over $2.00 per hour higher than LA County sites in 2016, and $0.12 cents lower than LA County in 2018. AOL and overall hourly wages also increased more significantly in LA County than the remainder of the state. However, LA County AOL was still more than $5 per hour less than the rest of the state. LA County and non-LA County overall wages per hour were essentially equivalent in 2018. As noted above, these data reflect a simple average wage per hour and include non-CRV and other business wages. We will further evaluate regional labor costs in future reports, including the Rural Recycler Cost Survey Report.

Exhibit 3-18
Comparison of Los Angeles County and non-Los Angeles County DYL, AOL, and Overall Wage per Hour (2016 and 2018)

Wage Category	LA County 2016 (n=46)	LA County 2018 (n=56)	LA County % Change	Non-LA County 2016 (n=97)	Non-LA County 2018 (n=98)	Non-LA County % Change
Minimum Wage	$10.50	$13.25	26%	$10.00	$11.00	10%
Direct Yard Labor (DYL)	$12.45	$15.38	24%	$14.59	$15.26	5%
All Other Labor (AOL)	$18.33	$31.59	72%	$27.11	$37.03	37%
Overall Wage per Hour	$13.49	$18.42	37%	$17.17	$18.79	9%

Reductions in Low Wage Recycling Centers

One of the inherent challenges of the cost survey methodology is that for sole proprietors, S-corporations, and partnerships where the owner(s) work in the recycling centers, owner's income or profits are equivalent to owner wages. These business categories represent a large share of the survey population—73 percent in 2018. Over the last several years, we have seen a growing number of recycling centers where the owner(s) work a significant number of hours but that have low-to-no profits. This results in hourly wages that are below minimum wage, driving cost per ton down. This is one of the reasons for the "death spiral" that has been discussed as it relates to the cost of recycling.

Crowe evaluated the number and percent of surveyed recyclers with overall hourly wages below minimum wage in 2016 and in 2018. **Exhibit 3-19** illustrates that there was a significant reduction in the number of surveyed recycling centers with overall average hourly wages that were less than minimum wage between 2016 and 2018. Although it is difficult to determine the extent of the impact, this is one factor that would lead to an increase in average hourly wages and an increase in CRV costs per ton.

A contributing factor to the reduction in low-wage sites may be the ongoing closure of recycling centers. Our analyses indicate that the reduction in survey population recycling centers between 2016 and 2018 was primarily due a reduction of stratum 3 recyclers. **Exhibit 3-20** provides a comparison of the 2016 survey population of 778 recycling centers by strata using 2018 cost survey strata definitions to the 2018 survey population of 674 recycling centers by strata using the same 2018 cost survey strata definitions.

Exhibit 3-19
Comparison of Low Wage Recycling Centers (2016 and 2018)

Category	2016 (n=143)	2018 (n=154)
California Minimum Wage	$10.00	$11.00
Number of Surveyed PF Recyclers < Minimum Wage	24	14
Percent of Surveyed Sites < Minimum Wage	17%	9%
Range of Hourly Wages < Minimum Wage	$0.00 to $9.97	$0.00 to $10.84

Exhibit 3-20
Comparison of Survey Population RCs by Strata using 2018 Strata Definitions (2016 and 2018)

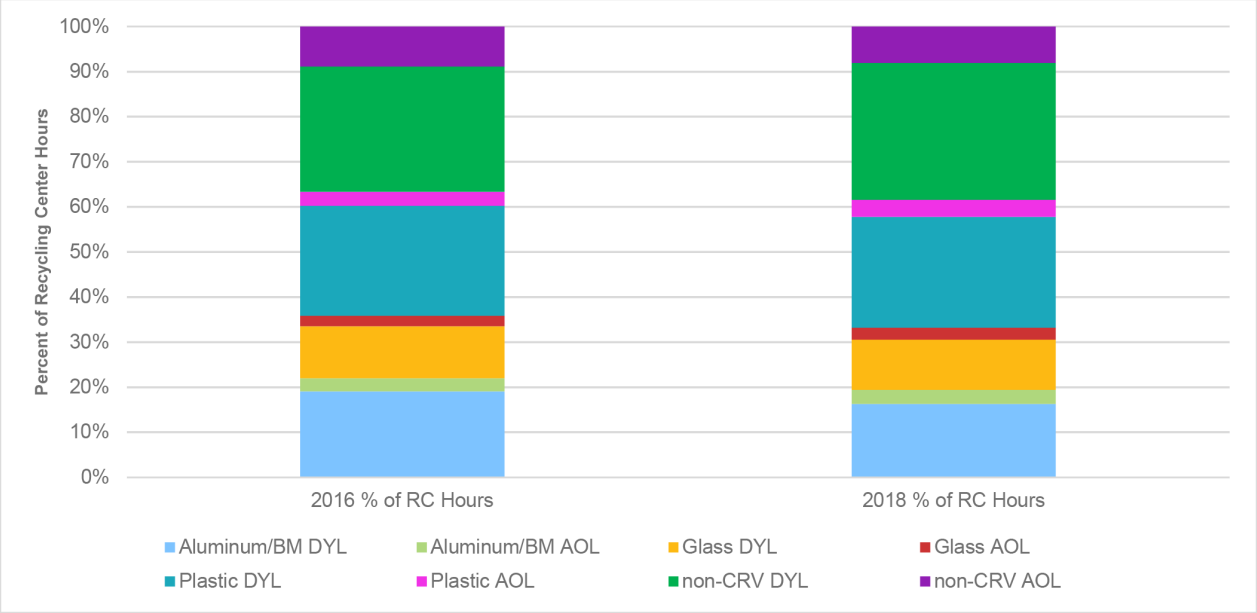
Strata Number and Definition	2016 Survey Population	2018 Survey Population	Difference
Strata 1: >=400 tons PET	54	53	-1
Strata 2: 200 tons to <400 tons PET	108	125	+17
Strata 3: <200 tons PET	616	496	-120
Total	**778**	**674**	**-104**

The number of large stratum 1 recyclers was the same between survey years, the number of mid-size stratum 2 recyclers increases slightly in 2018, and the number of small stratum 3 recyclers decreased by 120 recyclers. The closure of small recycling centers is consistent with Crowe's experience during the last two cost surveys, where a larger share of small recyclers selected for the survey have closed before we can complete the field visit to the site. One hypothesis that is consistent with our initial findings is that many of these closures were small, not-profitable recycling centers.

Labor Allocations

Determining the cost per ton by material type depends on labor allocations at the recycler level. We recognize that it is difficult for recyclers to allocate labor hours across non-CRV, CRV, and CRV material types. Crowe has developed extensive experience conducting thousands of recycling center cost surveys and labor allocations to help recyclers through this process. Because this process is not straightforward, we evaluated whether the increase in costs per ton was a result of allocating more labor hours to CRV materials. We analyzed total labor hours by category across the 2016 and 2018 surveyed recyclers, comparing percent of recycling center hours by various categories, illustrated in **Exhibit 3-21.**

Exhibit 3-21
Percent of Recycling Center Labor Hours by Activity (2016 and 2018)

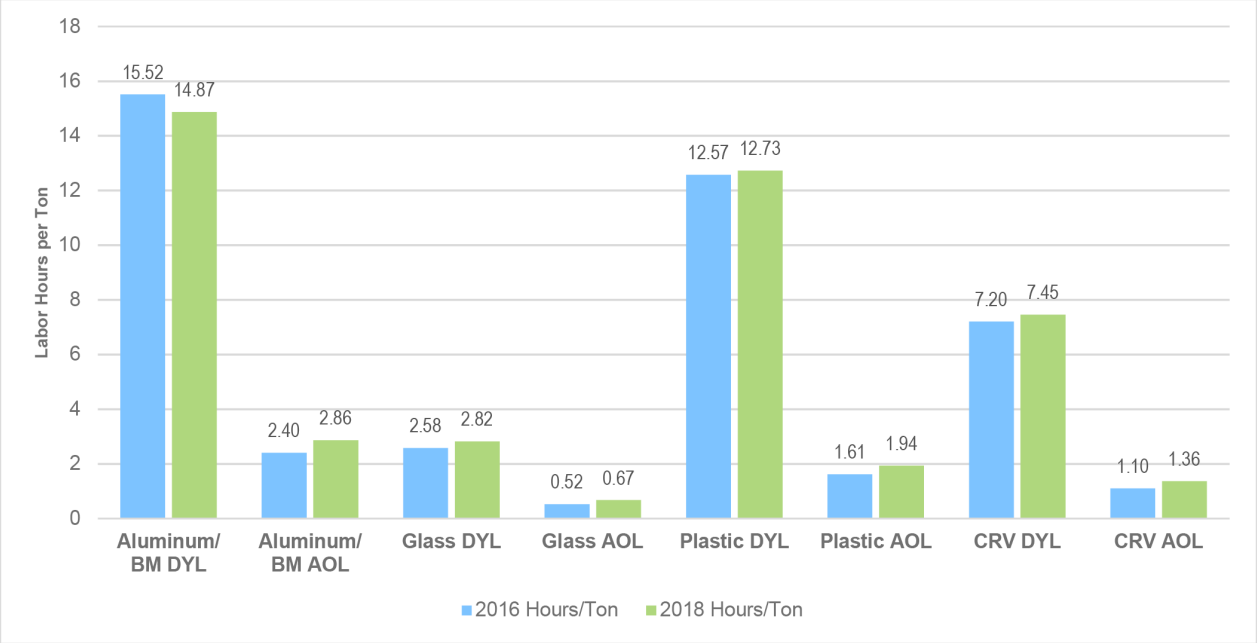


As Exhibit 3-21 illustrates, there were no significant changes in the allocation of CRV hours between material types or hours per ton by material type between surveyed processing fee recyclers in 2016 and 2018. There was an increase in CRV AOL, which accounted for 8 percent of CRV hours in 2016 and 10 percent of CRV hours in 2018. However, this 2-percentage point increase is not enough to explain the increased labor costs. In addition, the percent of hours allocated to non-CRV activity increased between 2016 and 2018; if all else was held equal, this would tend to reduce CRV costs.

Increased Hours Handling CRV Materials

Building on the labor hour analysis, we calculated average labor hours per ton by material type based on survey sample hours by category and survey sample tons for each material type. We excluded bi-metal tons, which reflect only .08 percent of aluminum/bi-metal total tons in 2018. For plastic, we included PET and HDPE tons, which represent 99.9 percent of total plastic tons. Both percentages are consistent between 2016 and 2018 survey samples. **Exhibit 3-22** illustrates that labor hours per ton increases slightly between 2016 and 2018 across all materials and labor categories, with the exception of aluminum/bi-metal DYL. However, none of the increases were significant, and even in combination were not enough to explain the increases in cost per ton between 2016 and 2018. In fact, the increase may have been in part because the 2018 survey sample had more strata 3 sites and fewer strata 1 sites as compared to 2016. Generally, strata 1 labor hours per ton are lower due to efficiencies of scale. This effect would be diminished in the weighted cost per ton results.

Exhibit 3-22
Labor Hours per Ton CRV Material by Activity (2016 and 2018)



High Wage Sites

To determine whether higher profits/owner wages were a factor in the increased cost per ton, we evaluated sites with the highest AOL wages per hour for the two-survey sample. In two prior surveys (2006 and 2008), high scrap prices (for aluminum and scrap metals) drove up owner wages significantly. While similar strong market conditions were not in place in 2018, we considered whether the higher AOL wages per hour might have been a factor in the higher cost per ton. To evaluate this, we compared high AOL wage sites for 2016 and 2018. AOL wages would be reflective of higher owner wages, as most high-wage owners are not working in the yard. AOL hourly wages include both CRV and non-CRV wages and hours, and on average accounts for approximately 10 percent of total recycler hours.

We focused on recycling centers with high AOL wages of over $100 per hour in order to give us an indication of whether high profits were impacting cost per ton. In both years, there were four surveyed recycling centers with AOL wages over $100 per hour. The highest AOL wages were significantly higher in 2018; however, these four sites contributed less to CRV labor costs and CRV total costs as compared to the four sites in 2016. This comparison illustrates that high AOL wage sites were not significantly different between 2016 and 2018, and thus not likely a factor in the increased cost per ton.

G. Changes in Transportation Costs

CRV transportation costs were analyzed to gain a better understanding of how transportation impacted the increase in cost per ton between 2016 to 2018. As mentioned above, transportation is among the largest contributors to the increase in overall CRV costs. To evaluate the impact of transportation on recycler costs, Crowe evaluated transportation and fuel costs for each material type by hauling method. The transportation and fuel line items include non-labor costs that should generally reflect the cost to recyclers of hauling material to processors. These line items also include general transportation costs and fuel for forklifts, so they are not exclusive to transporting specific materials, however, these non-hauling costs are minimal compared to hauling. To analyze how transportation influenced cost per ton, Crowe analyzed the changes in transportation costs, which impact overall cost per ton, with the objective of providing an explanation for the changes. Transportation (and fuel) costs represent roughly eight percent of total CRV costs for PF recyclers.

Exhibit 3-23 provides a comparison between diesel retail price per gallon‡‡‡ and average transportation costs per recycler center from 2010 to 2018. In 2016, California averaged $2.65 per gallon of diesel, whereas, in 2018, the average price increased 46 percent to $3.87 per gallon. From 2016 to 2018, average transportation costs per recycling center increased roughly 72 percent. The increase in diesel price per gallon from 2016 to 2018 is likely a primary contributor to the increase in transportation costs.

Exhibit 3-24 shows RC cost per ton for aluminum, glass, and PET #1 by different hauling methods: self-hauling, third-party, processor scrap deduction, and payment to processor. The lowest cost per ton is associated with processor pick-up with a scrap value deduction, as expected. When the processor takes a scrap value deduction, rather than charge the recycler for transportation, they reduce the scrap payment. Thus, there is no line-item transportation cost, instead there is a reduction in income. The most costly transportation method was self-hauling with recycler payment to processor ranking second, and third-party hauling ranking third. The differences in costs per ton in these exhibits reflect changes in transportation costs, but also other factors as well. Each cost per ton calculation reflects the costs and volumes of all recyclers in the sample that hauled material by a given method.

‡‡‡ Source: U.S. Energy Information Administration, Annual Retail Gasoline and Diesel Prices: https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_sca_w.htm

Exhibit 3-23
Comparison of Average Transportation Cost per Surveyed Recycling Center and Diesel Prices (2010–2018)

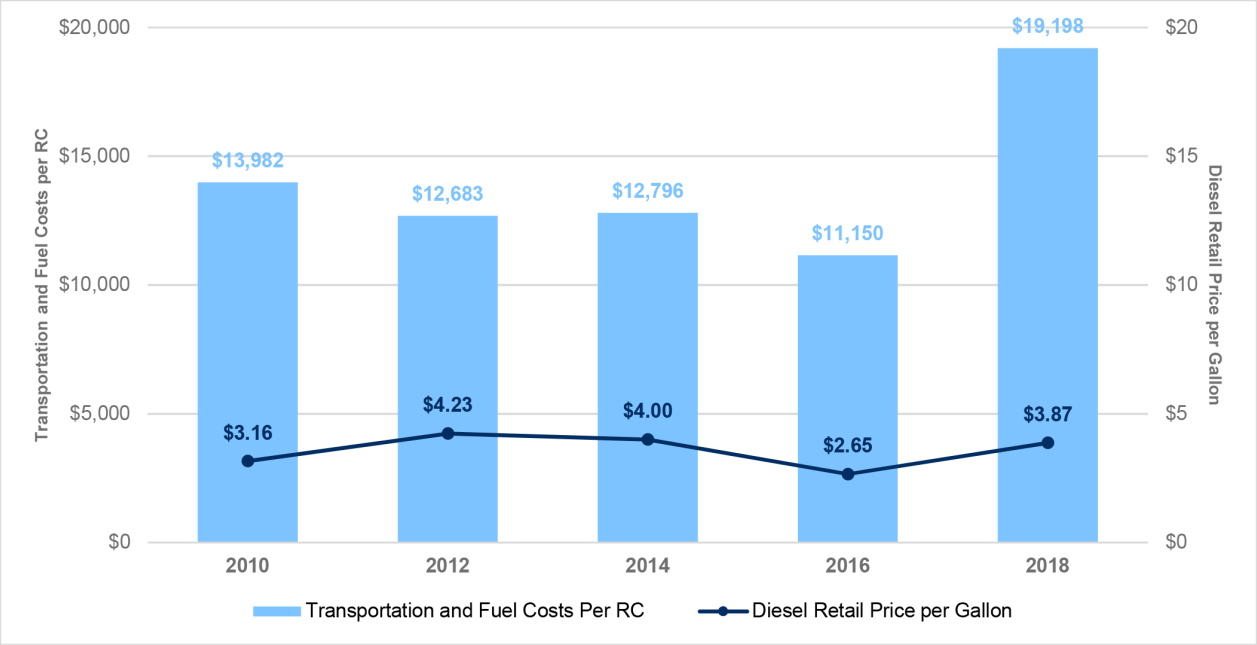
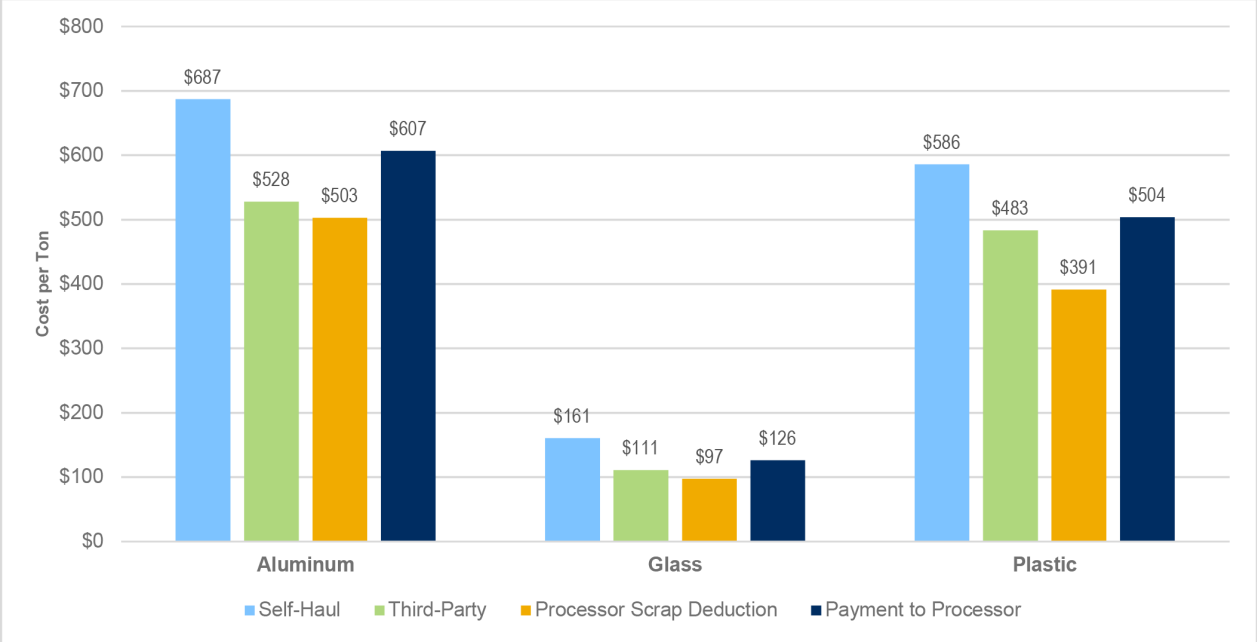


Exhibit 3-24
2018 Aluminum, Glass, and Plastic Cost Per Ton by Hauling Method



Exhibits 3-25, 3-26, and **3-27** show a comparison among hauling methods by aluminum, glass, and PET #1 between 2016 and 2018. With the exception of third-party hauling for aluminum, cost per ton for aluminum, glass, and PET #1 across all hauling methods increased from 2016 to 2018. In 2018, self-haulers had the highest cost per ton across all materials. By comparison, in 2016, third party hauling resulted in the highest cost per ton for aluminum, and self-hauling resulted in the highest cost per ton for glass and PET #1. In 2018, processor scrap value deductions resulted in the lowest cost per ton for all materials, while the trend was the same for aluminum in 2016, payment to processor resulted in the hauling method with the lowest cost per ton for glass and PET #1.

Exhibit 3-25
2016 vs 2018 – Aluminum Cost Per Ton by Hauling Method

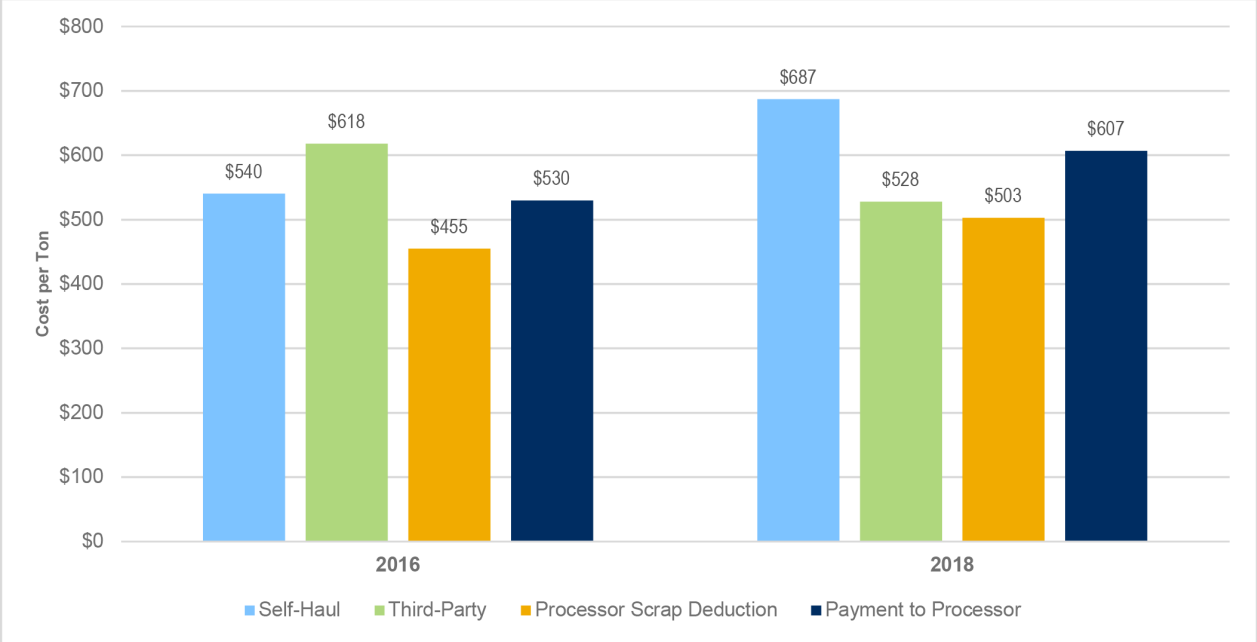


Exhibit 3-26
2016 vs 2018 – Glass Cost Per Ton by Hauling Method

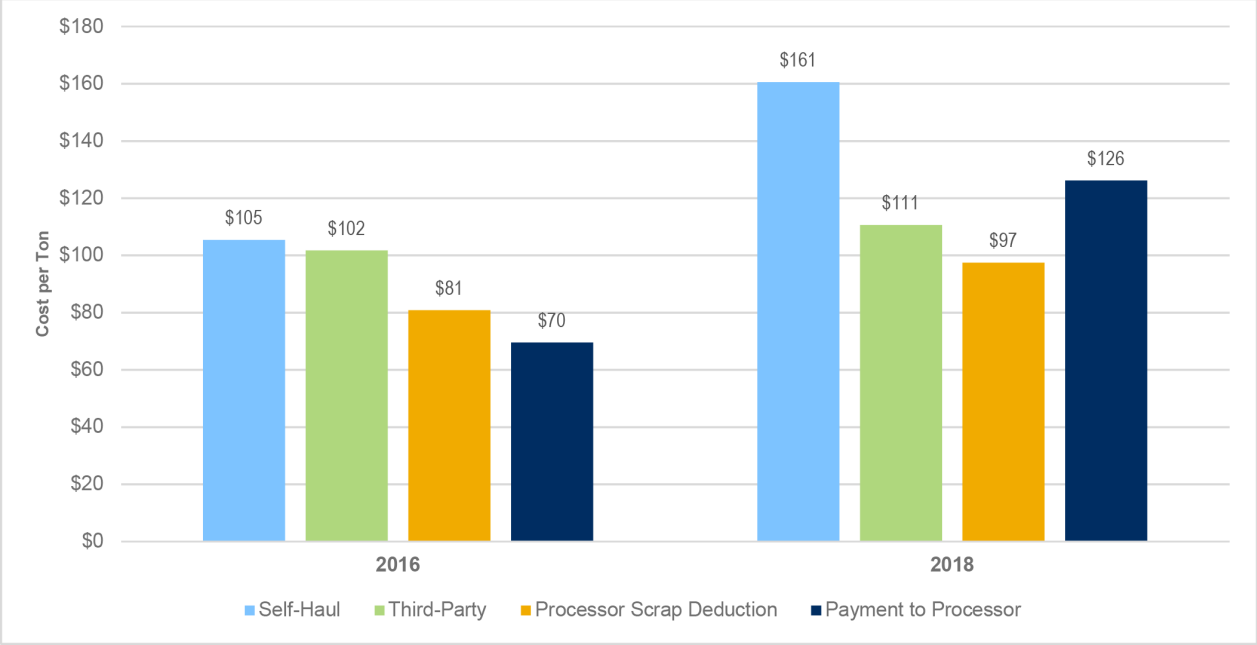


Exhibit 3-27
2016 vs 2018 – PET #1 Cost Per Ton by Hauling Method

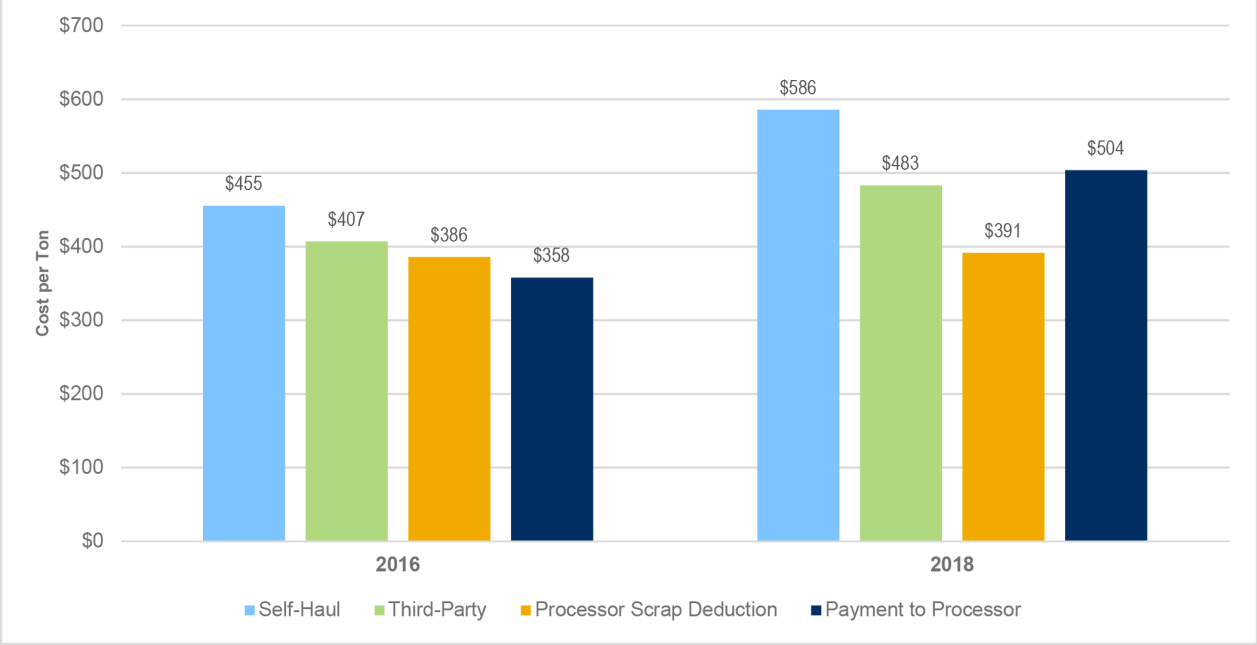
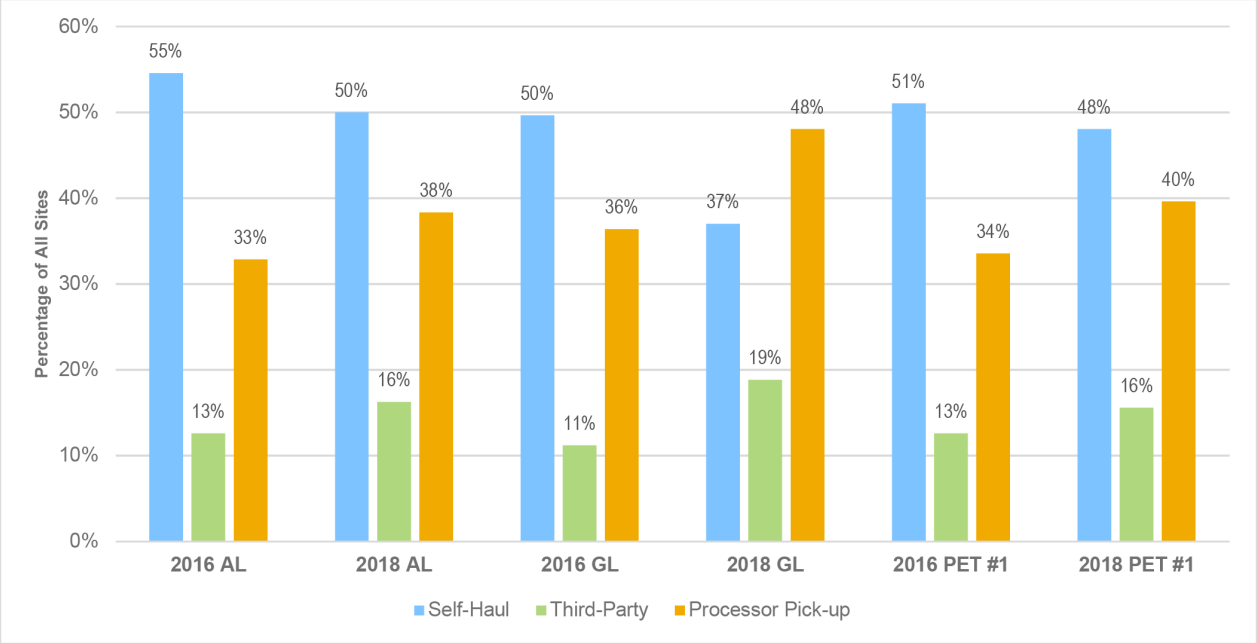


Exhibit 3-28 shows a comparison between 2016 to 2018 for the percent of the sampled PF recyclers that utilize each of the three transportation methods, by material type. Across all major material types, there is a shift from self-hauling to other hauling methods as less recyclers self-haul, while more utilize third-party and processor pick-up. The biggest negative change was the decrease in the rate of recyclers self-hauling glass, while the largest positive change was the increase in processor pick-up for glass, which were both just above a 10 percent change. The other methods for each material shifted roughly 5 percent or less.

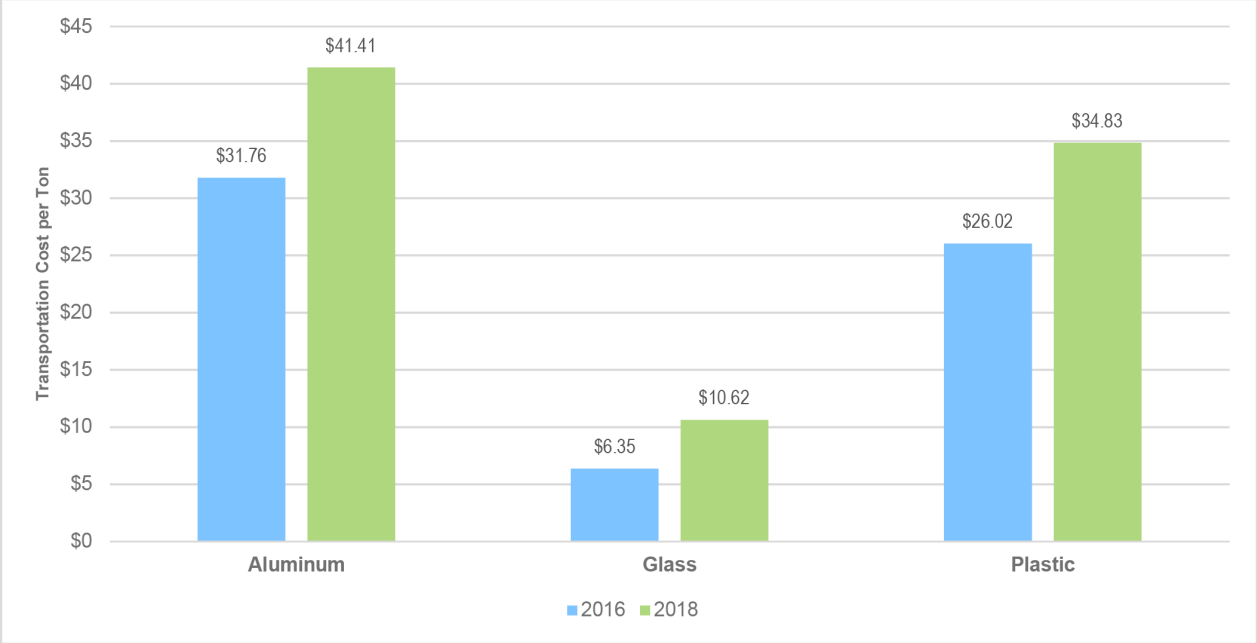
Exhibit 3-28
2016 vs 2018 – Comparison of Each Hauling Method*



* In 2016, “dual site” was treated as processor pick-up and in 2018, “dual site” was an additional hauling option, however, for the purpose of this comparison, “dual site” is categorized as processor pick up. Additionally, the sum of percentages exceeds 100 percent as some recyclers use more than one hauling method throughout the year.

Exhibit 3-29 shows a comparison between 2016 and 2018 for transportation cost per ton for aluminum, glass, and plastic. Transportation cost per ton was calculated by taking the sum of transportation and fuel costs divided by the total tons for each material for the 2016 and 2018 survey samples. The results show that transportation cost per ton for all materials increased, with glass experiencing the largest change with a 67 percent increase, while aluminum and plastic increased roughly 30 percent. **Exhibits 3-30, 3-31,** and **3-32** examine differences among small, medium, and large recyclers for aluminum, glass, and plastic. For both years, aluminum and plastic showed that the larger the recycler, the lower the transportation cost per ton. Though this trend was the same in 2016 for glass, in 2018, medium-sized recyclers had the lowest transportation cost per ton, switching positions with the large recyclers, which had the second lowest transportation cost per ton.

Exhibit 3-29
2016 vs 2018 – Aluminum, Glass, and Plastic Transportation Cost Per Ton*



* "Aluminum" includes aluminum and bi-metal. "Plastic" includes PET #1 and HDPE #2.

Exhibit 3-30
2016 vs 2018 – Aluminum Transportation Cost Per Ton by Strata

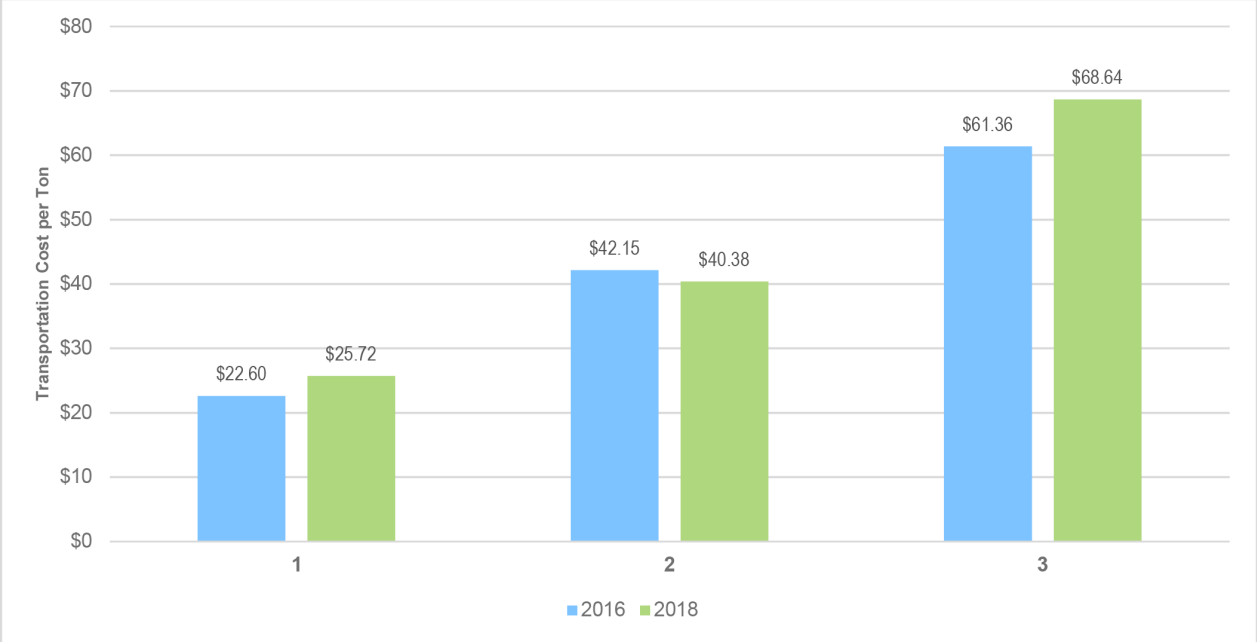


Exhibit 3-31
2016 vs 2018 – Glass Transportation Cost Per Ton by Strata

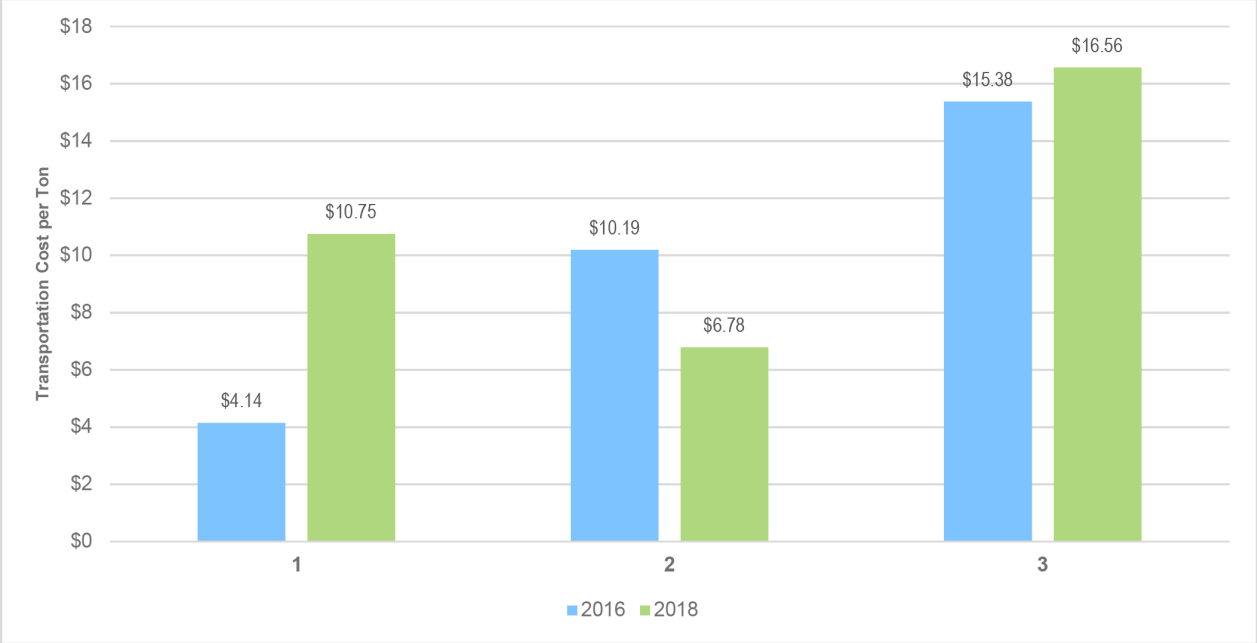


Exhibit 3-32
2016 vs 2018 – Plastic Transportation Cost Per Ton by Strata

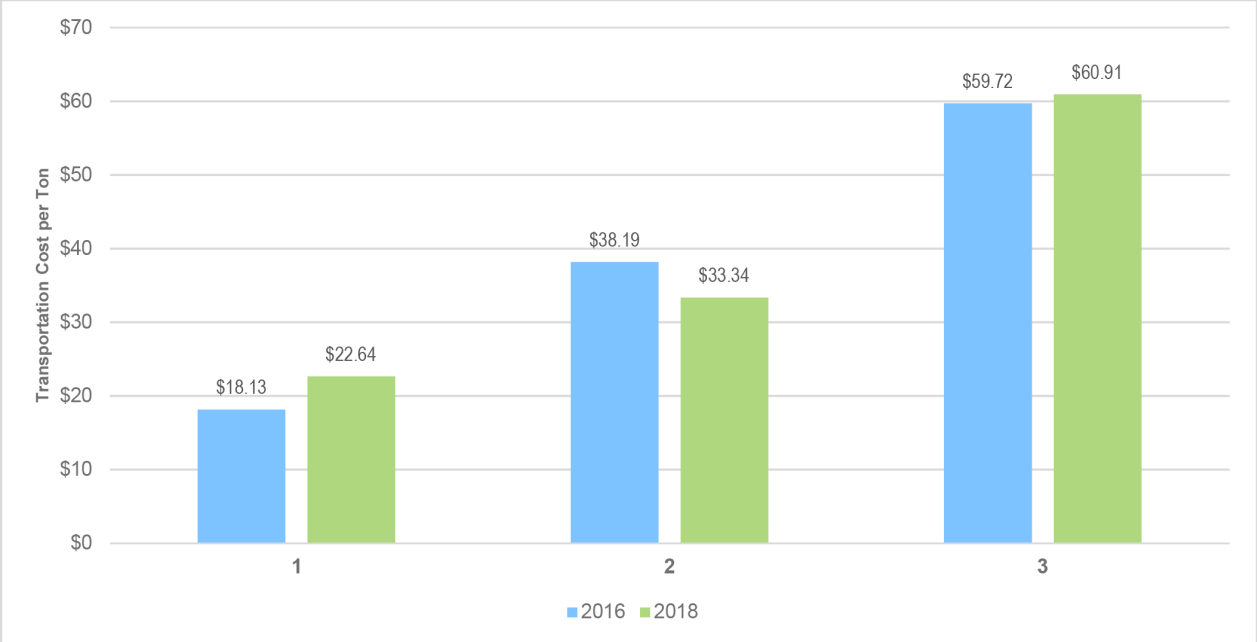
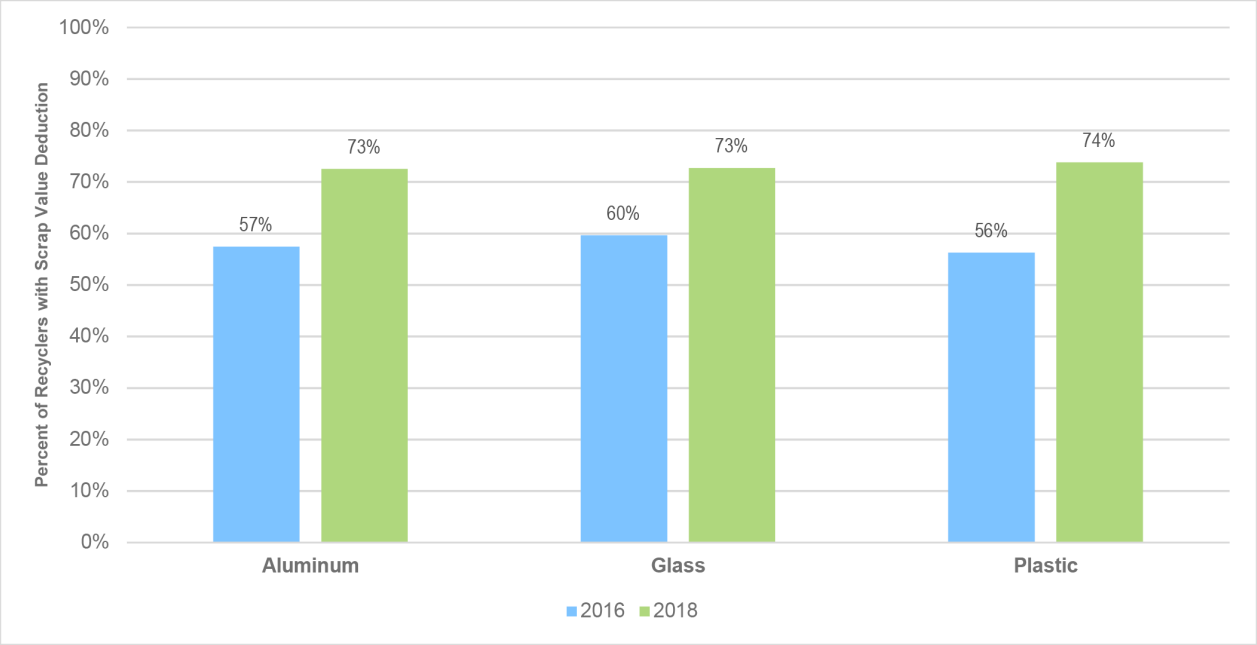


Exhibit 3-33 shows a comparison between 2016 and 2018 for the percent of recyclers that utilize scrap value deduction. The percentages are out of the recyclers that have a processor pick-up material, which are roughly one third of the total PF recyclers for both years. For all materials, the rate of scrap value deduction has increased roughly 15 percent to about 73 percent. For these recyclers, transportation costs are reflected as reduced income, so there is no transportation line item when a material has a scrap value deduction.

Exhibit 3-33
2016 vs 2018 – Aluminum, Glass, and PET #1 Transportation with Scrap Value Deduction



As shown in Exhibit 3-24, the cost per ton for self-hauling is the highest among all hauling methods. The decreased rate of self-hauling (and an increase in third party and processor pick-up) in Exhibit 3-28 would decrease the transportation cost per ton as well as the overall cost per ton for each material. Instead, transportation cost per ton has increased, which indicates that other factors are at play causing the increase.

As shown in Exhibit 3-33, an increased rate of scrap value deduction would contribute to a decrease in transportation cost per ton. Had the rate of scrap value deduction stayed the same, transportation cost per ton would be even higher, indicating this was not a potential cause of the increase.

The analyses of transportation costs illustrate that it is unlikely that a shift in hauling methods or the rate of scrap value deduction would have caused an increase in transportation cost per ton, which directly impacts overall cost per ton. More likely, the increase in gasoline and diesel prices were a contributor to the increased cost per ton between 2016 and 2018.

H. 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 3-34** 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 3-34
Example Calculation of 2018 Statewide, Weighted-Average Cost per Ton for Glass

Stratum	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton
Stratum 1	30,637.30	$3,066,633.82	$100.09[a]
Stratum 2	27,676.98	2,806,167.60	101.39[a]
Stratum 3	17,240.36	3,033,797.97	175.97[a]
Sample Total	75,554.64	$8,906,599.39	$117.88[a]

Stratum	Population Glass Tons	Population Glass Cost	Population Cost per Ton
Stratum 1[b]	56,176.83	$5,622,739.08	
Stratum 2[b]	76,727.79	7,779,430.90	
Stratum 3[b]	97,766.66	17,203,999.16	
Population Total[b]	230,671.28	$30,606,169.14	$132.68[c]

[a] Simple weighted-average cost per ton for each stratum, and simple weighted-average for the sample

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

[c] A statewide, weighted-average result of $132.68 per ton, calculated by dividing total population glass costs by total population glass tons

Exhibit 3-35 provides the weighted-average cost per ton by strata for glass, aluminum, PET #1, and HDPE #2 for 2016 and 2018, and the percent change between 2016 and 2018. The most apparent trend in cost per ton by strata between the two years is the significant increase in cost per ton for stratum 1 and stratum 3. The cost per ton for stratum 2 declined across PET #1, aluminum, and glass between 2016 and 2018, as

follows: PET #1 stratum 2 declined by 6 percent, aluminum stratum 2 declined by 3 percent, and glass stratum 2 declined by 4 percent. Generally, there was significant change across each HDPE stratum, ranging from 24 to 62 percent.

For all four material types, there were large increases in weighted average cost per ton for stratum 3. During the 2016 to 2018 time period, there were also a significant number of small recyclers that closed. The combination of challenging market conditions, reductions in aluminum quantities, and higher relative operating costs of small recyclers appears to have taken a toll on small recyclers.

Exhibit 3-35
Comparison of Cost per Ton by Material Type and Strata Between 2016 and 2018

Glass

Stratum	2016	2018	% Change
1	$71.95	$100.09	41%
2	120.76	101.39	-4%
3	172.24	175.97	13%

PET #1

Stratum	2016	2018	% Change
1	$356.37	$404.28	9%
2	464.21	422.07	-6%
3	608.48	636.49	25%

Aluminum

Stratum	2016	2018	% Change
1	$474.32	$503.25	9%
2	551.24	540.20	-3%
3	746.19	757.23	24%

HDPE #2

Stratum	2016	2018	% Change
1	$456.11	713.22	56%
2	590.50	661.39	24%
3	759.78	1,064.99	62%

Comparing recycling volumes and cost contributions, by strata, to the statewide, weighted-average cost per ton between 2012, 2014, 2016, and 2018 provides insight into the changes in cost per ton between survey years. As the strata definitions have changed over time, including the new strata definition in 2018, the cost per ton results cannot be directly compared between strata. It is important to note that Crowe conducted extensive analysis on strata definitions and the change in definition was not a factor in the increased cost per ton results.

Exhibits 3-36, 3-37, and **3-38** illustrate the percent of population tons recycled by each stratum and the percent of total population costs by each strata for 2012, 2014, 2016, and 2018. Note that the new strata definition for the 2016 and 2018 surveys resulted in a change in distribution of sites. For the 2016 survey strata update, more recyclers fell into stratum 1, and somewhat fewer fell into stratum 3. The number of recyclers in stratum 2 was slightly smaller in 2016, but proportionately larger than 2014. The 2018 change in distribution of sites resulted in an increased number of stratum 3 recyclers, with fewer stratum 1 and 2 recyclers.

Exhibit 3-36 provides the tons and cost comparison 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. In 2018, percentage tons increased significantly for strata 3 and declined for strata 1 and 2. In general, lower-cost per ton stratum 1 and 2 recyclers contributed proportionately less to the statewide, weighted-average cost per ton. Conversely, higher-cost per ton strata 3 recyclers contributed more to the statewide, weighted-average cost per ton.

Exhibit 3-37 illustrates the same data for aluminum. For aluminum, the shifts in tons and costs were similar between stratum 1, 2, and 3. In 2018, strata 1 and 2 accounted for 26 percent and 30 percent of aluminum volume, and contributed a slightly lower 21 percent and 26 percent, respectively, to costs. Stratum 3 for aluminum accounted for 44 percent of tons and 53 percent of costs, significantly more than 2012, 2014, and 2016.

Exhibit 3-38 illustrates the same data for PET #1. For PET #1, the shifts in tons and costs were similar between stratum 1, 2, and 3. Stratum 1 accounted for 28 percent of PET #1 volume in 2018, and only 22 percent of costs. Stratum 3 accounted for 40 percent of volume, but 50 percent of costs. Stratum 2 accounted for 33 percent of volume, and a slightly lower 27 percent of costs. The increase in costs in stratum 1 and stratum 3 dampened the 6 percent decline in stratum 2 cost per ton, resulting in an increase in PET #1 costs per ton between 2016 and 2018 of 19 percent. This increase occurred with a 2 percent decrease in overall tons recycled and a 13 percent increase in the average tons of PET #1 per recycler.

Exhibit 3-36
Percent of Population Glass Tons Recycled and Percent of Glass Total Costs (2012, 2014, 2016, and 2018)

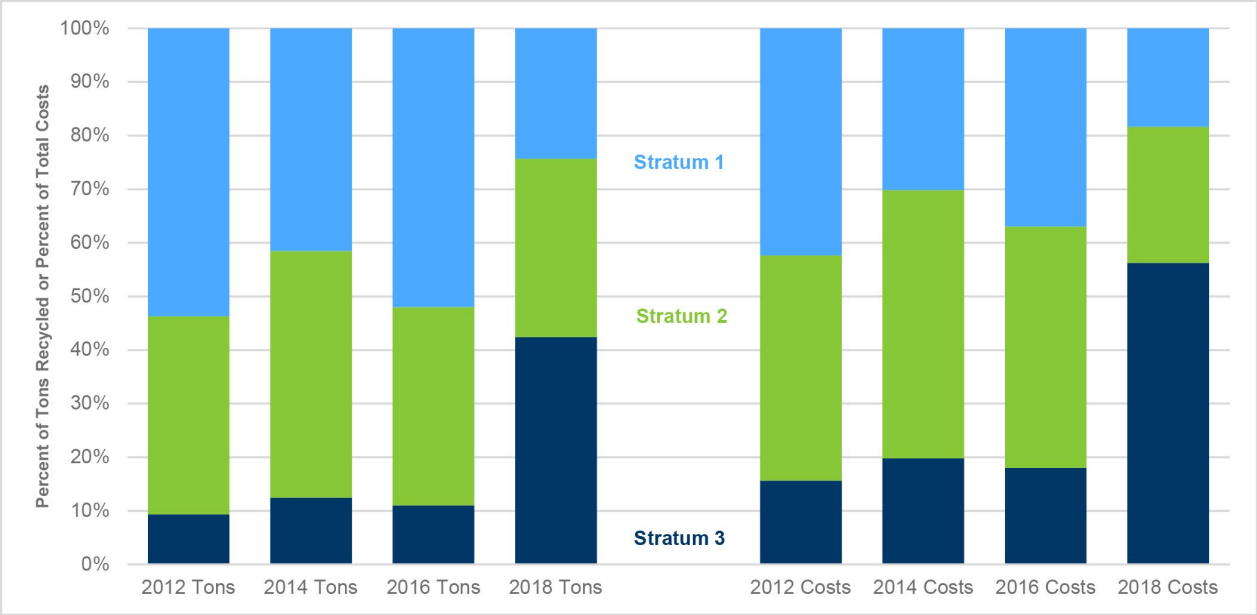


Exhibit 3-37
Percent of Population Aluminum Tons Recycled and Percent of Aluminum Total Costs (2012, 2014, 2016, and 2018)

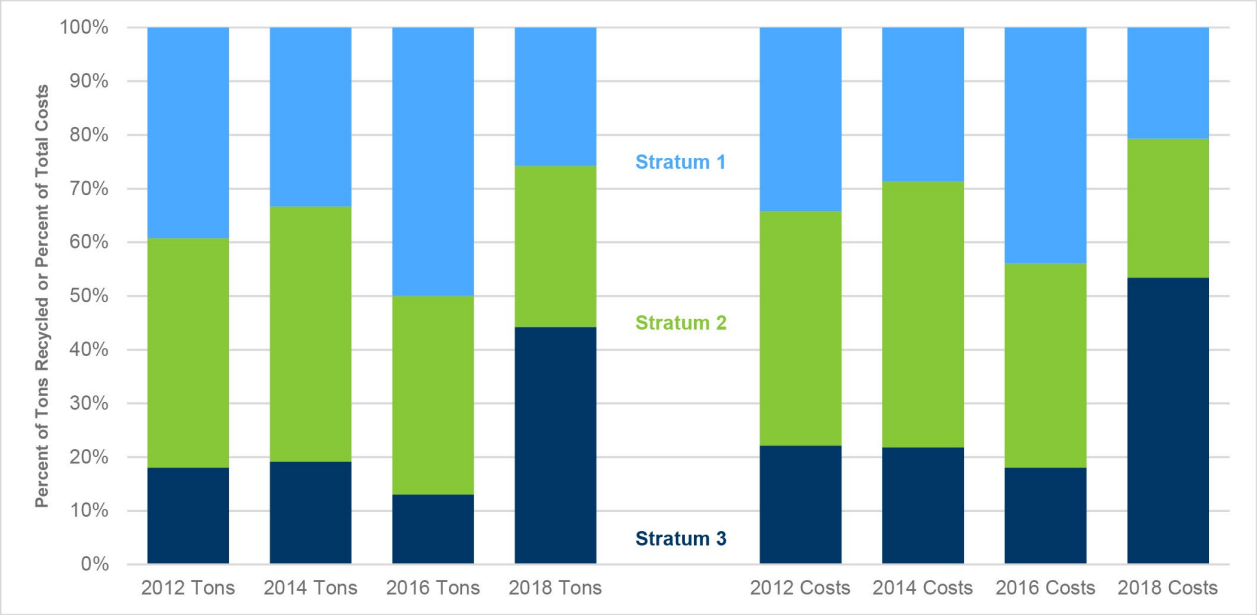
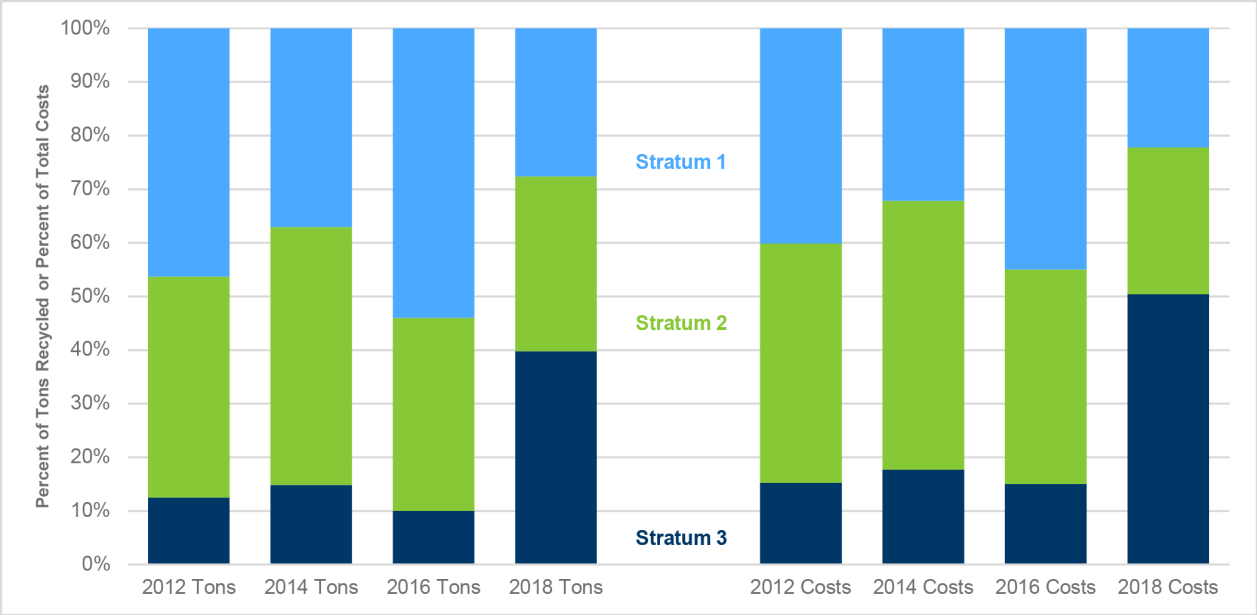


Exhibit 3-38
Percent of Population PET #1 Tons Recycled and Percent of PET #1 Total Costs (2012, 2014, 2016, and 2018)



I. Comparison of Total Costs, Total Tons, and Total Containers Recycled

To verify our observations about CRV material costs, we compared the change in total population costs, and change in total population volumes (tons and containers), from 2002–2018.

Exhibit 3-39 illustrates population costs[§§§] from 2002–2018. Total costs increased by 24 percent between 2002 and 2004, and 16 percent between 2004 and 2006. Between 2002 and 2006, costs increased faster than total population tons, which increased 10 percent between 2002 and 2004, and 7 percent between 2004 and 2006. Between 2006 and 2008, total costs increased by another 24 percent; in this case, costs increased slightly slower than tons recycled, which increased 27 percent. Between 2008 and 2010, total costs for all material types increased 6 percent, slightly more than the 1 percent increase in tons recycled. This slight change reflects the stability in price and tons recycled of the major material types as compared to previous years. Between 2012 and 2014, total costs

[§§§] The 2012, 2014, and 2018 population costs represent reduced populations for both years (269 investigated recyclers were removed for 2012, 42 investigated recyclers were removed for 2014, and 31 investigated recyclers were removed from 2018).

increased 9 percent. Between 2014 and 2016, total costs increased by 2 percent. Between 2016 and 2018, total costs increased by approximately 12 percent.

Exhibit 3-40 illustrates the changes in population tons[****] from 2002–2018. Tons recycled increased 10 percent between 2002 and 2004, with much of that increase due to a significant 46 percent increase in PET #1 tons recycled. Total tons increased again between 2004 and 2006, by a slightly lower amount (7 percent), again driven primarily by increased PET #1 tons. Between 2006 and 2008, tons increased by a substantially larger 27 percent, with increased recycling for all material types except PVC #3. Between 2008 and 2010, total tons increased only 1 percent, the smallest increase seen in the last five cost surveys. There were modest tons recycled increases for aluminum, PET #1, and HDPE #2, and a small decrease in glass tons. Glass is by far the heaviest material, which countered the small increases in the other materials. Total tons between the 2010 population and the 2012 reduced population decreased by 24 percent, which is within expectation considering the removal of the 269 recyclers from the 2012 population. Between 2012 and 2014, total tons recycled increased by 12 percent. Between 2014 and 2016, total tons increased by 1 percent. Between 2016 and 2018, total tons decreased by 8.5 percent.

In 2014, glass made up 58 percent of the tons recycled, while the remaining 42 percent was primarily split between aluminum (18 percent) and PET #1 (23 percent). HDPE #2 made up approximately 1 percent of total tons recycled, and the minority materials made up only a very small portion of total tons recycled, less than 0.09 percent.

In 2016, the percentage of glass was consistent (57 percent), but the shift from aluminum to PET #1 continued. The percentage of aluminum tons declined to 17 percent, and the percentage of PET #1 tons increased to 25 percent.

In 2018, the percentage of glass and aluminum decreased 1 percent (56 percent for glass and 16 percent for aluminum). PET #1 tons increased 1 percent to 26 percent; all other materials made up approximately 1 percent.

[****] The 2012, 2014, and 2018 population tons represent reduced populations for both years (269 investigated recyclers were removed for 2012, 42 investigated recyclers were removed for 2014, and 31 investigated recyclers were removed from 2018).

Exhibit 3-39
Total Population Costs for Processing Fee Recyclers (2002–2018)

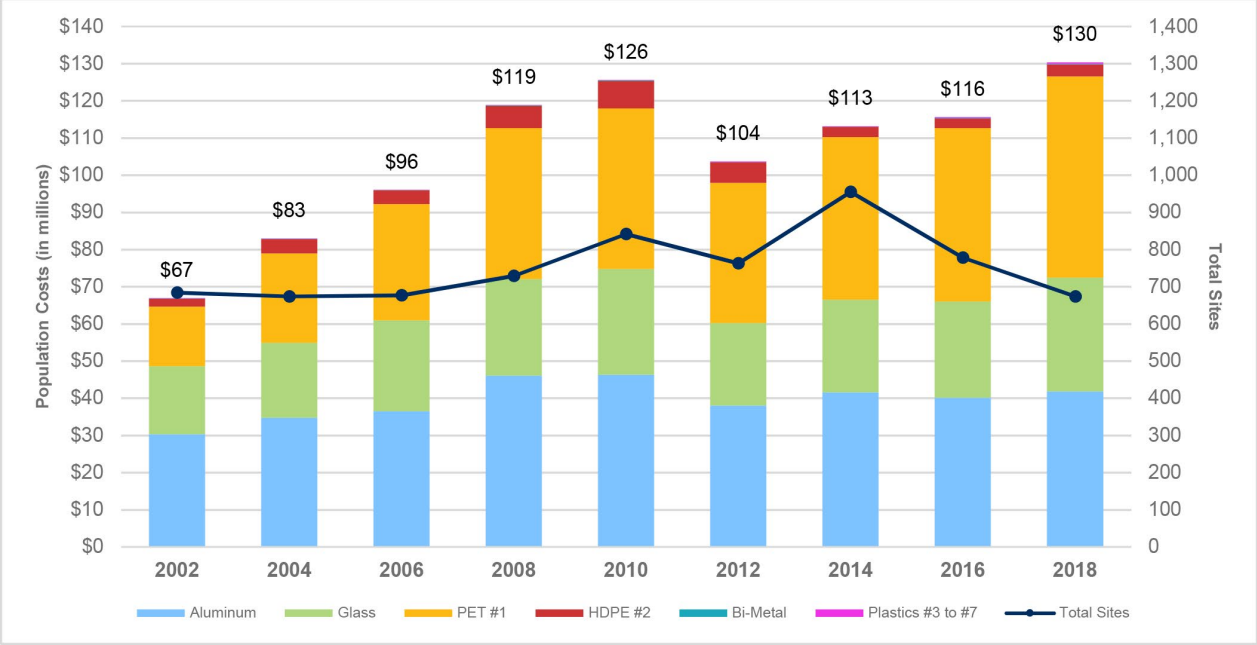
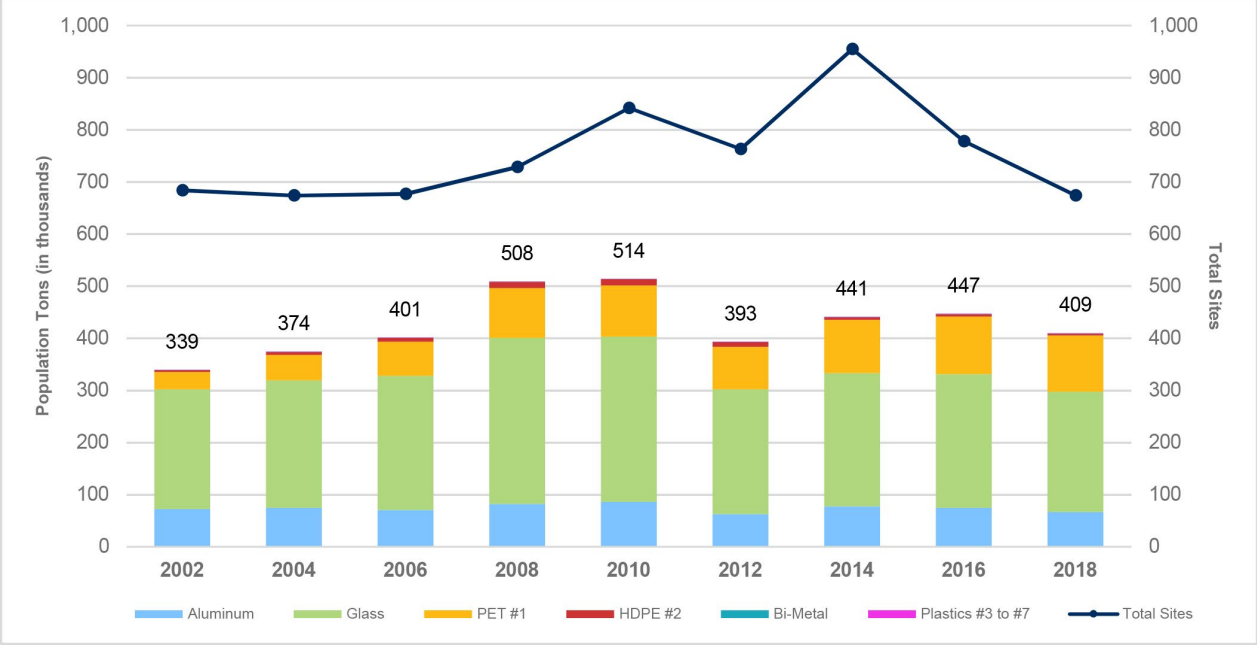


Exhibit 3-40
Total Population Tons for Processing Fee Recyclers (2002–2018)



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

Exhibit 3-41 through 3-45 provide the number of sites and tons per strata, for the four major material types from 2002–2018. For 2012 and 2014, the tables provide data for the full population of recyclers, consistent with the prior years' data. For 2016, the tables provide the survey population of recyclers, which excludes only seven sites. For 2018, the tables provide the survey population of recyclers, which excludes 31 investigated sites. The tables illustrate substantial shifts over time in the number of recyclers, size of recyclers, and tons of material recycled. Similar to the last survey, we continued to utilize a PET-based strata definition reflective of the current recycling marketplace. We did, however, change the strata tonnage parameters, which altered the number of sites per stratum between 2016 and 2018. We did not find a material impact in changing the tonnage parameters and provide further details within this section.

Examining results for each material type:

- Aluminum tons recycled has continued to drop to levels of the early 2000s. There was a continued large reduction in tons of aluminum recycled from the high levels of 2010 to 2014, perhaps due to stronger enforcement.
- Glass tons recycled has continued to decline over the last few surveys, back to levels seen in 2002. Glass tonnage is more evenly distributed across strata then previously, when stratum 1 sites handled the majority of material.
- PET#1 tons recycled has increased significantly since 2002. However, PET #1 tons recycled declined in 2018 from 2016.
- HDPE #2 tonnage increased up until 2012, but declined between 2012 and 2014, and continued to decline from 2016 to 2018††††, and in 2018 was the lowest level since 2002.

†††† 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 3-41
Population and Tons Detail for Four Major Materials, by Strata, for Processing Fee Recyclers

Year	Population Stratum 1	Population Stratum 2	Population Stratum 3	Total Population
2002	106	282	296	684
2004	112	290	272	674
2006	135	274	268	677
2008	173	270	286	729
2010	165	325	352	842
2012[a]	174	390	468	1,032
2014[b]	132	396	469	997
2016[c]	162	308	308	778
2018[d]	53	125	496	674

Year	Tons Redeemed Stratum 1	Tons Redeemed Stratum 2	Tons Redeemed Stratum 3	Total Tons
2002	166,766	136,008	33,551	336,325
2004	187,899	155,269	30,494	373,662
2006	226,453	142,533	31,695	400,681
2008	316,809	152,912	38,454	508,175
2010	290,519	176,393	45,911	513,323
2012[a]	288,271	201,672	63,869	553,812
2014[b]	208,716	210,381	65,760	484,857
2016[c]	231,186	165,589	49,564	446,339
2018[d]	103,885	133,394	171,706	408,985

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

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

[c] 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers.

[d] 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers.

Exhibit 3-42
Population and Tons Detail for Aluminum, by Strata, for Processing Fee Recyclers

Year	Population Stratum 1	Population Stratum 2	Population Stratum 3	Total Population
2002	104	282	290	676
2004	112	290	271	673
2006	135	274	268	677
2008	173	270	284	727
2010	165	325	349	839
2012[a]	174	389	465	1,028
2014[b]	132	396	467	995
2016[c]	162	308	308	778
2018[d]	53	125	496	674

Year	Tons Redeemed Stratum 1	Tons Redeemed Stratum 2	Tons Redeemed Stratum 3	Total Tons
2002	24,926	34,636	12,734	72,296
2004	28,084	35,999	10,482	74,565
2006	32,734	28,781	9,246	70,761
2008	42,173	29,899	10,227	82,299
2010	40,603	33,364	12,294	86,261
2012[a]	36,871	35,763	16,776	89,410
2014[b]	30,060	37,835	15,969	83,864
2016[c]	36,844	27,640	9,907	74,391
2018[d]	17,200	20,023	29,491	66,714

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

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

[c] 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers.

[d] 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers.

Exhibit 3-43
Population and Tons Detail for Glass, by Strata, for Processing Fee Recyclers

Year	Population Stratum 1	Population Stratum 2	Population Stratum 3	Total Population
2002	105	282	260	647
2004	112	290	246	648
2006	135	274	242	651
2008	173	270	259	702
2010	165	325	325	815
2012[a]	174	390	446	1,010
2014[b]	132	396	443	971
2016[c]	161	306	291	758
2018[d]	53	125	478	656

Year	Tons Redeemed Stratum 1	Tons Redeemed Stratum 2	Tons Redeemed Stratum 3	Total Tons
2002	126,851	85,781	16,857	229,489
2004	135,949	93,729	14,879	244,557
2006	156,301	85,415	15,423	257,139
2008	211,574	88,140	18,980	318,694
2010	191,462	102,385	23,183	317,030
2012[a]	189,465	116,798	31,133	337,396
2014[b]	132,334	119,758	32,956	285,049
2016[c]	132,920	95,976	27,637	256,637
2018[d]	56,177	76,728	97,728	230,672

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

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

[c] 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers.

[d] 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers.

Exhibit 3-44
Population and Tons Detail for PET #1, by Strata, for Processing Fee Recyclers

Year	Population Stratum 1	Population Stratum 2	Population Stratum 3	Total Population
2002	104	282	265	651
2004	112	290	251	653
2006	135	274	250	659
2008	173	270	269	712
2010	165	325	336	826
2012[a]	174	390	454	1,018
2014[b]	132	394	456	982
2016[c]	162	308	291	758
2018[d]	53	125	485	663

Year	Tons Redeemed Stratum 1	Tons Redeemed Stratum 2	Tons Redeemed Stratum 3	Total Tons
2002	14,220	15,323	3,920	33,463
2004	21,123	22,878	4,819	48,820
2006	33,545	25,383	6,528	65,456
2008	55,633	30,992	8,614	95,239
2010	51,821	36,493	9,601	97,915
2012[a]	54,282	43,995	14,742	113,019
2014[b]	44,079	50,064	16,099	110,243
2016[c]	59,190	39,978	11,367	110,535
2018[d]	29,786	35,145	42,885	107,816

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

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

[c] 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers.

[d] 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers.

Exhibit 3-45
Population and Tons Detail for HDPE #2, by Strata, for Processing Fee Recyclers

Year	Population Stratum 1	Population Stratum 2	Population Stratum 3	Total Population
2002	96	256	185	537
2004	107	277	184	568
2006	132	267	213	612
2008	168	262	236	666
2010	163	321	301	785
2012[a]	173	385	420	978
2014[b]	130	389	420	939
2016[c]	159	301	280	740
2018[d]	53	125	469	647

Year	Tons Redeemed Stratum 1	Tons Redeemed Stratum 2	Tons Redeemed Stratum 3	Total Tons
2002	769	268	40	1,077
2004	2,743	2,663	314	5,720
2006	3,873	2,954	498	7,325
2008	7,429	3,881	633	11,943
2010	6,633	4,651	833	12,117
2012[a]	7,422	4,948	1,178	13,548
2014[b]	2,242	2,723	735	5,700
2016[c]	2,232	1,994	548	4,775
2018[d]	722	1,498	1,563	3,783

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

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

[c] 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers.

[d] 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers.

Cost per Ton Results by Strata

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 3-46, 3-47, 3-48,** and **3-49** illustrate the 2018 costs per ton and population size by strata for aluminum, glass, PET #1, and HDPE #2.

These figures illustrate the following:

- With the exception of HDPE #2, costs per ton were lowest for large stratum 1 sites. Stratum 2 costs per ton were always lower than stratum 3 costs per ton.
- All four material types were significantly higher than the statewide, weighted-average cost per ton for small, stratum 3 recyclers, implying that on average, processing payments do not cover the costs of recycling for this stratum of recyclers.
- For all four material types, stratum 1 and 2 sites were below the statewide, weighted-average cost per ton.

Exhibit 3-46
Aluminum Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)

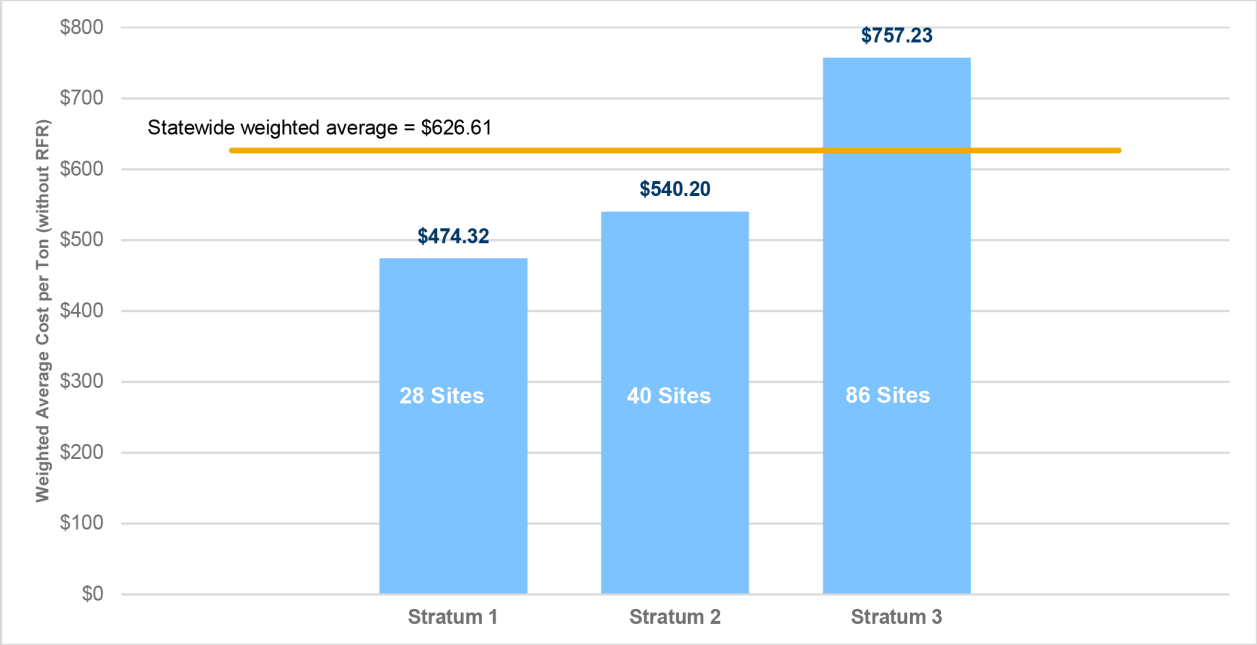


Exhibit 3-47
Glass Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)

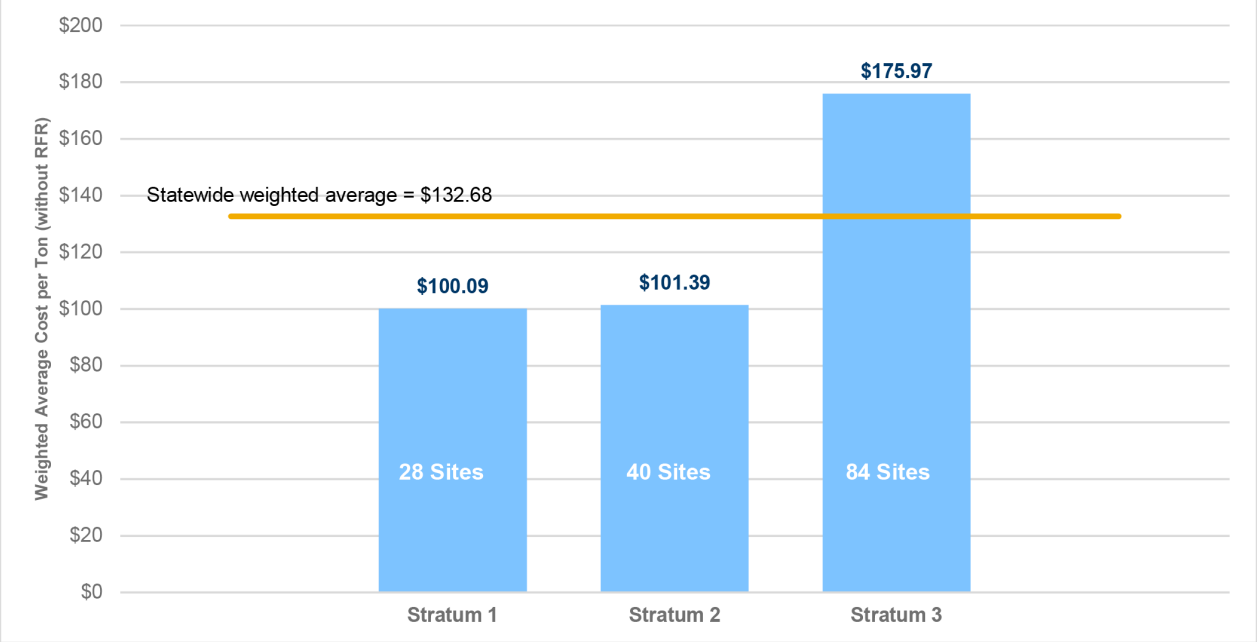


Exhibit 3-48
PET #1 Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)

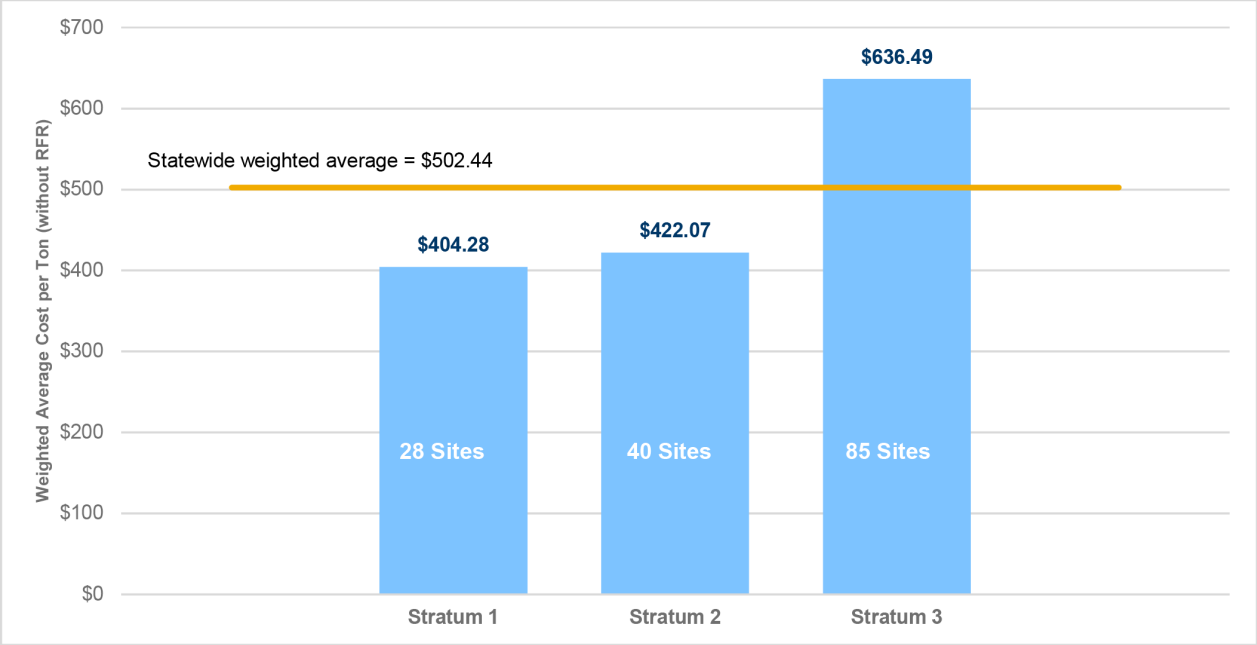
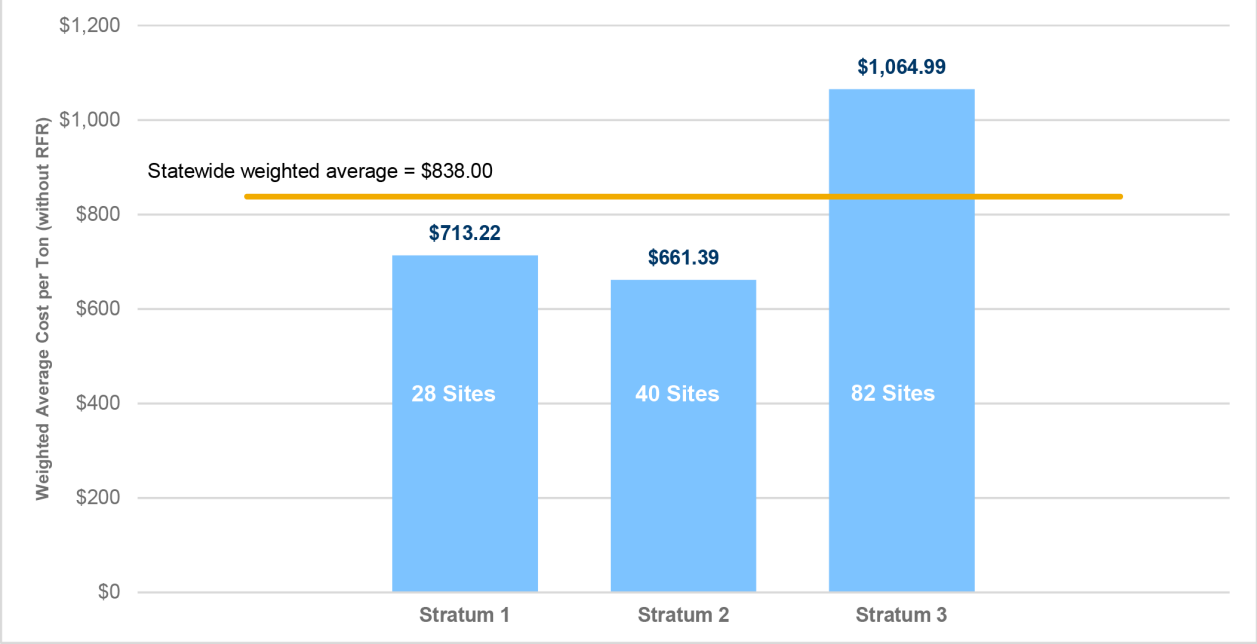


Exhibit 3-49
HDPE #2 Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)



K. Cost Survey Methodology Validation

Crowe conducted additional analysis to test the validity of the survey results. This subsection discusses distribution of cost per ton results. Based on the analyses described below and throughout this section, 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 2018 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 bunched up toward the left, with a "tail" stretching toward the right.

Exhibits 3-50 through 3-53 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. Note that the range for each horizontal bar represents an “up-to” amount; for example, the $200 bar represents from $100.01 to $200.

The histograms demonstrate extremely consistent distributions among all four material types. In addition, these histograms are extremely consistent as compared to the 2012, 2014, and 2016 frequency histograms, which were similarly right-skewed. 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. In prior years, we evaluated whether this could be a bimodal distribution. We determined that rather than a clear pattern of two sub-populations 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 3-50
2018 Sampled Processing Fee Recyclers, Distribution of Aluminum Cost per Ton

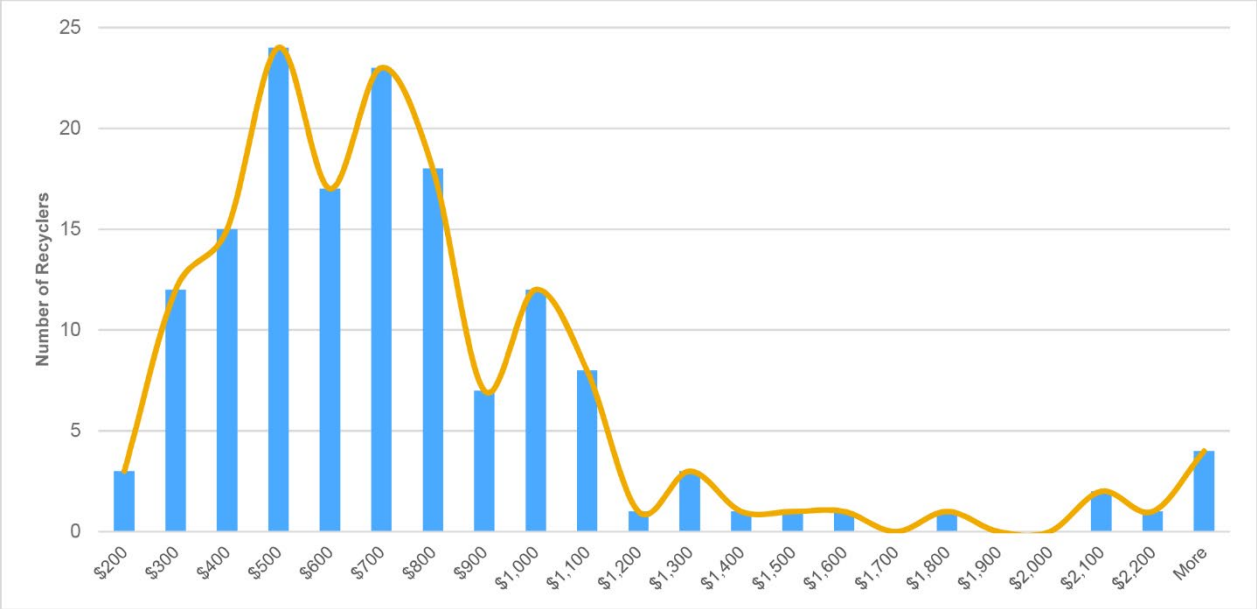


Exhibit 3-51
2018 Sampled Processing Fee Recyclers, Distribution of Glass Cost per Ton

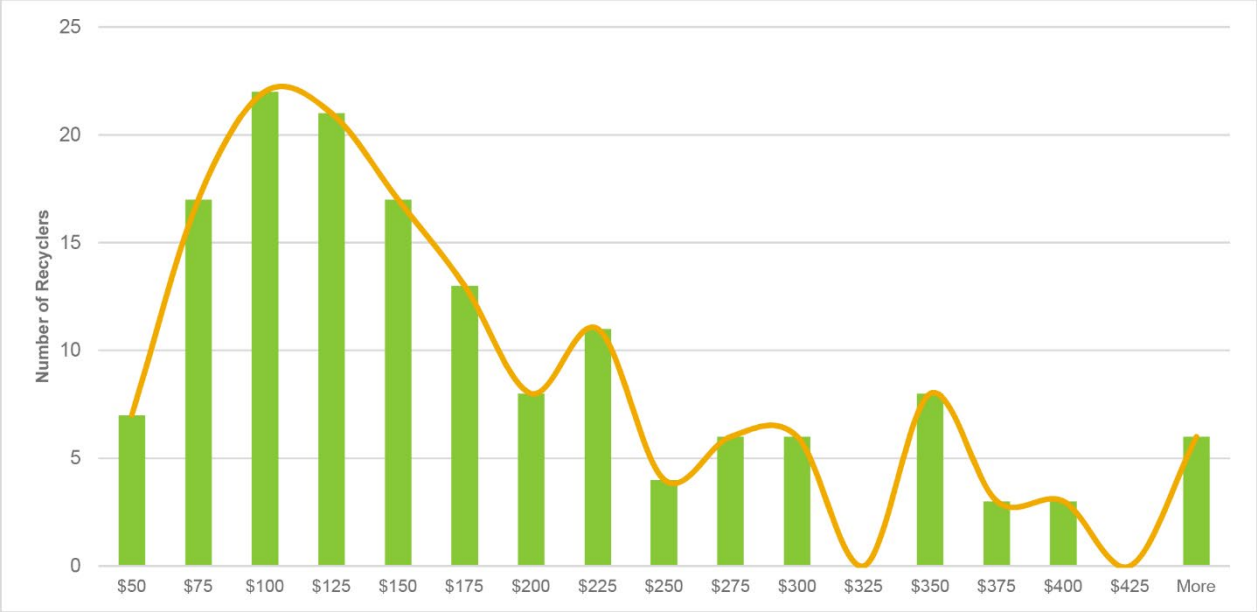


Exhibit 3-52
2018 Sampled Processing Fee Recyclers, Distribution of PET #1 Cost per Ton

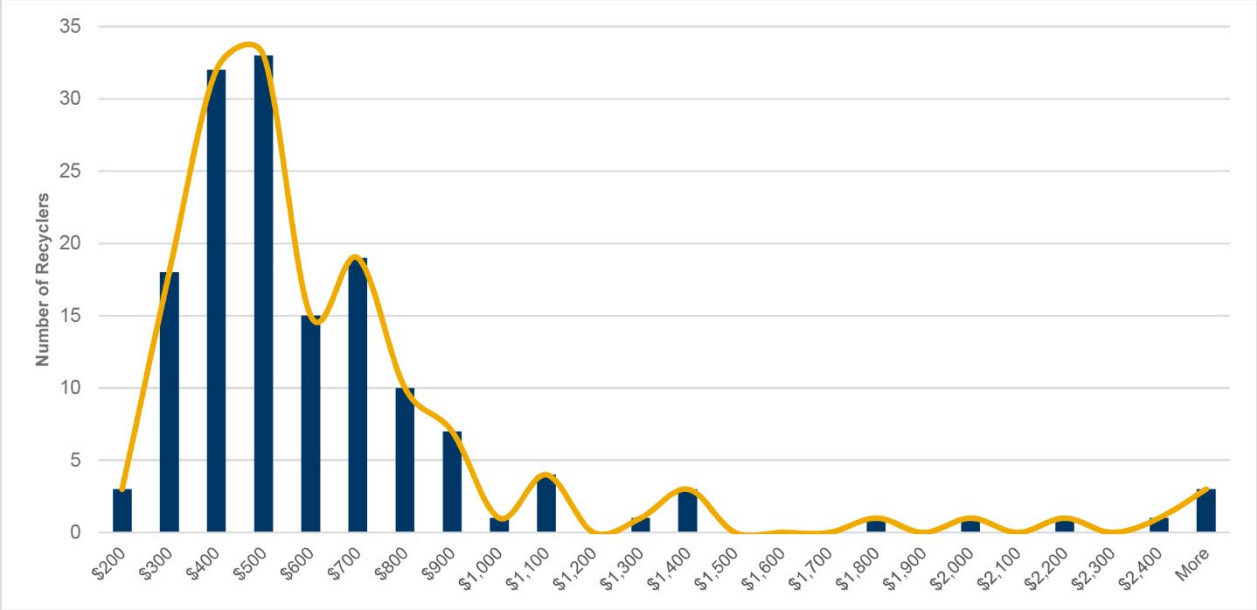
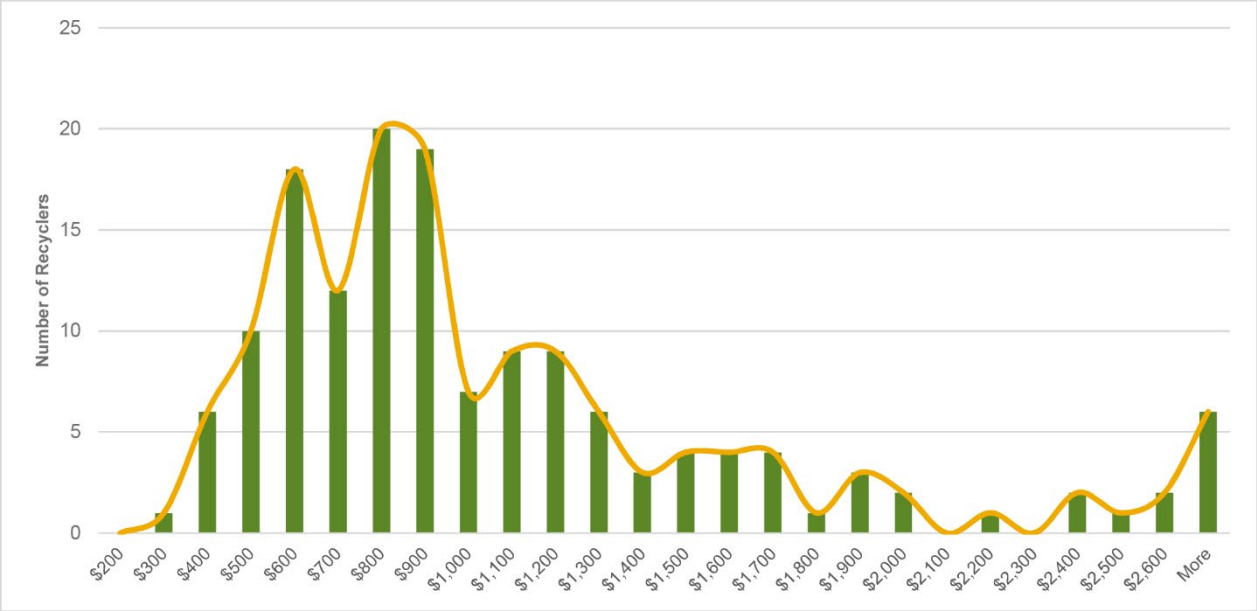


Exhibit 3-53
2018 Sampled Processing Fee Recyclers, Distribution of HDPE #2 Cost per Ton



Impact of Strata Definitions

Prior to the start of the cost survey, Crowe and CalRecycle analyzed a range of strata definitions and selected a PET-based strata definition that is more reflective of the current recycling marketplace than the prior 2016 survey plastic strata definition. We recalculated the 2016 survey costs per ton using the 2019 strata definitions, shifting from 75 tons PET cutoff from strata 3 to strata 2, to 200 tons PET. Similarly shifting from 200 tons PET cutoff from strata 2 to strata 1, to 400 tons.

To test whether the change in strata definitions was a factor in the increase in costs per ton, we tested 2017 survey results using 2019 strata definitions and 2019 survey results using 2017 strata definitions. Costs per ton using 2017 survey data and 2019 definitions were essentially equal to 2017 survey data using 2017 strata definitions. The changes in cost per ton for aluminum, glass, and PET #1 was at, or less than, one percent. Conversely, applying the 2017 strata definitions to the 2019 survey results did not reduce costs per ton, and in fact resulted in slightly higher costs per ton. Based on this comparison, the change in PET strata definition does not have an impact on the results.

Investigated Recycling Centers Removed from the Full Population and Sample

For the current 2018 cost survey, Crowe removed recycling centers (RCs) subject to investigation by CalRecycle for significant infractions from the population and the survey sample. This approach is consistent with the last several cost surveys. 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 RCs that had a major investigation from the full population would eliminate potential site visits to RCs that might be in an adversarial relationship with 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 2014 cost survey, we removed the 42 processing fee RCs that had been investigated from the full population of all RCs prior to selecting the sample. The 42 RCs under major investigation accounted 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 for 2014 consisted of 953 RCs.

For the 2016 cost survey, we removed only seven processing fee RCs that had been investigated from the full population of all RCs prior to selecting the sample. The removal of this small number of RCs that had been investigated had little impact on the overall population, accounting for approximately one percent of material recycled. The resulting processing fee recycler population for 2016 consisted of 778 RCs.

For the 2018 cost survey, we removed 31 processing fee RCs that had been investigated from the full population of all RCs prior to selecting the sample, representing 4 percent of the population. The removal of these RCs had an equivalent impact on material volume reduction, accounting for approximately four percent of material tonnage. The resulting processing fee recycler survey population for 2018 consisted of 674 RCs.

L. Summary of Processing Fee Cost Analyses

Overall, the change in cost per ton between 2016 and 2018 was significant. Between 2016 and 2018 there was a reduction in the overall survey population of PF recycling centers, and a decrease in the total tons of CRV material recycled. This combination alone could suggest an increase in cost per ton between 2016 and 2018. Our analyses of processing fee recycler survey results identified the following six factors that help explain relative increases in cost per ton between 2016 and 2018:

1. Higher average CRV hourly wages, reflective in part of increases in California and Los Angeles County minimum wage between 2016 and 2018
2. A reduction in the number of surveyed recycling centers with average hourly wages below minimum wage, potentially due to ongoing recycling center closures
3. Increased transportation costs between 2016 and 2018, driven in large part by increased fuel and diesel prices between 2016 and 2018
4. By random selection, there were fewer very high-volume and low-cost RCs selected for the 2018 survey.
5. The survey population volume and average tons of HDPE per site declined, as compared to 2016, all upward factors on cost per ton for HDPE.
6. Factoring in cost-of-living increases, the Consumer Price Index (CPI) increased 6.7 percent between 2016 and 2018, likely accounting for a portion of the cost per ton increases.

Exhibit 3-54 summarizes the percent change in statewide recycler cost per ton results, by material type.

Exhibit 3-54
Two-Year Percent Change in Statewide Recycler Cost per Ton, by Material Type

Material Type	2016 to 2018	2014 to 2016	2012 to 2014	2010 to 2012	2008 to 2010	2006 to 2008	2004 to 2006	2002 to 2004
1. Aluminum	**16%**	0.3%	-12%	+14%	-4%	+8%	+11%	+11%
2. Glass	**31%**	3.6%	+5%	+3%	+10%	-14%	+15%	+3%
3. PET #1	**19%**	-1.7%	-7%	+5%	+3%	-11%	-3%	+3%
4. HDPE #2	**53%** [a]	4.4%[a]	-14%[a]	0%[a]	+22%[a]	0%	-25%	+4%
5. Bi-Metal	**53%**	4.4%	-14%	0%	+22%	-28%	+46%	+19%
6. PVC #3	**53%**	4.4%	-14%	0%	+22%	+8%	-54%	+49%
7. LDPE #4	**53%**	4.4%	-14%	0%	+22%	-39%	-2%	-43%
8. PP #5	**53%**	4.4%	-14%	0%	+22%	+28%	-3%	-45%
9. PS #6	**53%**	4.4%	-14%	0%	+22%	0%	-80%	-50%
10. Other #7	**53%**	4.4%	-14%	0%	+22%	-8%	-41%	+67%

[a] The 53 percent change from 2016 to 2018, 4.4 percent change from 2014 to 2016, the -14 percent change from 2012 to 2014, the 0 percent change from 2010 to 2012, and the 22 percent from 2008 to 2010 are rounded. Between 2016 and 2018, the actual HDPE percent change was 53 percent. Between 2014 and 2016, the actual HDPE percent change—which was used to calculate the cost per ton for bi-metal and plastics #3 to #7—was 4.36 percent. Between 2012 and 2014, the actual percent change was -14.44 percent. Between 2010 and 2012 the actual percent change was 0.14 percent. Between 2008 and 2010, the actual HDPE percent change for the same calculation was 21.92 percent.

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, 2016, and 2018 processing payments and processing fees; and examines historical scrap value trends. The section is organized as follows:

A. Review of Reasonable Financial Return (RFR)
B. Processing Payment and Processing Fee Calculations
C. Scrap Values
D. Comparison of Historical Processing Payments and Processing Fees

A. Review of Reasonable Financial Return (RFR)

The Beverage Container Recycling and Litter Reduction Act Section 14575(b)(2) specifies "a reasonable financial return for recyclers" should be included in the processing payment calculation. The RFR is multiplied by the cost of recycling to determine a cost of recycling, with financial return. As described below, the cost of recycling is also multiplied by a Cost of Living Adjustment (COLA). This cost is used in the processing payment and processing fee calculations. **Exhibit 4-1** provides the RFRs since 1991.

Based on amendments to California Code of Regulations Section 2975, the RFR applied to the cost of recycling for the January 1, 2020 processing payment and processing fee calculations was ten percent. The California Code of Regulations, Section 2975, specifies how the RFR is to be calculated, as follows:

> *For calendar year 2020, the Department is proposing using a reasonable financial return of 10 percent when calculating processing payments instead of the Dun and Bradstreet index as stated in regulations. The reasonable financial return determined from the Dun and Bradstreet index will likely be much lower than 10 percent. This change will help support beverage container recycling in California by establishing a reasonable financial return that provides a balance between the risk associated with operating a beverage container recycling center under current market conditions and a return on investment that retains current operators. This measure is expected to stem ongoing recycling center closures which will preserve convenient redemption opportunities to consumers.*

The January 1, 2020 processing payment calculation also includes a COLA of 3.2 percent. Thus, the cost of recycling per ton used for calculating processing payments is equal to the cost of recycling × (1 + RFR) × (1 + COLA). The addition of the COLA closer matches the survey year to the year in which processing payment and processing fees are applied. The cost data for the January 1, 2020 processing payments and fees is from 2018 and the scrap value is based on average scrap values from October 1, 2018 through September 30, 2019. The difference in time periods is a result of the time lag in gathering and processing data for each of these measures. Implementing a COLA was recommended in the 2015 cost survey. By instituting the COLA, CalRecycle more closely matches the cost data with the processing payment and processing fee time period.

Exhibit 4-1
Historical Reasonable Financial Return Values (1991 to 2020)

Year	Reasonable Financial Return
1991	8.27%
1992	7.93%
1993	7.93%
1994	7.93%
1999	5.06%
2000	Not calculated
2001	2.63%
2002	2.87%
2003	2.87%
2004	2.55%
2005	3.60%
2006	5.43%
2007	4.43%
2008	5.60%
2009	6.45%
2010	5.76%
2011	2.65%
2012	3.94%
2013	3.12%
2014	4.10%
2015	2.81%
2016	0.92%
2017	-5.85%
2018 Nonrural	11.50%
2018 Rural	16.60%
2019 Nonrural	11.50%
2019 Rural	16.60%
2020	10.00%

Note: The year represents the publish year for the processing payments and processing fees.

B. 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 fees was that each container type should cover its own cost of recycling in order to create and maintain a marketplace that provides consumers with convenient recycling opportunities. 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 cost of living adjustment (COLA) and a reasonable financial return (RFR), and the average scrap value paid to recyclers (for the period October through September of the previous year). The equation is as follows:

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

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 (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, and 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 4-2.** The fiscal year 2017/2018 recycling rates were used to determine the maximum processing fee reduction factors for glass, bi-metal, and plastic resins. **Exhibit 4-3** 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 4-2
Processing Fee Reduction Factors with Adequate Funds

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

Exhibit 4-3
Processing Fee Reduction Factors for January 1, 2020, Processing Fees

Material	Percent of Processing Payment
Glass	11 Percent
PET #1	10 Percent
HDPE #2	11 Percent
PVC #3	65 Percent
LDPE #4	65 Percent
PP #5	65 Percent
PS #6	65 Percent
Other #7	65 Percent
Bi-Metal	65 Percent

Exhibit 4-4 provides the per ton processing payments for nonrural and rural recyclers, effective January 1, 2020.

Exhibit 4-5 is a copy of the 2018 Processing Fees notice, published by CalRecycle on December 16, 2019. 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. For purposes of calculating the processing fee, the processing payment is based on a weighted average of the nonrural and rural processing payments, shown in Exhibit 4-4. Exhibit 4-5 also documents the Section 14575(f) reduction in the processing fee for glass and PET #1.

Exhibit 4-4
January 1, 2020 Processing Payments

Material	Processing Payment
Glass	$153.00
PET #1	376.14
HDPE #2	755.38
PVC #3	1496.40
LDPE #4	2,128.76
PP #5	1,886.32
PS #6	1,173.60
Other #7	1,298.23
Bi-Metal	1,196.10

Exhibit 4-5
Processing Fees Public Notice (December 16, 2019)

Table 1 - 2020 Processing Fees

Effective January 1, 2020

	Glass	PET	HDPE	Vinyl	LDPE	PP	PS	Other	Bimetal
Cost of Recycling per Ton with Reasonable Financial Return & COLA (Statewide)	$150.62	$570.37	$951.30	$1,496.40	$2,134.75	$1,915.16	$1,186.27	$1,299.75	$1,199.17
Scrap Value per Ton	-$2.38	$194.23	$195.92	$0.00	$5.99	$28.84	$12.67	$1.52	$3.07
Processing Payments to All Participant Types									
Processing Payment Per Ton Redeemed	$153.00	$376.14	$755.38	$1,496.40	$2,128.76	$1,886.32	$1,173.60	$1,298.23	$1,196.10
Processing Payment Per Pound Redeemed	$0.07650	$0.18807	$0.37769	$0.74820	$1.06438	$0.94316	$0.58680	$0.64911	$0.59805
Processing Fees to be Paid by Beverage Manufacturers									
Manufacturers' Percentage of Processing Payment	11%	10%	11%	65%	65%	65%	65%	65%	65%
Processing Fee Pursuant to Section 14575(f)	$0.00438	$0.00082	$0.00602	$0.05014	$0.01696	$0.05573	$0.00348	$0.13610	$0.04799
Section 14575(j) Processing Fee Reduction	$0.00063	$0.00016	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Processing Fee to be Paid by Beverage Manufacturers	**$0.00375**	**$0.00066**	**$0.00602**	**$0.05014**	**$0.01696**	**$0.05573**	**$0.00348**	**$0.13610**	**$0.04799**

C. Scrap Values

CalRecycle is required to calculate the average scrap values paid to recyclers for the twelve 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, 2020, processing payments and fees, the average scrap value used for the calculation covers the time period from October 1, 2018, to September 30, 2019.

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 Scrap Value Purchases Survey Form. Processors are required to complete the form and submit it to CalRecycle by the tenth 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.

The annual average scrap values for the ten beverage container material types from October 1, 2018, through September 30, 2019 are shown in **Exhibit 4-6.** These were the values used for the January 1, 2020, processing payment and processing fee calculations.

Exhibit 4-6
Statewide Average Scrap Values for the January 1, 2020, Processing Payment and Processing Fee Calculations

Material	Scrap Value (per Ton)
1. Aluminum	$1,138
2. Glass	(2.38)
3. PET #1	194.23
4. HDPE #2	195.92
5. Bi-Metal	3.07
6. PVC #3	0.00
7. LDPE #4	5.99
8. PP #5	28.84
9. PS #6	12.67
10. Other #7	1.52

D. Comparison of Historical 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 4-7** compares the processing payments for the nine relevant material types for the years following the nine most recent cost surveys, i.e., for the January 1, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, and 2020 processing payments to recyclers. **Exhibit 4-8** compares the percent change in the processing payment per ton between each succeeding cost survey.

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. Between 2016 and 2018, processing payments to recyclers for all materials, with the exception of PVC #3, increased, in large part due to the higher RFRs. Increases in the 2020 processing payments as compared to 2018 are due to increases in cost per ton as well as reductions in scrap value.

Processing fees are paid by beverage manufacturers on each beverage container sold. **Exhibit 4-9** compares the per container processing fees from 2004-2020. **Exhibit 4-10** 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, 2018 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 Payments (per Ton) (2004-2020)

Material Type	2004	2006	2008	2010[a]	2012	2014	2016	2018 Nonrural (NR)	2018 Rural (R)	2020
1. Glass	$74.52	$83.68	$94.52	$66.87	$88.26	$94.72	$101.07	$119.96	$125.26	$153.00
2. PET #1	330.41	226.39	197.68	249.44	0.00	117.26	165.96	250.88	272.99	378.14
3. HDPE #2	510.62	402.65	216.33	207.77	289.94	317.56	183.01	420.44	449.15	755.38
4. Bi-metal	519.70	629.54	920.47	654.52	797.66	801.93	624.03	775.37	811.56	1,196.10
5. PVC #3	1,079.05	1,658.89	755.49	834.62	980.95	1,066.50	845.24	768.87	814.03	1,496.40
6. LDPE #4	3,395.76	1,511.58	1,919.68	1,189.57	1,248.65	1,263.96	1,179.64	1,406.01	1,470.44	2,128.76
7. PP #5	1,516.52	686.77	831.95	1,068.99	1,294.45	1,219.73	1,064.38	1,229.57	1,287.37	1,886.32
8. PS #6	6,293.42	3,085.51	871.41	650.27	786.51	772.55	562.76	710.32	746.13	1,173.60
9. Other #7	770.83	1,273.97	687.68	724.4	837.07	852.64	706.23	855.69	894.91	1,298.23

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

Exhibit 4-8
Comparison of the Percent Change in Processing Payments (per Ton) (2004-2020)

Material Type	2004 to 2006	2006 to 2008	2008 to 2010	2010 to 2012	2012 to 2014	2014 to 2016	2016 to 2018 NR	2016 to 2018 R	2018 NR to 2020
1. Glass	12%	13%	-29%	32%	7%	7%	19%	24%	27%
2. PET #1	-31%	-13%	26%	-100%	n/a	42%	51%	64%	50%
3. HDPE #2	-21%	-46%	-4%	40%	10%	-42%	130%	145%	79%
4. Bi-metal	21%	46%	-29%	22%	1%	-22%	24%	30%	54%
5. PVC #3	54%	-54%	10%	18%	9%	-21%	-9%	-4%	93%
6. LDPE #4	-55%	27%	-38%	5%	1%	-7%	19%	25%	51%
7. PP #5	-55%	21%	28%	21%	-6%	-13%	16%	21%	52%
8. PS #6	-51%	-72%	-25%	21%	-2%	-27%	26%	33%	65%
9. Other #7	65%	-46%	5%	16%	2%	-17%	21%	27%	51%

Exhibit 4-9
Comparison of Processing Fees (per Container) (2004-2020)

Material	2004	2006	2008	2010[b]	2012	2014	2016	2018	2020
1. Glass	$0.00181	$0.00229	$0.00240	$0.01373	$0.00237	$0.00182	$0.00232	$0.00283	$0.00375
2. PET #1	0.00167	0.00159	0.00072	0.00569	0.00000	0.00016	0.00024	0.00045	0.00066
3. HDPE #2	0.01042	0.00503	0.00216	0.01821	0.00213	0.00215	0.00140	0.00384	0.00602
4. Bi-metal	0.02194	0.02557	0.04825	0.04526	0.04470	0.03671	0.03027	0.03457	0.04799
5. PVC #3	0.03578	0.05501	0.02525	0.02768	0.01194	0.03895	0.00755	0.02248	0.05014
6. LDPE #4	0.03153	0.01181	0.01691	0.00982	0.01082	0.01017	0.00924	0.01124	0.01696
7. PP #5	0.07468	0.0248	0.09013	0.10857	0.04727	0.04505	0.05765	0.04912	0.05573
8. PS #6	0.0293	0.01437	0.00507	0.00176	0.00227	0.00223	0.00166	0.00206	0.00348
9. Other #7	0.0216	0.03664	0.04217	0.05009	0.07353	0.08660	0.07173	0.08716	0.13610

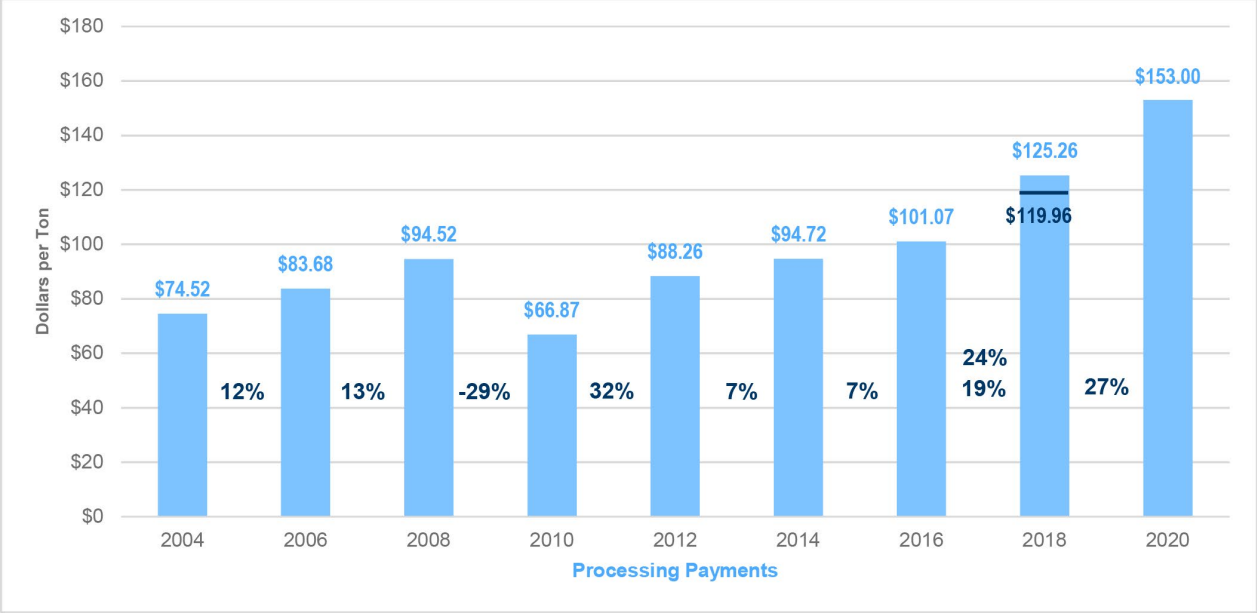
[b] Includes an increased manufacturer's percentage share as a result of the proportional reduction required due to insufficient funds.

Exhibit 4-10
Comparison of the Percent Change in Processing Fees (per Container) (2004-2020)

Material	2004 to 2006	2006 to 2008	2008 to 2010	2010 to 2012	2012 to 2014	2014 to 2016	2016 to 2018	2018 to 2020
1. Glass	27%	5%	472%	-83%	-23%	27%	22%	33%
2. PET #1	-5%	-55%	690%	-100%	n/a	50%	88%	47%
3. HDPE #2	-52%	-57%	743%	-88%	1%	-35%	174%	57%
4. Bi-metal	17%	89%	-6%	-1%	-18%	-18%	14%	39%
5. PVC #3	54%	-54%	10%	-57%	226%	-81%	198%	123%
6. LDPE #4	-63%	43%	-42%	10%	-6%	-9%	22%	51%
7. PP #5	-67%	263%	20%	-56%	-5%	28%	-15%	13%
8. PS #6	-51%	-65%	-65%	29%	-2%	-26%	24%	69%
9. Other #7	70%	15%	19%	47%	18%	-17%	22%	56%

Exhibits 4-11, 4-12, and **4-13** compare the processing payments and processing fees for 2004 to 2020 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. For 2018, these exhibits illustrate rural and nonrural processing payments. In all cases rural payments are higher than nonrural processing payments.

Exhibit 4-11
Comparison of Glass Processing Payments and Processing Fees (2004-2020)



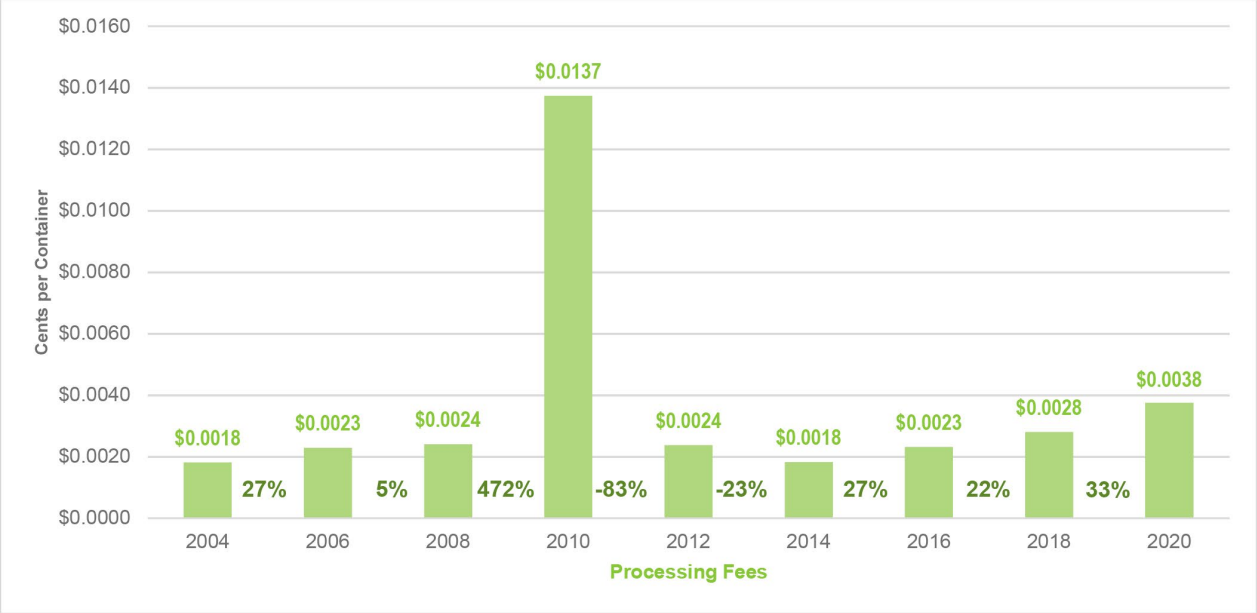
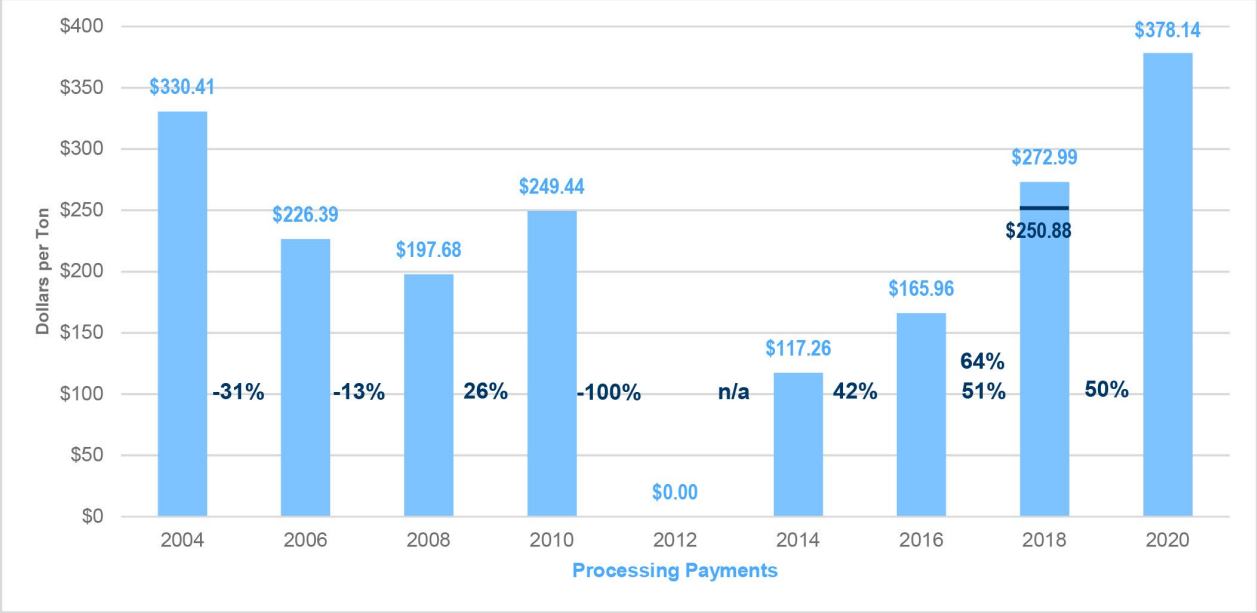


Exhibit 4-12
Comparison of PET #1 Processing Payments and Processing Fees (2004-2020)



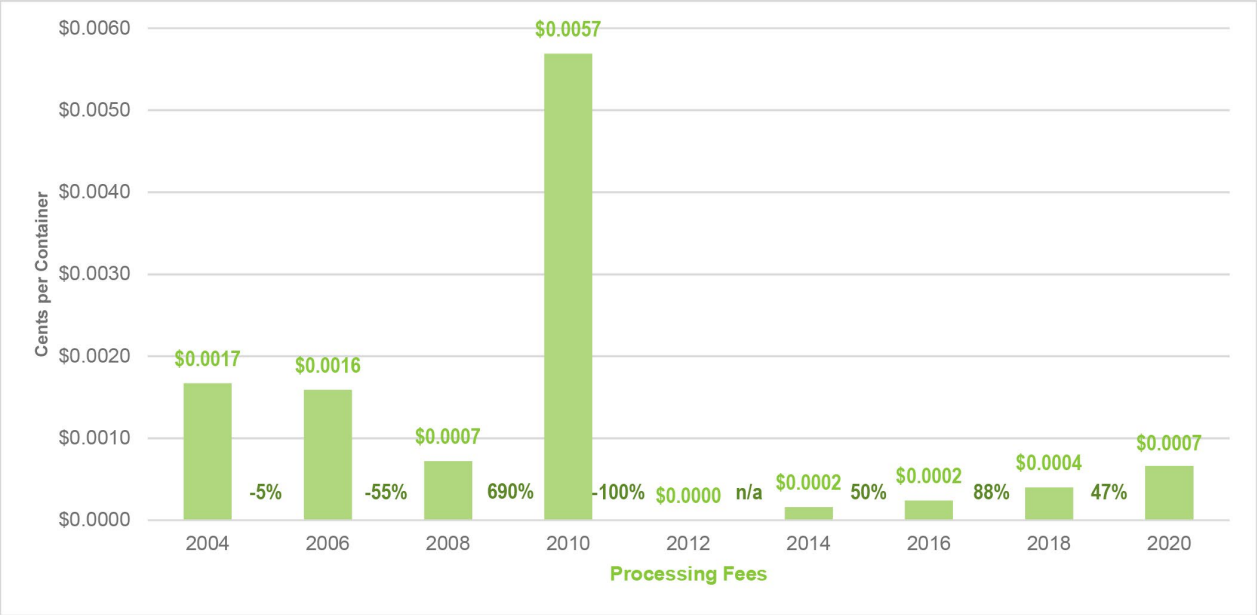
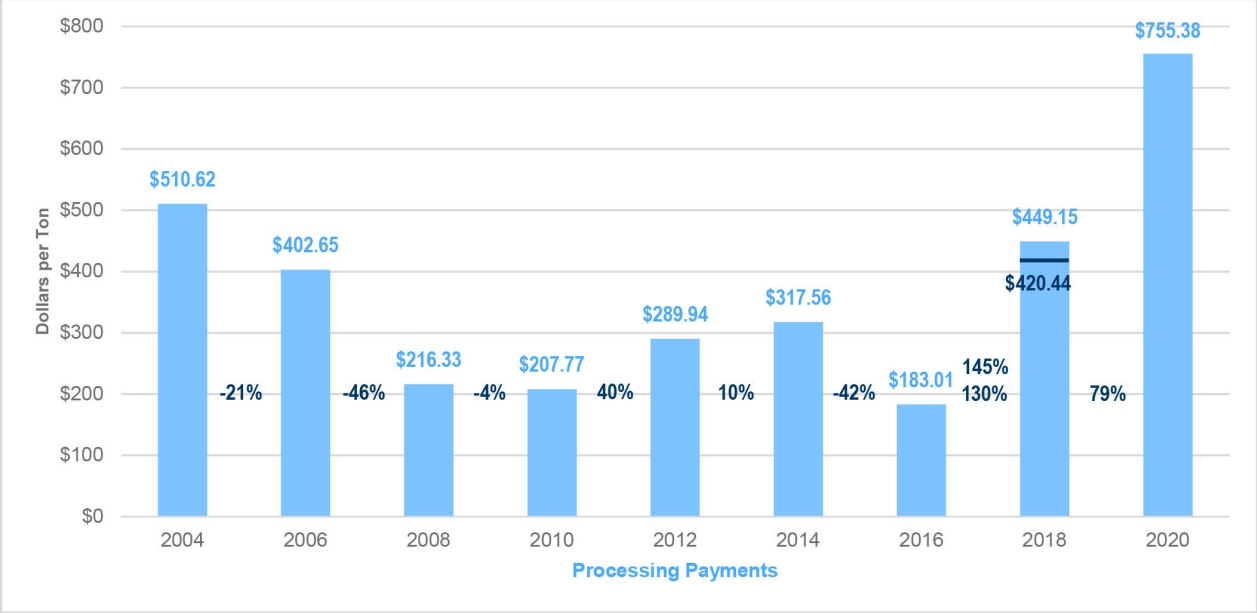
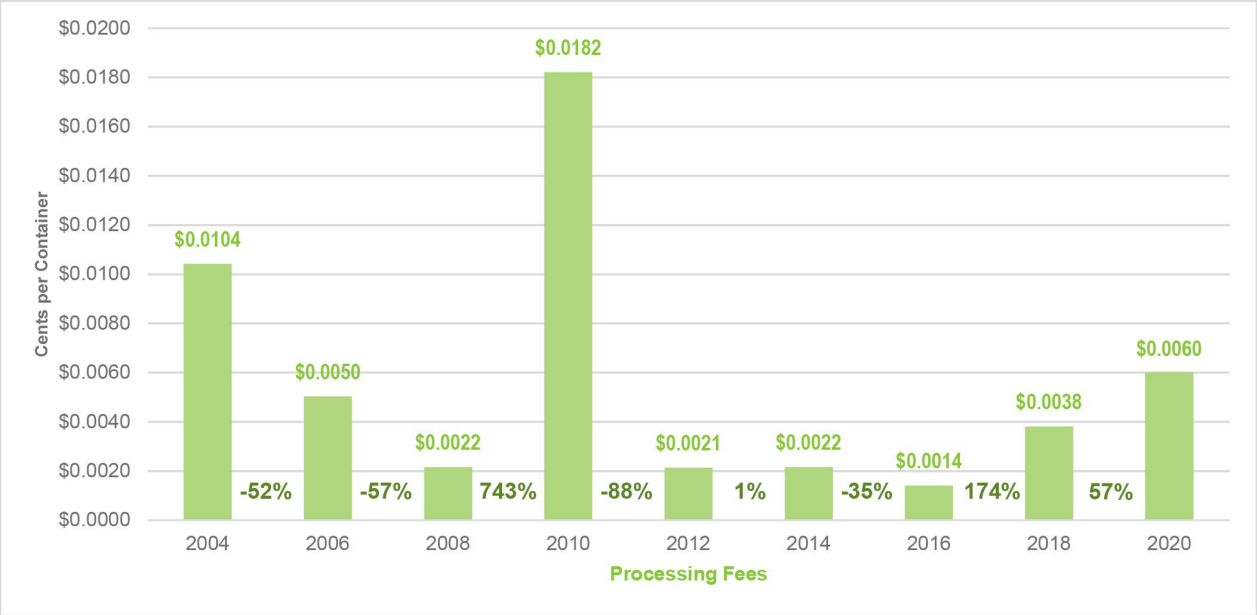


Exhibit 4-13
Comparison of HDPE #2 Processing Payments and Processing Fees (2004-2020)





Appendix A: Accessibility Additional Information

This appendix provides additional data and explanations for the various bar graph and line chart exhibits presented in this report.

Exhibit ES-4
CPI Adjusted Statewide Recycler Costs per Ton, by Material Type

Year	Aluminum	Glass	PET #1	HDPE #2
1987	$342.09	$72.52	$270.29	NA
1988	NA	NA	NA	NA
1989	$366.39	$74.84	$930.42	NA
1990	$324.32	$88.69	$930.42	NA
1991	$322.02	$86.98	$785.56	NA
1992	NA	NA	NA	NA
1993	NA	NA	NA	NA
1994	$349.07	$93.75	$754.16	NA
1995	NA	NA	NA	NA
1996	NA	NA	NA	NA
1997	$417.60	$81.09	$611.74	NA
1998	$394.41	$84.85	$606.62	NA
1999	$354.30	$86.25	$584.14	NA
2000	NA	NA	NA	NA
2001	NA	NA	NA	NA
2002	$418.95	$79.81	$479.63	$645.91
2003	NA	NA	NA	NA
2004	$465.90	$82.45	$493.31	$671.73
2005	NA	NA	NA	NA
2006	$516.13	$94.98	$477.73	$500.64
2007	NA	NA	NA	NA
2008	$559.23	$81.60	$426.76	$501.67
2009	NA	NA	NA	NA

2018 Processing Fee Cost Survey

Year	Aluminum	Glass	PET #1	HDPE #2
2010	$537.06	$89.76	$440.61	$611.62
2011	NA	NA	NA	NA
2012	$609.81	$92.88	$462.79	$612.50
2014	$537.29	$97.50	$428.55	$524.23
2016	$539.11	$101.04	$421.30	$547.11
2018	$626.61	$132.68	$502.44	$838.00

Exhibit ES-7
Historical Processing Fee Recycler Cost per Ton (without RFR)
(1987–2018)

Year	Aluminum	Glass	PET #1
1987	$342.09	$72.52	$270.29
1988	NA	NA	NA
1989	$366.39	$74.84	$930.42
1990	$324.32	$88.69	$930.42
1991	$322.02	$86.98	$785.56
1992	NA	NA	NA
1993	NA	NA	NA
1994	$349.07	$93.75	$754.16
1995	NA	NA	NA
1996	NA	NA	NA
1997	$417.60	$81.09	$611.74
1998	$394.41	$84.85	$606.62
1999	$354.30	$86.25	$584.14
2000	NA	NA	NA
2001	NA	NA	NA
2002	$418.95	$79.81	$479.63
2003	NA	NA	NA
2004	$465.90	$82.45	$493.31
2005	NA	NA	NA
2006	$516.13	$94.98	$477.73
2007	NA	NA	NA

2018 Processing Fee Cost Survey

Year	Aluminum	Glass	PET #1
2008	$559.23	$81.60	$426.76
2009	NA	NA	NA
2010	$537.06	$89.76	$440.61
2011	NA	NA	NA
2012	$609.81	$92.88	$462.79
2014	$537.29	$97.50	$428.55
2016	$539.11	$101.04	$421.30
2018	$626.61	$132.68	$502.44

Exhibit 1-4
Processing Fee and Handling Fee Cost Survey Sample (2018)

- This relationship diagram illustrates the total number of processing fee and handling fee recyclers surveyed, and the number of recyclers in the processing fee cost survey. A total of 343 total unique PF and HF sites is broken down into 110 unique HF for HF sites and 233 unique PF sites. For the 233 unique PF sites, it is further broken down into 154 unique PF for PF sites and 79 unique PF for HF sites. The 154 unique PF for PF sites is even further broken down into 115 unique PF for PF only sites and 39 non-unique PF for PF and PF for HF sites. These 39 non-unique PF for PF and PF for HF combined with the 79 unique PF for HF sites result in a total of 118 total PF for HF sites.

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

- This diagram illustrates the two calculation approaches (Approach A and B) we used for determining processing fee recycler costs per ton for ten beverage container material types.
- Approach A involves aluminum, glass, plastics #1, and plastics #2 costs per ton. For example, the equation for glass cost per ton is as follows: Part (1) - glass stratum 1 sample costs divided by glass stratum 1 sample volumes multiplied by glass stratum 1 population volumes, which equals glass stratum 1 total population costs; Part (2) – glass stratum 2 sample costs divided by glass stratum 2 sample volumes multiplied by glass stratum 2 population volumes equals glass stratum 2 total population costs; Part (3) – glass stratum 3 sample costs divided by glass stratum 3 sample volumes multiplied by glass stratum 3 population volumes equals glass stratum 3 total population costs. Then, all three parts are summed then divided by total population volumes, which equal statewide stratified weighted-average cost per ton.

- Approach B involves bi-metal, and plastics #3 to #7 costs per ton. First, determine the HDPE percent change in cost per ton between 2016, which was $547.11, and 2018, which was $838 by using the following equation: percent change equals $838 subtracted by $547.11, then divided by $547.11 equals $290.89 over $547.11, which is equal to an increase of 53.17 percent. Second, calculate the cost per ton for bi-metal and plastics #3 to #7 by using the following equation: Add 2016 cost per ton to the 2016 cost per ton multiplied by 53.17 percent.

Exhibit 3-1
Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton (1987–2018)

- A line graph that provides the historical cost per ton results for all seventeen years in which recycler cost surveys were conducted. Below is a table describing the graph:

Year	Aluminum	Glass	PET #1	HDPE #2
1987	$342.09	$72.52	$270.29	NA
1989	$366.39	$74.84	$930.42	NA
1990	$324.32	$88.69	$930.42	NA
1991	$322.02	$86.98	$785.56	NA
1994	$349.07	$93.75	$754.16	NA
1997	$417.60	$81.09	$611.74	NA
1998	$394.41	$84.85	$606.62	NA
1999	$354.30	$86.25	$584.14	NA
2002	$418.95	$79.81	$479.63	$645.91
2004	$465.90	$82.45	$493.31	$671.73
2006	$516.13	$94.98	$477.73	$500.64
2008	$559.23	$81.60	$426.76	$501.67
2010	$537.06	$89.76	$440.61	$611.62
2012	$609.81	$92.88	$462.79	$612.50
2014	$537.29	$97.50	$428.55	$524.23
2016	$539.11	$101.04	$421.30	$547.11
2018	$626.61	$132.68	$502.44	$838.00

Exhibit 3-2
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002–2018)

Year	Aluminum	Glass	PET #1	HDPE #2
2002	$543.97	$103.63	$622.76	$838.66
2004	$590.25	$104.46	$624.97	$851.01
2006	$628.98	$115.75	$582.19	$610.11
2008	$651.88	$95.12	$497.46	$584.79
2010	$622.86	$104.10	$511.00	$709.33
2012	$681.36	$103.78	$517.09	$684.36
2014	$584.33	$106.04	$466.07	$570.12
2016	$570.97	$107.01	$446.20	$579.44
2018	$626.61	$132.68	$502.44	$838.00

Exhibit 3-4
Aluminum Processing Fee Recycler Cost per Ton and Tons Recycled (2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018)

Year	Cost/Ton	Percent Change
2002	$418.95	NA
2004	$465.90	11%
2006	$516.13	11%
2008	$559.23	8%
2010	$537.06	-4%
2012	$609.81	14%
2014	$537.29	-12%
2016	$539.11	0.3%
2018	$626.61	16%

Year	Tons Recycled	Percent Change
2002	72,297	NA
2004	74,565	3%
2006	70,762	-5%

Year	Tons Recycled	Percent Change
2008	82,299	16%
2010	86,261	5%
2012	89,410	4%
2014	77,350	-13%
2016	74,391	-4%
2018	66,714	-10%

Exhibit 3-5
Glass Processing Fee Recycler Cost per Ton and Tons Recycled
(2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018)

Year	Cost/Ton	Percent Change
2002	$79.81	NA
2004	$82.45	3%
2006	$94.98	15%
2008	$81.60	-14%
2010	$89.76	10%
2012	$92.88	3%
2014	$97.50	5%
2016	$101.04	4%
2018	$132.68	31%

Year	Tons Recycled	Percent Change
2002	229,489	NA
2004	244,557	7%
2006	257,139	5%
2008	318,694	24%
2010	317,030	-1%
2012	337,396	6%
2014	255,763	-24%
2016	256,637	0.3%
2018	230,671	-10%

Exhibit 3-6
PET #1 Processing Fee Recycler Cost per Ton and Tons Recycled
(2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, and 2018)

Year	Cost/Ton	Percent Change
2002	$479.63	NA
2004	$493.31	3%
2006	$477.73	-3%
2008	$426.76	-11%
2010	$440.61	3%
2012	$462.79	5%
2014	$428.55	-7%
2016	$421.30	-2%
2018	$502.44	19%

Year	Tons Recycled	Percent Change
2002	33,462	NA
2004	48,820	46%
2006	65,456	34%
2008	95,239	46%
2010	97,915	3%
2012	113,019	15%
2014	102,048	-10%
2016	110,536	8%
2018	107,815	-2%

Exhibit 3-7
HDPE #2 Processing Fee Recycler Cost per Ton and Tons Recycled
(2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016 and 2018)

Year	Cost/Ton	Percent Change
2002	$645.91	NA
2004	$671.73	4%
2006	$500.64	-25%
2008	$501.67	0%
2010	$611.62	22%
2012	$612.50	0%
2014	$524.23	-14%
2016	$547.11	4.4%
2018	$838.00	53%

Year	Tons Recycled	Percent Change
2002	3,316	NA
2004	5,720	73%
2006	7,325	28%
2008	11,943	63%
2010	12,117	1%
2012	13,548	12%
2014	5,170	-62%
2016	4,775	-8%
2018	3,783	-21%

Exhibit 3-8
Processing Fee Recycler 2018 Costs per Ton for Bi-Metal and Plastics #3 to #7

- A bar graph that illustrates the processing fee recycler costs per ton for each of the six minority material types, bi-metal, and the five plastic resin types: PVC #3, LDPE #4, PP #5, PS #6, and Other #7. Below is a table describing the graph:

Material	Tons Recycled
Bi-Metal	$1,056.35
PVC #3	$1,318.18
LDPE #4	$1,880.50
PP #5	$1,687.06
PS #6	$1,044.99
Other #7	$1,144.95

Exhibit 3-9
2002–2018 Number of Processing Fee Recycling Centers

- A line graph that provides the average tons of aluminum, glass, and PET #1 recycled per RC for each cost survey year, 2002 through 2018. Below is a table describing the graph

Year	Number
2002	684
2004	674
2006	677
2008	729
2010	842
2012*	1,032
2014	953
2016	778
2018	705

Exhibit 3-10
2002–2018 (every 2 years) Average Tons of Aluminum, Glass, and PET #1 Recycled per Processing Fee Recycler

Year	Aluminum	Glass	PET #1
2002	106	336	49
2004	111	363	72
2006	104	379	96
2008	113	437	131
2010	102	377	116
2012	82	313	107
2014	81	268	107
2016	96	330	142
2018	99	342	160

Exhibit 3-11
Percent Change in Tons per Recycler, Costs per Recycler, and Statewide, Weighted-Average Processing Fee Recycler Cost per Ton (2016 to 2018)

Year	Aluminum	Glass	PET #1	HDPE #2
Tons per Recycling Center	4%	4%	13%	-9%
Cost per Recycling Center	20%	36%	34%	40%
Cost per Ton	16%	31%	19%	53%

Exhibit 3-12
2010, 2012 2014, 2016, and 2018 Sampled Processing Fee Recyclers Average Labor Hours per Ton of Aluminum, Glass, and All Plastic Recycled

- A bar graph that shows the labor hours allocated per ton of material recycled. Below is a table describing the graph:

Year	Aluminum	Glass	All Plastic
2010	17.8	2.8	14.4
2012	21.9	3.2	16.8
2014	19.0	3.1	15.2
2016	17.9	3.1	14.1
2018	17.7	3.5	14.6

Exhibit 3-13
2010, 2012, 2014, 2016, and 2018 Sampled Processing Fee Recyclers
Average CRV Wages per Hour

- A bar graph that provides PF for PF recycler average hourly CRV wage since 2010 and compares these results with minimum wage and inflation-adjusted average hourly CRV wages. Below is a table describing the graph:

Exhibit 3-15
2012, 2014, 2016, and 2018 Sampled Processing Fee Recyclers
Labor and Non-Labor Costs per Ton

	2012 Labor	2014 Labor	2016 Labor	2018 Labor	2012 Non-Labor	2014 Non-Labor	2016 Non-Labor	2018 Non-Labor
Aluminum	$328.12	$280.71	$282.53	$317.26	$281.69	$256.58	$256.58	$309.35
Glass	$49.03	$49.98	$52.04	$62.23	$43.85	$47.52	$49.00	$70.45
PET #1	$244.90	$233.85	$219.27	$264.01	$217.89	$194.70	$202.03	$238.43

Exhibit 3-16
Comparison of CRV Hourly Wages Overall and by Strata (2016 and 2018)

Year	Overall	Strata 1	Strata 2	Strata 3
2016	$15.09	$16.09	$14.50	$12.11
2018	$17.65	$19.26	$17.30	$16.31

Exhibit 3-21
Percent of Recycling Center Labor Hours by Activity (2016 and 2018)

	AL/ BM DYL	AL/ BM AOL	Glass DYL	Glass AOL	Plastic DYL	Plastic AOL	non-CRV DYL	non-CRV AOL
2016 % of RC Hours	19%	3%	12%	2%	24%	3%	28%	9%
2018 % of RC Hours	16%	3%	11%	3%	25%	4%	30%	8%

Exhibit 3-22
Labor Hours per Ton CRV Material by Activity (2016 and 2018)

	AL/ BM DYL	AL/ BM AOL	Glass DYL	Glass AOL	Plastic DYL	Plastic AOL	CRV DYL	CRV AOL
2016 Hours/Ton	15.52	2.40	2.58	0.52	12.57	1.61	7.20	1.10
2018 Hours/Ton	14.87	2.86	2.82	0.67	12.73	1.94	7.45	1.36

Exhibit 3-23
Comparison of Average Transportation Cost per Surveyed Recycling Center and Diesel Prices (2010–2018)

Year	Transportation and Fuel Costs Per RC	Diesel Retail Price per Gallon
2010	$13,982	$3.16
2012	$12,683	$4.23
2014	$12,796	$4.00
2016	$11,150	$2.65
2018	$19,198	$3.87

Exhibit 3-24
2018 Aluminum, Glass, and Plastic Cost Per Ton by Hauling Method

Hauling Method	Aluminum	Glass	Plastic
Self-Haul	$687	$161	$586
Third-Party	$528	$111	$483
Processor Scrap Deduction	$503	$97	$391
Payment to Processor	$607	$126	$504

Exhibit 3-25
2016 vs 2018 – Aluminum Cost Per Ton by Hauling Method

Hauling Method	2016	2018
Self-Haul	$540	$687
Third-Party	$618	$528
Processor Scrap Deduction	$455	$503
Payment to Processor	$530	$607

Exhibit 3-26
2016 vs 2018 – Glass Cost Per Ton by Hauling Method

Hauling Method	2016	2018
Self-Haul	$105	$161
Third-Party	$102	$111
Processor Scrap Deduction	$81	$97
Payment to Processor	$70	$126

Exhibit 3-27
2016 vs 2018 – PET #1 Cost Per Ton by Hauling Method

Hauling Method	2016	2018
Self-Haul	$455	$586
Third-Party	$407	$483
Processor Scrap Deduction	$386	$391
Payment to Processor	$358	$504

Exhibit 3-28
2016 vs 2018 – Comparison of Each Hauling Method*

Year	2016 AL	2018 AL	2016 GL	2018 GL	2016 PET #1	2018 PET #1
Self-Haul	55%	50%	50%	37%	51%	48%
Third-Party	13%	16%	11%	19%	13%	16%
Processor Pick-up	33%	38%	36%	48%	34%	40%

Exhibit 3-29
2016 vs 2018 – Aluminum, Glass, and Plastic Transportation Cost Per Ton*

Year	Aluminum	Glass	Plastic
2016	$31.76	$6.35	$26.02
2018	$41.41	$10.62	$34.83

Exhibit 3-30
2016 vs 2018 – Aluminum Transportation Cost Per Ton by Strata

Year	Strata 1	Strata 2	Strata 3
2016	$22.60	$42.15	$61.36
2018	$25.72	$40.38	$68.64

Exhibit 3-31
2016 vs 2018 – Glass Transportation Cost Per Ton by Strata

Year	Strata 1	Strata 2	Strata 3
2016	$4.14	$10.19	$15.38
2018	$10.75	$6.78	$16.56

Exhibit 3-32
2016 vs 2018 – Plastic Transportation Cost Per Ton by Strata

Year	Strata 1	Strata 2	Strata 3
2016	$18.13	$38.19	$59.72
2018	$22.64	$33.34	$60.91

Exhibit 3-33
2016 vs 2018 – Aluminum, Glass, and PET #1 Transportation with Scrap Value Deduction

Year	Aluminum	Glass	Plastic
2016	57%	60%	56%
2018	73%	73%	74%

Exhibit 3-36
Percent of Population Glass Tons Recycled and Percent of Glass Total Costs (2012, 2014, 2016, and 2018)

	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs
Stratum 1	54%	42%	52%	24%	42%	30%	37%	18%
Stratum 2	37%	46%	37%	33%	42%	50%	45%	25%
Stratum 3	9%	12%	11%	42%	16%	20%	18%	56%

Exhibit 3-37
Percent of Population Aluminum Tons Recycled and Percent of Aluminum Total Costs (2012, 2014, 2016, and 2018)

	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs
Stratum 1	39%	33%	50%	26%	34%	29%	44%	21%
Stratum 2	43%	48%	37%	30%	44%	49%	38%	26%
Stratum 3	18%	19%	13%	44%	22%	22%	18%	53%

Exhibit 3-38
Percent of Population PET #1 Tons Recycled and Percent of PET #1 Total Costs (2012, 2014, 2016, and 2018)

	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs
Stratum 1	46%	37%	54%	28%	40%	32%	45%	22%
Stratum 2	41%	48%	36%	33%	45%	50%	40%	27%
Stratum 3	12%	15%	10%	40%	15%	18%	15%	50%

Exhibit 3-39
Total Population Costs for Processing Fee Recyclers (2002–2018)

	2002	2004	2006	2008	2010	2012	2014	2016	2018
Aluminum	$30,288,983	$34,740,163	$36,522,001	$46,023,789	$46,327,388	$38,035,847	$41,559,304	$40,104,850	$41,803,720
Glass	$18,316,346	$20,162,822	$24,421,969	$26,004,432	$28,455,835	$22,182,615	$24,935,661	$25,931,830	$30,606,169
PET #1	$16,049,669	$24,083,401	$31,270,355	$40,644,150	$43,142,783	$37,703,897	$43,732,676	$46,568,725	$54,171,104
HDPE #2	$2,141,980	$3,842,372	$3,669,033	$5,991,360	$7,411,290	$5,544,897	$2,710,146	$2,612,527	$3,170,047
Bi-Metal	$23,546	$53,874	$93,333	$143,305	$126,303	$100,930	$11,485	$123,170	$157,206
Plastics #3 to #7	$5,405	$11,358	$21,820	$51,525	$115,964	$147,211	$196,907	$265,408	$388,410
Total Sites	684	674	677	729	842	763	955	778	674
Total Costs	$66,825,929	$82,893,990	$95,998,511	$118,858,561	$125,579,563	$103,715,397	$113,146,179	$115,606,510	$130,296,656

Exhibit 3-40
Total Population Tons for Processing Fee Recyclers (2002–2018)

Material Type	2002	2004	2006	2008	2010	2012	2014	2016	2018
Aluminum	72,297	74,656	70,762	82,299	86,261	62,374	77,350	74,391	66,714
Glass	229,489	244,557	257,139	318,697	317,030	239,837	255,763	256,637	230,671
PET #1	33,462	48,820	65,456	95,239	97,915	81,471	102,048	110,536	107,815
HDPE #2	3,316	5,720	7,325	11,943	12,117	9,053	5,170	4,775	3,783
Bi-Metal	46	89	106	227	164	131	155	178	149
Plastics #3 to #7	5	9	29	76	138	176	278	356	340
Total Sites	684	674	677	729	842	763	955	778	674
hidden	338,615	373,851	400,817	508,481	513,625	393,042	440,764	446,873	409,471
Total Tons	338,615	373,851	400,817	508,481	513,625	393,042	440,764	446,873	409,471

Exhibit 3-46
Aluminum Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)

Strata	Costs per Ton	Sites
Stratum 1	$474.32	28
Stratum 2	$540.20	40
Stratum 3	$757.23	86
Statewide Average	$626.61	n/a

Exhibit 3-47
Glass Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)

Strata	Costs per Ton	Sites
Stratum 1	$100.09	28
Stratum 2	$101.39	40
Stratum 3	$175.97	84
Statewide Average	$132.68	n/a

Exhibit 3-48
PET #1 Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)

Strata	Costs per Ton	Sites
Stratum 1	$404.28	28
Stratum 2	$422.07	40
Stratum 3	$636.49	85
Statewide Average	$502.44	n/a

Exhibit 3-49
HDPE #2 Costs per Ton and Reduced Population Size by Strata for Processing Fee Recyclers (2018)

Strata	Costs per Ton	Sites
Stratum 1	$713.22	28
Stratum 2	$661.39	40
Stratum 3	$1,064.99	82
Statewide Average	$838.00	n/a

Exhibit 3-50
2018 Sampled Processing Fee Recyclers,
Distribution of Aluminum Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$100	0
$100–$200	3
$200–$300	12
$300–$400	15
$400–$500	24
$500–$600	17
$600–$700	23
$700–$800	18
$800–$900	7
$900–$1,000	12
$1,000–$1,100	8
$1,100–$1,200	1
$1,200–$1,300	3
$1,300–$1,400	1
$1,400–$1,500	1
$1,500–$1,600	1
$1,600–$1,700	0
$1,700–$1,800	1
$1,800–$1,900	0
$1,900–$2,000	0
$2,000–$2,100	2
$2,100–$2,200	1
>$2,200	4

Exhibit 3-51
2018 Sampled Processing Fee Recyclers,
Distribution of Glass Cost per Ton

Cost per Ton	Number of Recyclers
$0–$50	7
$50–$75	17
$75–$100	22
$100–$125	21
$125–$150	17
$150–$175	13
$175–$200	8
$200–$225	11
$225–$250	4
$250–$275	6
$275–$300	6
$300–$325	0
$325–$350	8
$350–$375	3
$375–$400	3
$400–$425	0
>$425	6

Exhibit 3-52
2018 Sampled Processing Fee Recyclers,
Distribution of PET #1 Cost per Ton

Cost per Ton	Number of Recyclers
$100–$200	3
$200–$300	18
$300–$400	32
$400–$500	33
$500–$600	15
$600–$700	19
$700–$800	10
$800–$900	7
$900–$1,000	1
$1,000–$1,100	4
$1,100–$1,200	0
$1,200–$1,300	1
$1,300–$1,400	3
$1,400–$1,500	0
$1,500–$1,600	0
$1,600–$1,700	0
$1,700–$1,800	1
$1,800–$1,900	0
$1,900–$2,000	1
$2,000–$2,100	0
$2,100–$2,200	1
$2,200–$2,300	0
$2,300–$2,400	1
>$2,400	3

Exhibit 3-53
2018 Sampled Processing Fee Recyclers,
Distribution of HDPE #2 Cost per Ton

Cost per Ton	Number of Recyclers
$100–$200	0
$200–$300	1
$300–$400	6
$400–$500	10
$500–$600	18
$600–$700	12
$700–$800	20
$800–$900	19
$900–$1,000	7
$1,000–$1,100	9
$1,100–$1,200	9
$1,200–$1,300	6
$1,300–$1,400	3
$1,400–$1,500	4
$1,500–$1,600	4
$1,600–$1,700	4
$1,700–$1,800	1
$1,800–$1,900	3
$1,900–$2,000	2
$2,000–$2,100	0
$2,100–$2,200	1
$2,200–$2,300	0
$2,300–$2,400	2
$2,400–$2,500	1
$2,500–$2,600	2
>$2,600	6

Exhibit 4-5
Processing Fees Public Notice (December 16, 2019)

	Glass	PET	HDPE	Vinyl	LDPE	PP	PS	Other	Bimetal
Cost of Recycling per Ton with Reasonable Financial Return & COLA (Statewide)	$150.62	$570.37	$951.30	$1,496.40	$2,134.75	$1,915.16	$1,186.27	$1,299.75	$1,199.17
Scrap Value per Ton	$-2.38	$194.23	$195.92	0.00	$5.99	$28.84	$12.67	$1.52	$3.07
Processing Payments to All Participant Types	NA	NA	NA	NA	NA	NA	NA	NA	NA
Processing Payment Per Ton Redeemed	$153.00	$376.14	$755.38	1,496.40	$2.128.76	$1,886.32	$1,173.60	$1,298.23	$1,196.10
Processing Payment Per Pound Redeemed	0.0765	0.18807	$0.37769	$0.74820	$1.06438	$0.94316	$0.58680	$0.64911	$0.59805
Processing Fees to be Paid by Beverage Manufacturers	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manufacturers' Percentage of Processing Payment	11%	10%	11%	65%	65%	65%	65%	65%	65%
Processing Fee Pursuant to Section 14575(f)	$0.00438	$0.00082	$0.00602	$0.05014	$0.01696	$0.05573	$0.00348	$0.13610	$0.04799
Section 14575(j) Processing Fee Reduction	$0.00063	$0.00016	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Processing Fee to be Paid by Beverage Manufacturers	$0.00375	$0.00602	$0.00602	$0.05014	$0.01696	$0.05573	$0.00348	$0.13610	$0.04799

Exhibit 4-11
Comparison of Glass Processing Payments and Processing Fees (2004-2020)

Year	Dollars per Ton	Percent Change
2004	$74.52	–
2006	$83.68	12%
2008	$94.52	13%
2010	$66.87	-29%
2012	$88.26	32%
2014	$94.72	7%
2016	$101.07	7%
2018	$125.26	19%
2020	$153.00	27%

Year	Cents per Container	Percent Change
2004	$0.0018	–
2006	$0.0023	27%
2008	$0.0024	5%
2010	$0.0137	472%
2012	$0.0024	-83%
2014	$0.0018	-23%
2016	$0.0023	27%
2018	$0.0028	22%
2020	$0.0038	33%

Exhibit 4-12
Comparison of PET #1 Processing Payments and Processing Fees (2004-2020)

Year	Dollars per Ton	Percent Change
2004	$330.41	–
2006	$226.39	-31%
2008	$197.68	-13%
2010	$249.44	26%
2012	$0.00	-100%
2014	$117.26	n/a
2016	$165.96	42%
2018	$272.99	51%
2020	$378.14	50%

Year	Cents per Container	Percent Change
2004	$0.0017	–
2006	$0.0016	-5%
2008	$0.0007	-55%
2010	$0.0057	690%
2012	$0.0000	-100%
2014	$0.0002	n/a
2016	$0.0002	50%
2018	$0.0004	88%
2020	$0.0007	47%

Exhibit 4-13
Comparison of HDPE #2 Processing Payments and Processing Fees (2004-2020)

Year	Dollars per Ton	Percent Change
2004	$510.62	–
2006	$402.65	-21%
2008	$216.33	-46%
2010	$207.77	-4%
2012	$289.94	40%
2014	$317.56	10%
2016	$183.01	-42%
2018	$449.15	130%
2020	$755.38	79%

Year	Cents per Container	Percent Change
2004	$0.0104	–
2006	$0.0050	-52%
2008	$0.0022	-57%
2010	$0.0182	743%
2012	$0.0021	-88%
2014	$0.0022	1%
2016	$0.0014	-35%
2018	$0.0038	174%
2020	$0.0060	57%