CalRecycle

California Department of Resources
Recycling and Recovery

2021 Processing Fee Final Report

January – December 2020 Cost of Recycling

April 4, 2022

Produced Under Contract By: Crowe

State of California
Gavin Newsom
Governor

California Environmental Protection Agency
Jared Blumenfeld
Secretary

Department of Resources Recycling and Recovery
Rachel Machi Wagoner
Director

Public Affairs Office
1001 I Street (MS 22-B)
P.O. Box 4025
Sacramento, CA 95812-4025
www.calrecycle.ca.gov/Publications/
1-800-RECYCLE (California only) or (916) 341-6300

Publication # DRRR-2022-1709

Prepared as part of contract number DRR 20035.

CalRecycle does not discriminate on the basis of disability in access to its programs. CalRecycle publications are available in accessible formats upon request by calling the Public Affairs Office at (916) 341-6300. Persons with hearing impairments can reach CalRecycle through the California Relay Service, 1-800-735-2929.

Disclaimer: This report was produced under contract by the Crowe LLP. The statements and conclusions contained in this report are those of the contractor and not necessarily those of the Department of Resources Recycling and Recovery (CalRecycle), its employees, or the State of California and should not be cited or quoted as official Department policy or direction.

The state makes no warranty, expressed or implied, and assumes no liability for the information contained in the succeeding text. Any mention of commercial products or processes shall not be construed as an endorsement of such products or processes.

Table of Contents

Acknowledgments

The CalRecycle Cost Survey requires a high degree of communication and collaboration by all involved. Crowe LLP thanks CalRecycle management and staff for their support throughout the entire project. In addition, Crowe acknowledges and appreciates the cooperation and time commitment of the many recycling centers that were selected to participate in the processing fee cost survey.

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 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:

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

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

California Public Resources Code, Division 12.1, Chapter 4, Section 14575 directs CalRecycle to calculate processing payments and fees. Processing payments are defined as the difference between the statewide, weighted-average cost of recycling a beverage container material in the AB 2020 program, including a reasonable financial return (RFR) and 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 an AB 2020 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. CalRecycle has been conducting processing fee cost surveys every two years since 2002.

AB 3056 (Committee on Natural Resources, Chapter 907, Statutes of 2006) added the handling fee cost survey. The handling fee cost survey is implemented in conjunction with the processing fee cost survey. This is to determine statewide weighted-average costs per container to recycle for processing fee (PF) recyclers which are recycling centers that do not receive handling fees, and handling fee (HF) recyclers which are recycling centers that do receive handling fees. 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 the California statewide weighted-average 2020 certified recycler costs per ton for four beverage container material types, and the percent change in HDPE #2 cost per ton between 2018 and 2020. Recycler center costs were surveyed and analyzed in 2021 (mid-April through mid-November), using recycler center calendar year 2020 financial statements. Recycler center costs measured by this survey will be used for the processing fee calculation, effective January 1, 2022.

This overall 2020 processing fee cost survey had a similar sample size as compared to the previous three processing fee cost surveys (146 unique sites). The Crowe team completed 146 recycler cost surveys during field work (April 26, 2021, to October 28, 2021) 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. This cost survey generally achieved the same high level of accuracy as prior cost surveys undertaken by CalRecycle.

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-1.** Exhibit ES-1 compares 2020 costs per ton to the nine prior cost surveys in which CalRecycle measured recycler costs (including years 2002 through 2018). Note that costs per ton in Exhibit ES-1 are not adjusted for inflation, reasonable financial return (RFR), or COLA.

Exhibit ES-2 provides the two-year percent change in cost per ton between cost surveys. The 2020 cost per ton results are mixed as compared with 2018 results. The 2020 cost per ton results for aluminum decreased 9 percent, glass increased 3 percent, PET #1 decreased 11 percent, and HDPE #2 increased 6 percent.

Exhibit ES-3 illustrates the non-adjusted costs per ton for aluminum, glass, PET #1, and HDPE #2 from 2002 to 2020.

For comparison, **Exhibit ES-4** provides 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.[1]

[1] Source: http://www.dof.ca.gov/Forecasting/Economics/Indicators/Inflation/

Exhibit ES-1
Historical Statewide Costs per Ton (Without Reasonable Financial Return) (2002 through 2020)

Material Type	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**$569.76**	$626.61	$539.11	$537.29	$609.81	$537.06	$559.23	$516.13	$465.90	$418.95
2. Glass	**136.73**	132.68	101.04	97.50	92.88	89.76	81.60	94.98	82.45	79.81
3. PET #1	**446.34**	502.44	421.30	428.55	462.79	440.61	426.76	477.73	493.31	479.63
4. HDPE #2	**885.21**	838.00	547.11	524.23	612.50	611.62	501.67	500.64	671.73	645.91
5. Bi-Metal	**1,115.82**	1,056.35	689.66	660.65	771.88	770.80	632.22	883.55	607.03	508.18
6. PVC #3	**1,392.39**	1,318.18	860.60	824.65	963.49	962.14	789.16	731.37	1,583.72	1,064.52
7. LDPE #4	**1,986.37**	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	**1,782.04**	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	**1,103.82**	1,044.99	682.24	653.74	763.80	762.73	625.60	623.11	3,051.82	6,137.30
10. Other #7	**1,209.41**	1,144.95	747.50	716.27	836.86	835.69	685.44	741.93	1,264.47	759.32

Exhibit ES-2
Percent Change in Statewide Recycler Cost per Ton, by Material Type (2012 through 2020)

Material Type	2018 to 2020	2016 to 2018	2014 to 2016	2012 to 2014	2010 to 2012	2008 to 2010	2006 to 2008	2004 to 2006	2002 to 2004	2018 to 2020
1. Aluminum	**-9%**	16%	0.3%	-12%	+14%	-4%	+8%	+11%	+11%	**-9%**
2. Glass	**3%**	31%	3.6%	+5%	+3%	+10%	-14%	+15%	+3%	**3%**
3. PET #1	**-11%**	19%	-1.7%	-7%	+5%	+3%	-11%	-3%	+3%	**-11%**
4. HDPE #2	**5.6%[a]**	53% [a]	4.4%[a]	-14%[a]	0%[a]	+22%[a]	0%	-25%	+4%	**5.6%[a]**
5. Bi-Metal	**5.6%**	53%	4.4%	-14%	0%	+22%	-28%	+46%	+19%	**5.6%**
6. PVC #3	**5.6%**	53%	4.4%	-14%	0%	+22%	+8%	-54%	+49%	**5.6%**
7. LDPE #4	**5.6%**	53%	4.4%	-14%	0%	+22%	-39%	-2%	-43%	**5.6%**
8. PP #5	**5.6%**	53%	4.4%	-14%	0%	+22%	+28%	-3%	-45%	**5.6%**
9. PS #6	**5.6%**	53%	4.4%	-14%	0%	+22%	0%	-80%	-50%	**5.6%**
10. Other #7	**5.6%**	53%	4.4%	-14%	0%	+22%	-8%	-41%	+67%	**5.6%**

Note: The percent change for HDPE, bi-metal, and plastics #3 to #7 are rounded in the exhibit.
Between 2018 and 2020, the actual HDPE percent change was 5.63%

.

Exhibit ES-3
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results (2002 through 2020)

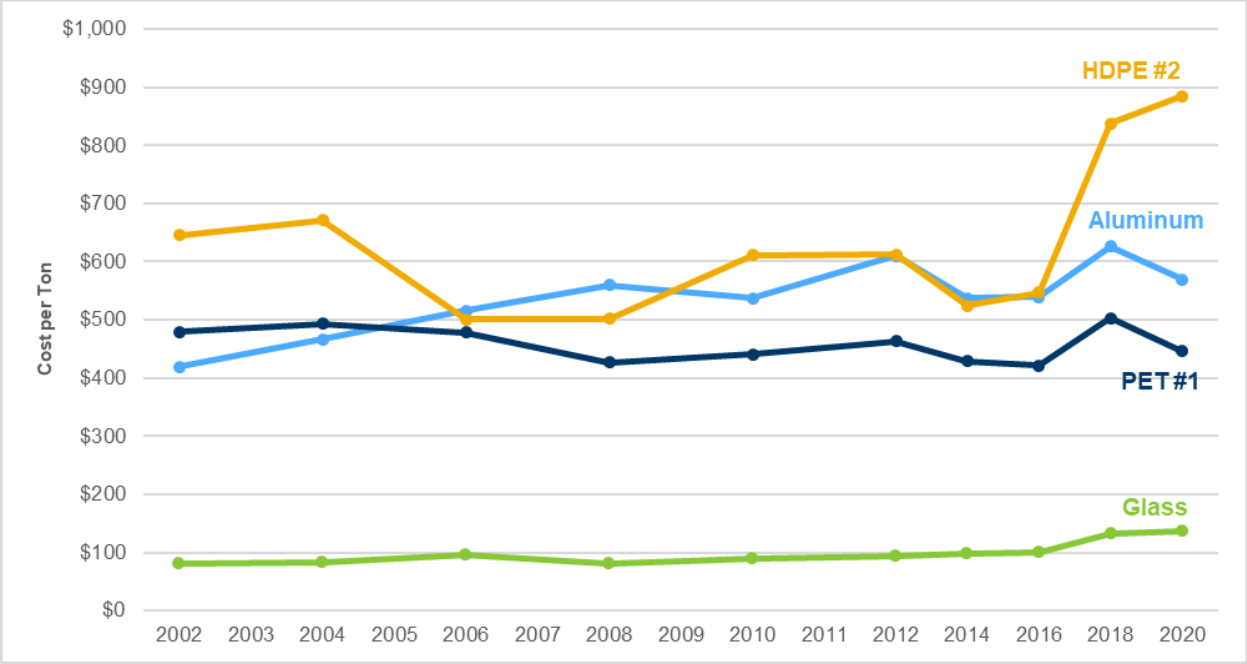
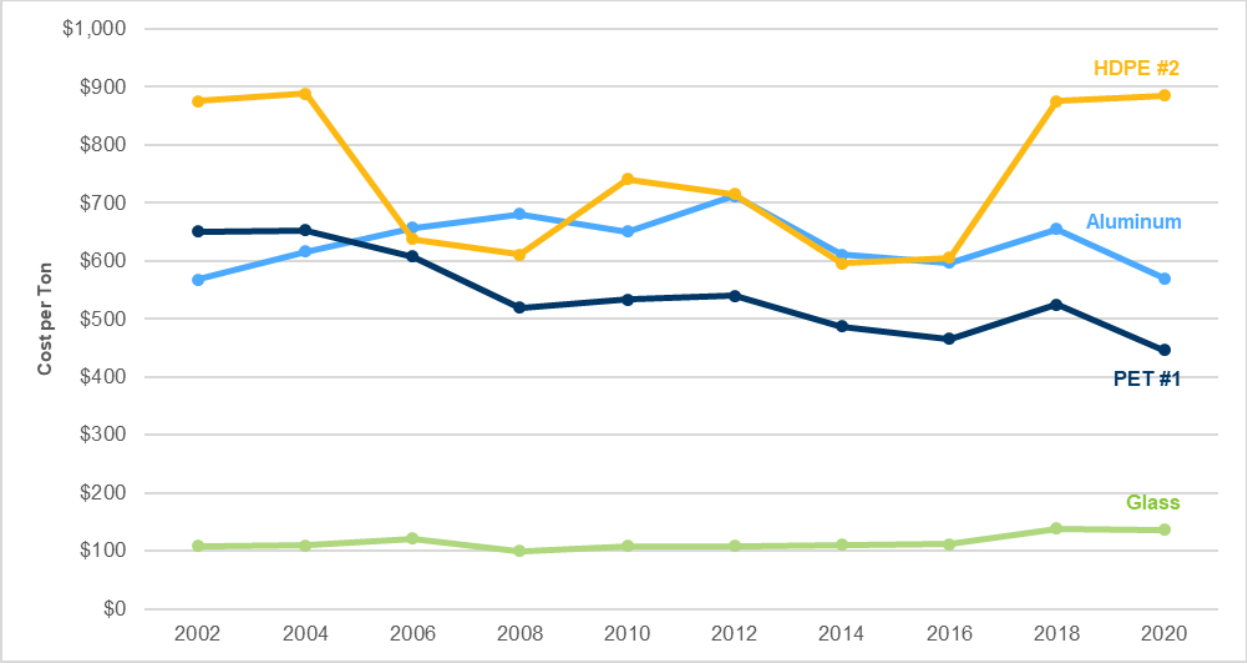


Exhibit ES-4
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002 through 2020)



.

Aluminum

The aluminum cost per ton results decreased roughly 9 percent from $626.61 cost per ton in 2018 to $569.76 cost per ton in 2020. In 2020, the processing fee recycler population recycled 65,104 tons of aluminum down from 66,714 tons recycled in 2018. 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 2020 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 previous survey years. However, the decrease in the cost per ton to recycle aluminum coupled with volatile scrap market conditions in 2020 indicate a decline in potential profits from aluminum for recyclers. In 2020, aluminum made up nearly 18 percent of tons of CRV material recycled by the population, approximately a 1.5 percent increase from 2018.

Glass

The glass cost per ton results increased 3 percent from $132.68 cost per ton in 2018 to $136.73 cost per ton in 2020. The results reflect a continued trend of increased glass costs since 2008, resulting in a cost per ton over $100 for the third time. In 2020, total glass volumes, at 196,273 tons, were lower compared to all the other survey years. Glass volumes continued to decline between 2018 to 2020, compared to the stabilized levels between 2014 and 2016, following a large decrease between 2012 and 2014. Average tons of recycled glass per recycler slightly decreased from 342 tons in 2018 to 337 tons in 2020. In 2020, glass made up its lowest historical percent share of CRV material recycled at 53 percent. 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 PET #1 cost per ton results decreased 11 percent from $502.44 cost per ton in 2018 to $446.34 cost per ton in 2020. The costs have generally fluctuated year to year within a relatively narrow band (e.g., from its lowest $421 per ton in 2016 to its highest $502 per ton in 2018). Tons of PET #1 recycled decreased 5 percent from 2018 to 2020. On a per-recycler basis, average tons recycled per year increased to the highest level yet, from approximately 107 tons in 2012 and 2014, 160 tons in 2018, to 177 tons in 2020. In 2020, PET #1 made up its greatest share of CRV materials recycled, at 28 percent, an increase of two percent from 2018.

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 became a mainstream, established business. The historical decline of cost per ton also is likely due to significant increases in tons recycled. The 2020 PET #1 cost per ton results are slightly lower than the average of all cost per ton results from combined surveys (2002 to 2020 average is $457 cost per ton).

HDPE #2

The HDPE #2 cost per ton results increased 5.6 percent from $838 cost per ton 2018 to $885 cost per ton in 2020. In 2018, the 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 plastic resins. The requirement to redeem separated CRV-only material continued to have an impact on HDPE #2 recycling in 2020. It 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 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 #1 commingled rate increased to almost 100 percent. These changes increase relative costs for HDPE #2, reflecting the additional cost of sorting non-CRV HDPE #2 from HDPE #2 beverage containers. Another factor continuing to increase HDPE #2 costs per ton is that the overall volumes and tons per recycler both decreased in 2020. Tons of HDPE #2 declined 21 percent between 2016 and 2018, the lowest level since 2002. In 2020, tons continued to decline 11 percent from 2018 to 2020.

Bi-Metal and Plastics #3 to #7

As required by Senate Bill 1357 (Padilla, Chapter 697, Statutes of 2008), CalRecycle calculated the cost per ton for bi-metal and plastics #3 to #7 based on the percent change in HDPE #2 cost per ton from the 2019 cost survey.

In calendar year 2020, HDPE #2 made up only 0.45 percent of all beverage containers recycled. In total, bi-metal and plastics #3 through #7 made up 0.25 percent of containers recycled. 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 5.63 percent increase in HDPE #2 between 2018 and 2020. Thus, for the 2020 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 5.63 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 ninth consecutive survey, the 2020 sampling plan was based on a more accurate 90 percent CI, and a 10 percent error rate.

Exhibit ES-5 provides the 2020 sample error rates for each relevant material type. In 2020, 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 CI threshold.

The error rates in 2020 were consistent with the low error rates for each of the four materials over the prior nine 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-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 146 because a small number of recycling centers in the stratified random sample did not report all four material types.

Exhibit ES-5
Sample Error Rates for Processing Fee Recyclers, by Material Type (2002 through 2020)

Material Type	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**5.80%**	7.52%	6.71%	5.86%	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass	**7.91%**	6.88%	7.80%	6.49%	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1	**5.29%**	7.40%	6.11%	6.23%	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2	**8.29%**	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	N/A	6.89%	8.31%	9.83%	7.57%
6. PVC #3	N/A	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	N/A	100% Sample	100% Sample	100% Sample	100% Sample
8. PP #5	N/A	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	N/A	100% Sample	100% Sample	100% Sample	100% Sample
10. Other #7	N/A	N/A	N/A	N/A	N/A	N/A	9.53%	9.95%	100% Sample	100% Sample

Exhibit ES-6
Sample Sizes and Sample Method by Material Type (2020)

Material Type	2020 Sample Size	2020 Sample Method
1. Aluminum	**146**	Stratified Random Sample
2. Glass	**142**	Stratified Random Sample
3. PET #1	**146**	Stratified Random Sample
4. HDPE #2	**138**	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 Crowe summarizes 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. Crowe determined the number of recycling centers to be selected for the stratified random sample used to measure costs of aluminum, glass, PET #1, and HDPE #2 recycling. Following the sample design, Crowe randomly identified certified recycling centers selected to participate in the cost survey.
- Revised and updated the Cost Survey Training Manual and training materials. Crowe continued to update the evolving training manual, based on the 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 as well as developed videos and other training content. For the 2021 cost survey, the team performed significant training materials updates to accommodate shifting from an in-person classroom training to a virtual environment. The presentations include videos of recycling centers, animated training videos, quizzes, and activities specific to each topic area.

- Revised and conducted cost survey training consisting of eight half-days of interactive training sessions, training site visits, and follow-up sessions. Activities during the first six days included conducting cost survey interview role playing activities, mentoring from experienced survey team members, and completing site visit cost models and associated documentation. Following the six days of virtual classroom training, each new survey team member conducted a cost survey site visit 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 visit. Following the field visits, new survey members spent one to two days working together to complete the site files. The entire survey team reconvened after the training site visits to present and discuss them and review the remainder of the training materials. For this 2020 Cost Survey, Crowe also conducted a one-hour training for quality control reviewers.
- Updated and calibrated the Labor Allocation Cost Survey Model, an 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 2020 container per pound and CRV payment information, as well as procedural changes to the cost survey. In addition, calibrated the Indirect Cost Allocation Sub-Models for Aluminum/Bi-Metal and All-Plastics with 2020 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. For this 2021 cost survey, Crowe also created a tool within the model to streamline directing costs between material types for common material combinations.
- 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.

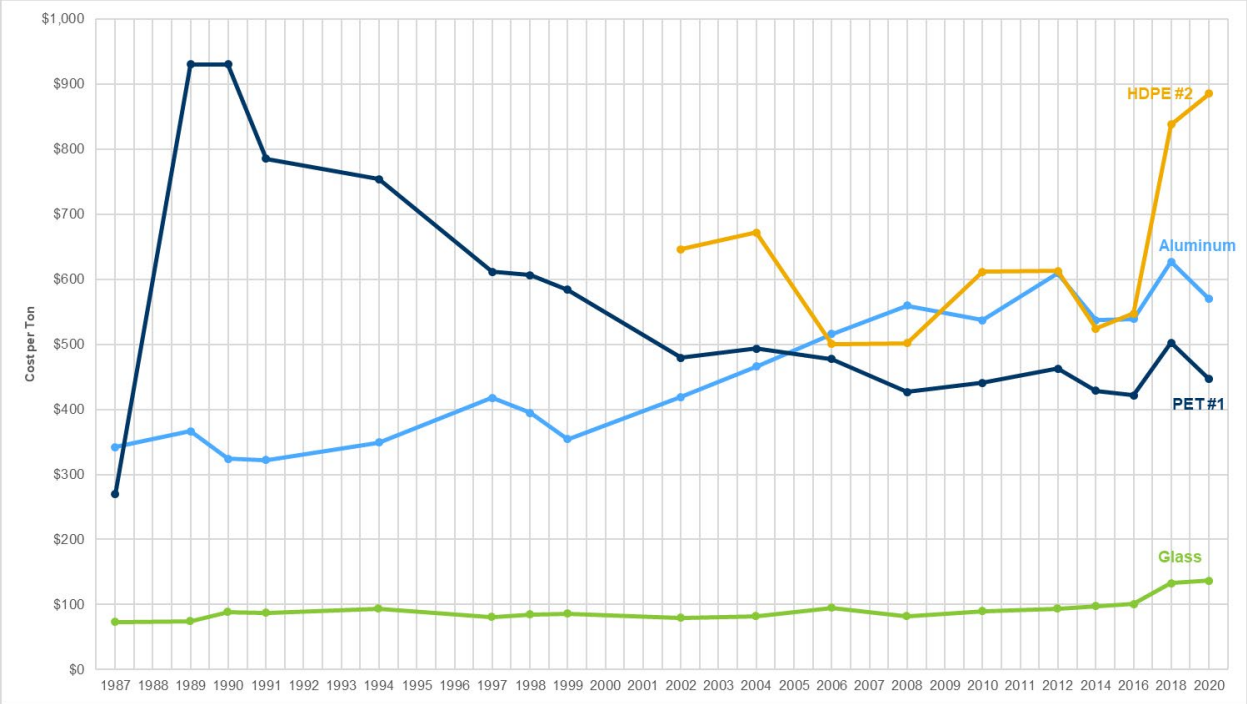
- Scheduled, conducted, and completed 146 recycling center on-site visits during 26 weeks between April 26, 2021, and October 28, 2021, using the statistical sample frame developed by Crowe. Throughout the scheduling and site visits, the Crowe team built upon the field working relationships established 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 analysts. 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 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 11.5 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 validated that each site file was complete and accurate and that all results from the labor allocation model and the indirect cost allocation sub-models were accurate. In total, over 27 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 146 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 2018 and 2020. 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 2020 cost per ton on the percent change in HDPE #2 cost per ton between 2018 and 2020 (bi-metal and plastics #3 to #7). Using defined and documented statistical procedures, Crowe calculated error rates at a 90 percent CI for the four relevant material types, and conducted additional detailed analyses of the results, as presented in this report.

E. Processing Fee Cost Analyses and Implications

Crowe conducted several analyses of the cost per ton results for the cost survey. Much of the 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 2018 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 the cost survey methodology. These analyses are summarized below:

- Examined historical processing fee cost survey results. This cost survey represented the 18th 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
Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton (1987 through 2020)



- Evaluated changes in recycling center productivity between 2012 through 2020. Between 2018 and 2020, the number of RCs decreased while for many materials the total tons of material recycled also decreased at varying levels. Productivity improved for recycling centers (RC) that recycle aluminum and all plastics and slightly decreased for glass. Costs per ton for these materials and average cost per RC significantly decreased from 2018 to 2020 for aluminum and PET, but slightly increased for glass and HDPE.
- Analyzed the relationship between recycler population and productivity. Between 2018 and 2020, recycler productivity (i.e., average tons recycled by RC) increased for the third time since 2008. Recycler productivity increases generally result in lower costs per ton, as recyclers gain efficiency. The 2020 statewide processing fee recycler cost per ton results indicate recyclers continue to gain efficiencies due to a continued decline in the recycler population. In total, between 2018 and 2020, the average tons per RC of glass remained nearly unchanged, aluminum increased 13 percent, and PET #1 increased 10 percent.
- 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 2020 processing fee cost survey are consistent with historical results. Crowe conducted several additional analyses to test the validity of the survey results. Crowe concluded that the methodology was consistent with prior years. Crowe is confident that based on the methodology required by law, the cost per ton results consistently reflects recycler operations and costs.
- Performed a cost category comparison between 2018 and 2020 RC costs, including adjusting 2018 RC costs using the CPI of 4.5 percent. Average CRV costs per RC decreased by 8 percent between 2018 and 2020. Consistent with prior cost surveys, the cost categories that make up the largest share of RC costs are direct labor, indirect labor, general business overhead, transportation, and rent.
- Evaluated 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; conducted evaluations of several potential factors related to labor hours, labor allocations, hourly yard wages, hourly administrative wages, and minimum wage.
- Analyzed owner's profitability from survey years 2016, 2018, and 2020. The owner's profitability analysis provides insight into a recycler's profitability, which have implications to both overall costs and recycler survivability. One finding is that owner's wages as a percent of total CRV costs have decreased from 31 to 24 percent from 2018 to 2020 for all RC's (a 22 percent reduction in the share of costs attributed to owners), with most of the decrease attributed to the significant decrease in owner's wages for stratum 3 recyclers.

- Analyzed CRV transportation costs to gain a better understanding of how transportation impacted the changes in cost per ton between 2018 to 2020. Transportation decreased in 2020 but was still one of the larger contributors to overall CRV costs.
- Evaluated the effects of COVID-19 on recyclers. Recyclers experienced a range of effects due to the COVID-19 pandemic. Approximately two-thirds of the 146 PF recyclers surveyed identified COVID-19 impacts to their business in 2020, including: shutdowns, shortened hours, fewer employees, and need for additional supplies. As in all aspects of social and economic life, 2020 was an unusual year for recyclers.
- Conducted a detailed analysis of the impacts of changes in scrap prices on recycler's overall revenues. Aluminum and plastic scrap prices experienced dramatic declines in 2020, negatively affecting recycler profitability. Scrap prices in 2021 increased such that recyclers, on average, were profitable. That said, scrap prices and processing payments are lagged over time; a recycler that suffered losses in 2020 may take time to return to full profitability, even if on paper scrap prices have recovered.
- Analyzed the use of wage and transportation adjustment factors, in addition to COLA, on cost per ton. Crowe evaluated the use of category-specific adjustment factors (percent change in minimum wage and a fuel index) to supplement the COLA adjustment to cost per ton. These specific adjustments result in a 12.36 percent adjustment to costs, as compared to the 5.1 percent COLA adjustment.

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 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, 2022, per ton processing payments, and per container processing fees. As compared to the 2021 processing payments, the new 2022 processing payments represent a significant decline for PET #1 and HDPE #2. The reduction in PET #1 cost per ton is one factor in that reduced payment; however, the significant increase in plastic scrap prices over the last year is the primary reason that the 2022 processing payment is lower.

Exhibit ES-8
Processing Payments and Processing Fees
January 1, 2022

Material Type	Processing Payment (per Ton)	Processing Fee (per Container)
1. Aluminum	None	None
2. Glass	$165.32	$0.00426
3. PET #1	265.58	0.00045
4. HDPE #2	615.27	0.00574
5. Bi-Metal	1,609.73	0.05393
6. PVC #3	2,296.17	0.01794
7. LDPE #4	2,048.81	0.06109
8. PP #5	1,266.52	0.00385
9. PS #6	1,395.28	0.14628
10. Other #7	1,289.09	0.05371

G. Summary of Results

Overall, the change in cost per ton between 2018 and 2020 was significant. The analyses identify a combination of factors that may be impacting recycling costs. The cost per ton for aluminum and PET #1 decreased, as compared to 2018. The cost per ton for glass and HDPE #2 increased, as compared to 2018. Many factors combine to influence recycling center costs, tons, and cost per ton, both upward and downward.

Cost per ton is the quotient determined by dividing recycling center costs (numerator) by recycling center tons (denominator). Because costs and tons for the surveyed PF recycling centers can each increase, decrease, or not change between subsequent cost surveys, and because these changes can differ in their rate of change, causes for changes in cost per ton over time are complex. In addition, because the cost per ton calculation is a statewide, weighted average, based on a stratified sample, changes within the population of recycling centers can also influence cost per ton results.

Between 2018 and 2020 there was a reduction in the overall survey population of PF recycling centers, and to a lesser extent, a decrease in the total tons of CRV material recycled. This combination alone could suggest a possible decrease in cost per ton between 2018 and 2020. The analysis of 2018 and 2020 cost survey data identifies six factors appear to have that contributed to changes in costs per ton between 2018 and 2020. The six factors are:

- The average number of tons per recyclers increased significantly while average costs per recycler were either flat or decreased. The average number of tons per recycler for aluminum increased by 13.2 percent and PET #1 increased 10.8 percent while average costs per recycler did not change for aluminum and decreased 9 percent for PET #1. In general, higher volume recyclers are more efficient and have lower costs per ton. Increasing the amount of material moving through a recycler means workers are more productive, handling more tons per hour. This increased efficiency and ultimately contributes to overall lower costs per ton.
- The proportion of surveyed recycling centers with average hourly wages below minimum wage roughly doubled, which was likely due to a higher percentage of owners making low to no profit as sole proprietors and partnerships. Lower wages contribute to lower recycling costs.
- The 13 percent decrease in diesel fuel prices between 2018 and 2020 contributed to lower transportation costs, which contributed to lower overall costs (note: changes in scrap value deduction did not contribute to lower costs since it decreased between 2018 and 2020; also, the changes in hauling method did not contribute to lower costs).
- The proportion of small stratum 3 recyclers slightly decreased when using 2020 strata definitions, which indicates the recycler population as a whole is shifting to lower cost, strata 1 and 2, recyclers.
- The proportion of owner's CRV wages (owner income/profitability) of total CRV costs decreased from 31 to 24 percent between 2018 and 2020.[2] Lower proportion of owner profitability would contribute to lower costs.
- For glass and HDPE #2, average tons per recycler were steady (glass), or decreased slightly (HDPE). This is likely the largest contributor to the increase in costs per ton for these materials. The increased costs per ton for glass and HDPE #2 likely reflect general operating cost increases between 2018 and 2020 – increases that were counteracted by higher volumes per recycler for aluminum and PET #1.

[2] Comparison made for recyclers with available owner's income data only, which was 80 of 154 sampled recyclers for 2018, and 101 of 146 sampled recyclers for 2020.

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*
J. *Cost Survey Methodology Validation.*

A. Survey Design

Crowe LLP (Crowe) personnel, for the tenth time, developed the survey design for the cost survey. Crowe generally utilized the survey design methodology developed for the previous cost survey.

Crowe followed processing fee and handling fee cost survey procedures consistent with the nine prior cost surveys. While Crowe further revised the training approach for this 2020 cost survey and updated strata parameters, the fundamentals of conducting the cost survey remain consistent. Costs per ton for aluminum and PET #1 in 2020 decreased and show low error rates (between 5.4 percent and 6.0 percent). Cost per ton of glass and HDPE #2 increased in 2020, similarly showing low error rates (between 7.9 percent and 8.4 percent). Aluminum, glass, PET #1, and HDPE #2 cost per ton results follow a similar normal distribution to prior years.

This processing fee cost survey was used to estimate California statewide, weighted average, 2020 certified recycler cost per ton, for four beverage container material types, and the percent change in HDPE #2 cost per ton between 2018 and 2020. Recycler center costs were surveyed and analyzed in 2021 (late-April through late-October), using recycler center calendar year 2020 financial statements. Recycler center costs measured by this survey were used for the processing fee calculation, effective January 1, 2022.

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 2020 and December 2020, (2) certified and operational on or before March 1, 2020, (3) reported redemption volume between January 2020 and December 2020, (4) not subsidized by the Department of Rehabilitation, and (5) not subject to CalRecycle investigation for major infractions. There were 30 sites removed from the population due to investigations, leaving 581 recycling centers in this total traditional recycling center population.

This overall 2020 processing fee cost survey had a similar sample size to the most recent processing fee cost surveys (2020: 146 unique sites, 2018: 154 unique sites, 2016: 143 unique sites). The Crowe team completed 146 recycler cost surveys during April 2021 through October 2021 to obtain these cost survey results. These 146 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 146 recyclers were treated equally in terms of scheduling, site visits, and quality control. Since the passage of Senate Bill 1357 (SB 1357, Padilla, Chapter 697, Statutes of 2008) CalRecycle has not determined costs per ton for all ten beverage container material types. Rather, CalRecycle adjusts 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 2020, HDPE #2 made up 0.45 percent of all beverage containers recycled. Bi-metal and plastics #3 through #7 made up between 0.00001 percent and 0.2 percent of containers recycled.

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 survey population was divided into three strata, based on PET volume, as shown in **Exhibit 1-1.**

Exhibit 1-1
Strata Definitions for Processing Fee Recyclers (2020)

Strata	Annual PET Volume
1	Greater than, or equal to, 400 tons
2	Greater than, or equal to 200 tons, and less than 400 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 2018 survey plastic strata definition. To evaluate the impact of this change, Crowe recalculated the 2018 survey costs per ton using the 2021 strata definitions, shifting strata thresholds up by 50 tons. These changes reflect the higher volumes per site seen in 2020 as compared to 2018.

This slight change in strata definitions results in the largest share of recyclers and largest proportion of volumes for the small, stratum 3, recyclers. This set of strata definitions weights small recyclers slightly more than the other three strata definitions. Broadly, Stratum 3 recyclers tend to have the highest average costs per ton.

Sample Design Results

Exhibit 1-2 provides the 2020 sample error rates for each relevant material type. In 2020, 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 2020 were consistent with the low error rates for each of the four materials over the last nine 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 (2002 through 2020)

Material Type	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**5.80%**	7.52%	6.71%	5.86%	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass	**7.91%**	6.88%	7.80%	6.49%	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1	**5.29%**	7.40%	6.11%	6.23%	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2	**8.29%**	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	N/A	6.89%	8.31%	9.83%	7.57%
6. PVC #3	N/A	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	N/A	100% Sample	100% Sample	100% Sample	100% Sample
8. PP #5	N/A	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	N/A	100% Sample	100% Sample	100% Sample	100% Sample
10. Other #7	N/A	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 (2020)

Material Type	2020 Sample Size	2020 Sample Method
1. Aluminum	146	Stratified Random Sample
2. Glass	142	Stratified Random Sample
3. PET #1	46	Stratified Random Sample
4. HDPE #2	138	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 consisted of 238 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.

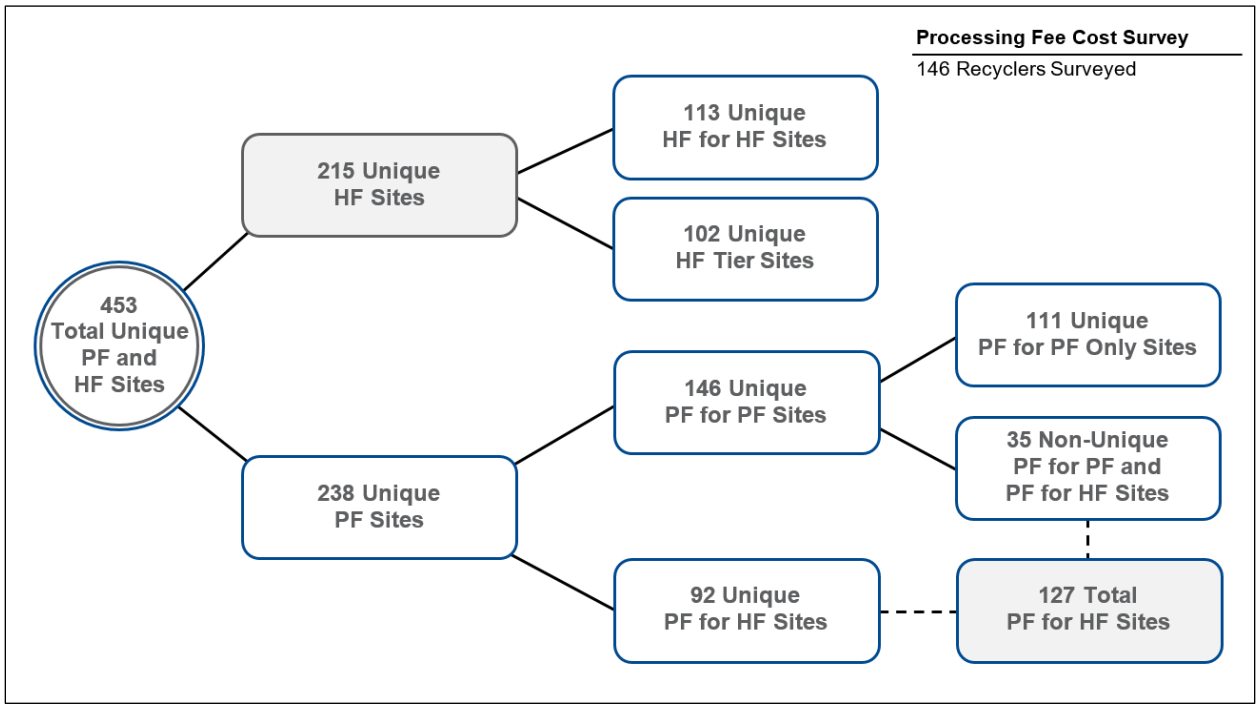
For this 2020 cost survey, there were a significant number of processing fee recycling centers that closed during 2020 or in 2021 prior to the survey site visit. When possible, Crowe surveyed sites that had closed, meeting with the site owner to obtain the required financial and labor information. However, 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 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 238 processing fee and 113 handling fee recyclers. The final 238 processing fee recyclers included 146 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. The team surveyed an additional 102 handling fee sites for a tiered handling fee cost analysis, increasing the total number of unique HF sites to 215 and total unique PF and HF sites to 453.

Exhibit 1-4
Processing Fee and Handling Fee Cost Survey Sample (2020)



Note: 35 PF sites within the 146 also were within the handling fee (HF) cost survey (PF for HF sites), for a total 127 (92 + 35) 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 December) 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. Crowe's approach was to communicate with site operators and managers from the start of the process to help them understand what the cost survey entailed, the information sought, 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 2021. In the second stage of communication, a Crowe scheduling coordinator established telephone contact with the recyclers to schedule site visits. In addition to the call, the scheduler typically sent a confirmation email to recyclers.

The survey team contacted the recycler directly approximately one week before the site visit for final visit confirmation. Site visits were generally conducted by a team of two surveyors, including accountants and/or recycling experts. Each survey team 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 17 site survey team personnel, diverse geographic locations, and availability of the recycling centers. During any given week, up to four 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 the 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, each company contractor – Crowe LLP (Prime Contractor); Geiss Consulting (Subcontractor); Encina Advisors, LLC (Subcontractor); Boisson Consulting (Subcontractor); and Bohica Advisors LLC (Disabled Veteran Business Enterprise Subcontractor) also signed company Confidentiality Agreements.

C. Training Manual Updates

The first *Processing Fee Cost Survey Training Participant Manual* was prepared by NewPoint Group in 1995 to support the cost survey training provided to (then) Division of Recycling (DOR) staff. This manual contained hundreds of example case studies, problem sets, quizzes, sample financial documents, handouts, reading assignments, and procedures to develop skills needed to conduct successful processing fee cost surveys. Because the training manual was originally prepared in 1995, it required extensive revisions and adjustments.

For the 2015 cost survey, Crowe evaluated the entire 700-page training manual used in prior years, removing outdated and duplicative information. Crowe identified 17 training modules for revision, developing learning objectives and interactive exercises for each. Subsequently, Crowe performed several iterative updates, including streamlining the manual to ten chapters, each emphasizing actions for survey team members to take in the field and when completing site files. The updated training modules also reflected the change to the file assembly and review process from a manual, paper-based process to a secure online, SharePoint-based process. Crowe also developed and refined new PowerPoint presentations covering topics in the Training Manual.

For the current cost survey, Crowe continued to update and revise the training manual and training materials. The 2021 training manual updates included new COVID protocols. Crowe also performed a significant overhaul of the training materials, in response to shifting from classroom training to a 100 percent virtual training environment.

The virtual presentations include recycling center news videos, training videos, recycler case studies, quizzes, demonstrations, and activities specific to each presented topic. This shift to a virtual learning environment also included moving to half-day online training sessions from the previous full day in person sessions, and redefining training topics and goals for each session. Crowe created new work assignments and interactive exercises as part of the training update.

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)

The training manuals, provided to CalRecycle as one of the project soft copy reports, 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.

Roughly two-thirds of the individuals who conducted site visits for this survey had experience in the previous processing fee cost surveys 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 a 16-hour virtual training course in 2021.The new survey team members completed the full 32-hour virtual training program and participated in field training.

Following the first six half-days of remote classroom training, each new survey team member conducted a cost survey site visit with a highly experienced team member 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 visit. Following the field visits, new survey members spent time working together to complete the site; with the experienced surveyor providing guidance and oversight. 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 the remote classroom component of the training, Crowe prepared and presented multi-media presentations for each training module, including training videos and PowerPoint presentations. A significant segment of the training sessions was spent on hands-on activities and preparing three site files (simple, moderate, complex) using data from prior cost surveys. 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 remote 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 17 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 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 each cost survey. Prior to conducting the current cost survey, Crowe reviewed and updated the cost model to reflect 2020 container per pound and CRV payment information, as well as procedural changes to the cost survey. Crowe added fields in the model's Direct Cost Worksheet to streamline surveyor entered costs directed to a subset of material types for commonly occurring cost allocations. The model also included added quality control indicators.

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 2020 cost survey, Crowe 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 subsequent cost surveys. In addition, Crowe calibrated the Indirect Cost Allocation Sub-Models for Aluminum/Bi-Metal and All-Plastics with 2020 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/material handling factors (weight of containers, number of containers, volume (size) of containers, and commingled rate), along with a weighting allocation across these factors, form 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 and 2018 cost surveys, 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. 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 site.

At any point in time during the surveys, the Crowe Project Manager 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 (2020)

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	• 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 2020 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 site. 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. In response to the COVID-19 pandemic, the survey team followed State and local COVID guidance while traveling and during on-site visits.

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 and/or email 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 11.5 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 QC 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 QC 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 QC 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 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 Crowe 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.

J. Cost Survey Methodology Validation

Crowe conducted additional analyses 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, Crowe concludes that the methodology is consistent with prior years. Crowe is confident that that based on the methodology required by law, the cost per ton results consistently reflects recycler operations and costs.

Distribution of Cost per Ton Results

Crowe evaluated the distribution of 2020 cost per ton results. The assumption was that if the cost survey was conducted without bias, one would expect a generally “right skewed” normal distribution of cost per ton results from the 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 1-6 through **1-9** 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 and PET #1, $200 increments in HDPE #2, and in $25 increments for glass. Note that the range for each horizontal bar is represents an “up-to” amount; for example, the $200 bar represents from $100.01 to $200.

Exhibit 1-6
2020 Sampled Processing Fee Recyclers, Distribution of Aluminum Cost per Ton

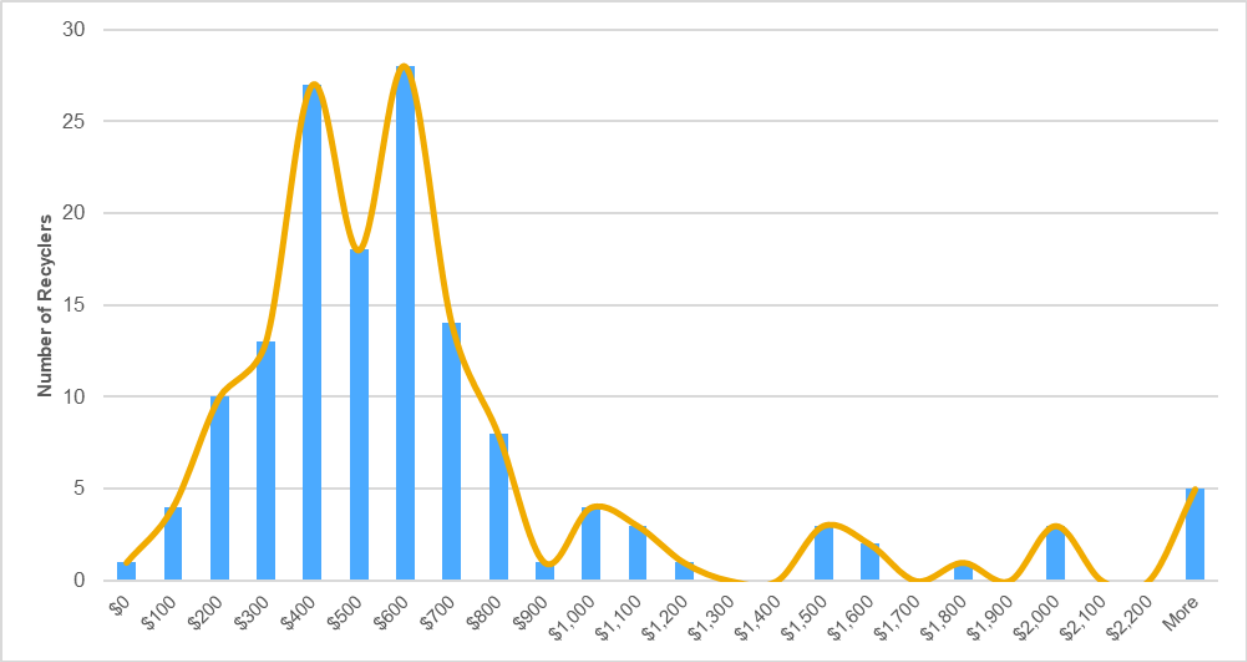


Exhibit 1-7
2020 Sampled Processing Fee Recyclers, Distribution of Glass Cost per Ton

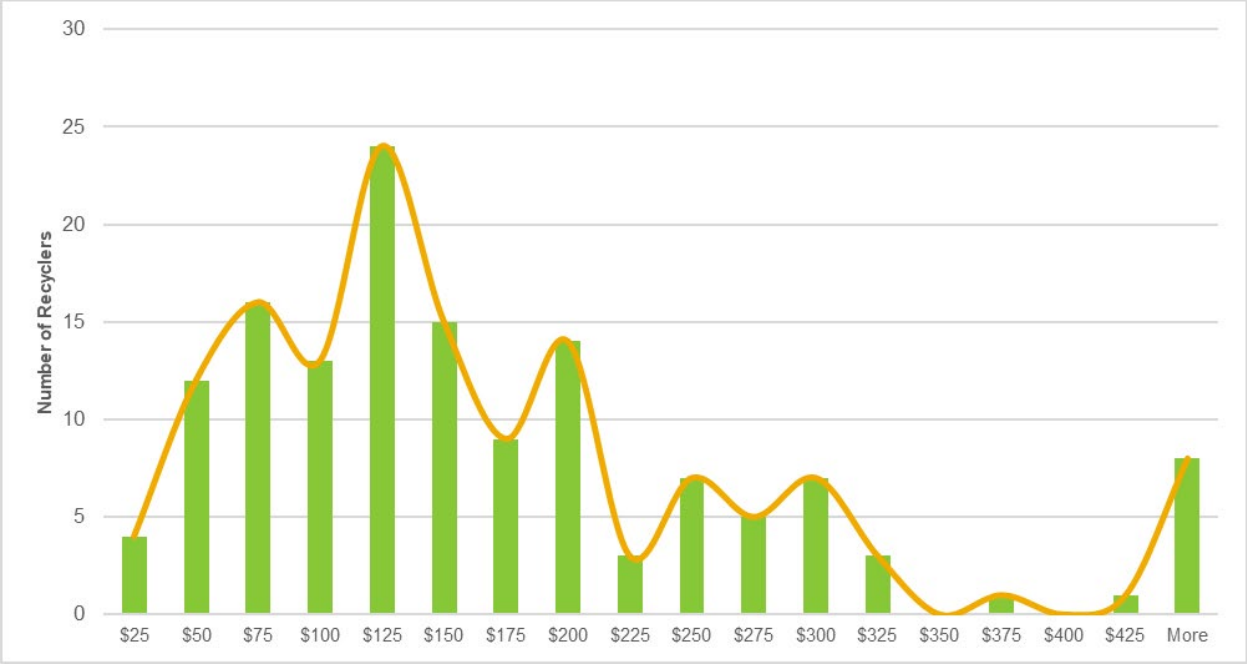


Exhibit 1-8
2020 Sampled Processing Fee Recyclers, Distribution of PET #1 Cost per Ton

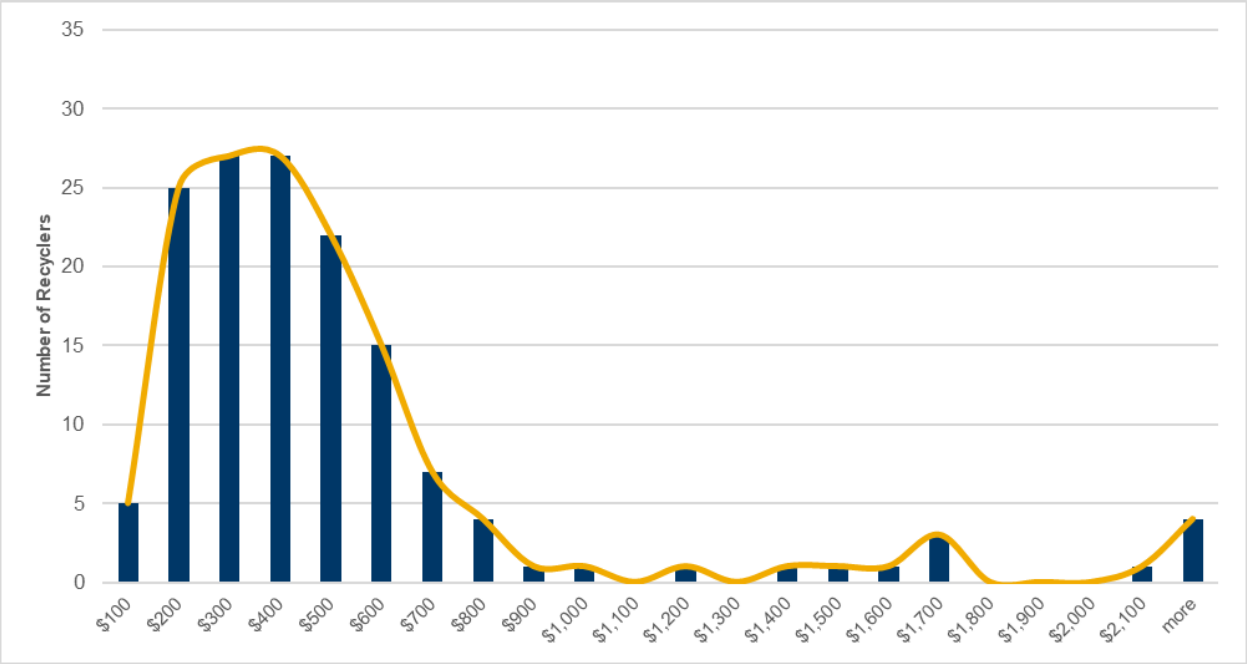
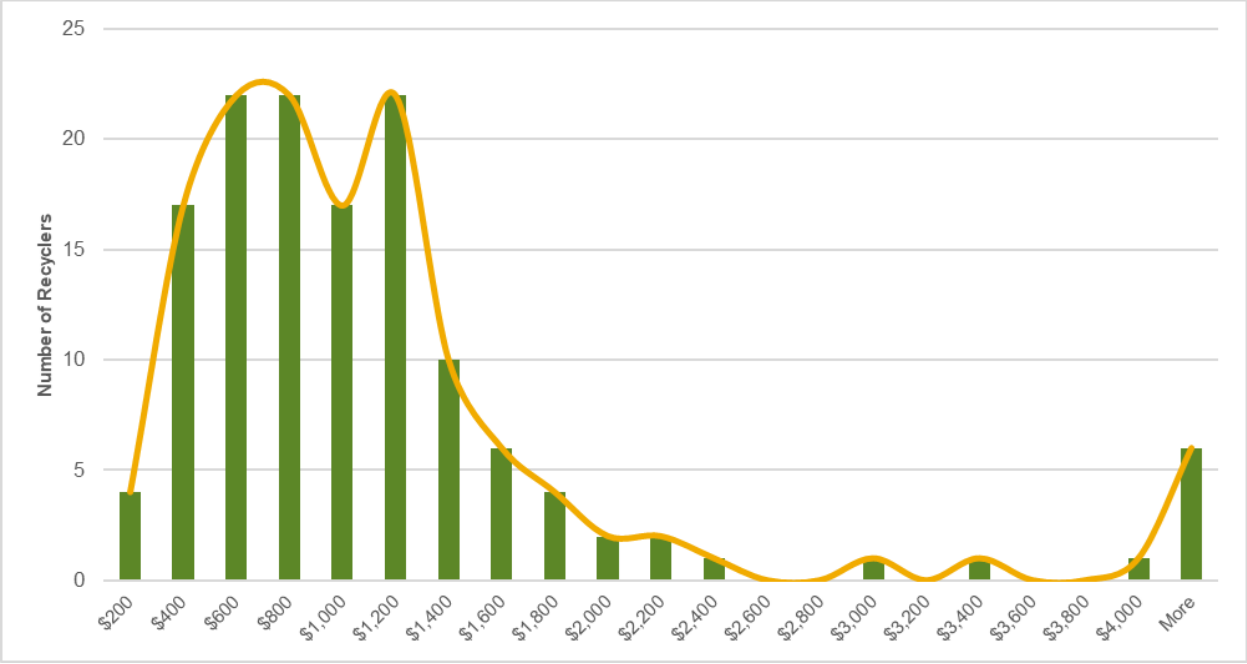


Exhibit 1-9
2020 Sampled Processing Fee Recyclers, Distribution of HDPE #2 Cost per Ton



The histograms demonstrate extremely consistent distributions among all four material types. In addition, these histograms are consistent as compared to the frequency histograms from the four prior cost surveys, 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 is some actual, baseline amount of 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.

Three of the four histograms also show 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, Crowe evaluated whether this could be a bimodal distribution. Crowe 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.

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 2018 survey plastic strata definition. To evaluate the impact of the revised strata definitions, Crowe recalculated the 2018 survey costs per ton using the 2021 strata definitions, shifting PET strata cutoffs upward by 50 tons.

This slight change in strata definitions results in the largest share of recyclers and largest proportion of volumes for the small, stratum 3, recyclers. This set of strata definitions weights small recyclers slightly more than the other three strata definitions. Broadly, Stratum 3 recyclers tend to have the highest average costs per ton.

Investigated Recycling Centers Removed from the Full Population and Sample

For the current 2020 cost survey, Crowe removed recycling centers (RCs) subject to investigation by CalRecycle for significant infractions from the population and the survey sample. For the 2012 survey, Crowe 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, Crowe 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 personnel recommended removing only the RCs being investigated for major violations from the population and the sample. Crowe personnel reasoned that removing only major investigated RCs from the full population would eliminate potential site visits to RCs that might be in an adversarial relationship 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.

Exhibit 1-10 provides the removed investigated sites for each survey. This includes the identification and removal of 30 sites for this 2020 processing fee cost survey, resulting in a processing fee recycler population of 581.

Exhibit 1-10
Recycler Population and Investigated Sites Between 2012 and 2020

Cost Survey Year	2012	2014	2016	2018	2020
Full Population	1,032	995	785	705	611
Investigated Sites	269	42	7	31	30
PF Recycler Population	763	953	778	674	581
% of Full Population	26%	4%	1%	4%	5%
% of Materials Recycled	N/A	9%	1%	4%	5%

Note: The 2012 cost survey population determination included removal of all 269 investigated recyclers. In subsequent years, the processing fee recycler population only includes a removal of major investigated recycling centers.

2. Processing Fee Cost Calculations and Results

This section describes the calculations used, and the 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*
C. *Historical Trends in Cost per Ton Results*
D. *Comparison of 2002-2020 Cost per Ton Results for Aluminum, Glass, PET #1, and HDPE #2*
E. *Cost per Ton Results for Six Minority Material Types*

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.[3] For this 2020 processing fee cost survey, Crowe LLP (Crowe) utilized only one type of sample design, a stratified random sample based on tons of PET recycled.

For the stratified random sample, Crowe used a weighted average by strata calculation to determine cost per ton. Crowe 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 2018 and 2020 cost surveys. **Exhibit 2-1** illustrates the two calculation approaches used for determining processing fee recycler costs per ton for ten beverage container material types.

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

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

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 2018 ($838.00) and 2020 ($885.21):

$$\text{Percent change} = \frac{\$885.21 - \$838.00}{\$838.00} = \frac{\$47.21}{\$838.00} = +5.63\%$$

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

2018 cost per ton + (2018 cost per ton × +5.63%)

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

Most recyclers in the total population accept and recycle these four material types.[4] As a result, for these materials, Crowe used a weighted (by strata) average statewide cost per ton. There were 146 recyclers in the random sample, divided into three strata. Within each of the three sample strata, Crowe determined the total sample costs and the total sample tons. CalRecycle provided the 2020 tons data for both the sample and population. The next step was to calculate the average cost per ton by strata, equal to the sample strata cost divided by the sample strata tons. Next, multiplied this figure by the strata population tons, to determine the total population costs for each stratum, for each material type. Lastly, determined the statewide, weighted-average cost per ton by summing the three strata total population costs, then dividing by the total population tons. The approach is illustrated in **Exhibit 2-1A**. **Exhibit 2-2** 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 2020 cost survey was the sixth 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 (SB 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). Therefore, the cost per ton to recycle bi-metal and plastics #3 to #7 was based on the calculated 5.6% percent change in HDPE #2 costs per ton between 2018 and 2020. For the 2020 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 1.056 times the respective minority material cost per ton measured in 2018. The approach is illustrated in **Exhibit 2-1B**.

[4] 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.

Exhibit 2-2
Example Calculation of 2020 Statewide, Weighted-Average Cost per Ton for Glass

Strata	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton[5]
1	24,998.66	$ 3,103,494.27	$124.15
2	18,598.08	2,416,076.57	129.91
3	17,488.45	2,663,718.27	152.31
Sample Total	61,085.19	$8,183,289.11	$133.97

Strata[6]	Population Glass Tons	Population Glass Cost	Population Cost per Ton
1	54,075.58	$6,713,483.10	n/a
2	68,518.50	8,901,238.34	n/a
3	73,678.44	11,221,963.56	n/a
Sample Total	196,272.52	$26,836,685.00	$136.73[7]

Financial Return

The Beverage Container Recycling and Litter Reduction Act, California Public Resources Code, Division 12.1, Chapter 4, Section 14575(b)(2) specifies "a reasonable financial return for recyclers" (RFR) 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 the California Code of Regulations, Title 14, Division 2, Chapter 5, Section 2975, the RFR applied to the cost of recycling for the January 1, 2022, processing payment and processing fee calculations was ten percent.

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

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

[7] A statewide, weighted-average result of $136.73 per ton, calculated by dividing total population glass costs by total population glass tons.

The cost to recycle used to determine processing fees and processing payments for January 1, 2022, included a COLA of 5.1 percent. This was the fifth time that CalRecycle has utilized a COLA in the cost of recycling calculation. The COLA adjustment was a mechanism to account for the fact that the 2020 cost data was already over a year old when the processing fees and processing payments went into effect on January 1, 2022.

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 2020 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 (2020)

Material	Cost per Ton without Financial Return	Cost per Ton with Financial Return and COLA	N = Sample Number of Sites
1. Aluminum	$569.76	$658.70	146
2. Glass	136.73	158.07	142
3. PET #1	446.34	516.01	146
4. HDPE #2	885.21	1,023.40	138
5. Bi-Metal	1,115.82	1,290.00	N/A
6. PVC #3	1,392.39	1,609.74	N/A
7. LDPE #4	1,986.37	2,296.44	N/A
8. PP #5	1,782.04	2,060.21	N/A
9. PS #6	1,103.82	1,276.12	N/A
10. Other #7	1,209.41	1,398.20	N/A

Note: The reasonable financial return (RFR) is 10% and the COLA is 5.1%. Overall, 146 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 (2020)

Stratum 1 – High PET #1 Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 1 Total Costs
Aluminum	$4,183,226.47	9,061.62	20,855.56	$9,627,761.32
Glass	3,103,494.27	24,998.66	54,075.58	6,713,483.10
PET #1	5,603,265.48	14,617.00	33,666.12	12,905,570.65
HDPE #2	308,081.71	334.54	673.93	620,619.74

Stratum 2 – Medium PET #1 Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 2 Total Costs
Aluminum	$3,674,068.55	6,590.41	21,200.56	$11,819,100.92
Glass	2,416,064.01	18,598.08	68,518.50	8,901,237.83
PET #1	4,513,941.69	10,941.64	35,696.60	14,726,633.38
HDPE #2	344,864.75	426.28	1,300.81	1,052,379.08

Stratum 3 – Low PET #1 Tons

Material Type	Sample Costs	Sample Tons	Population Tons	Stratum 2 Total Costs
Aluminum	$3,629,417.93	5,346.21	23,047.50	$15,646,483.78
Glass	2,663,718.27	17,488.45	73,678.44	11,221,963.56
PET #1	4,250,597.19	7,794.18	33,600.11	18,324,157.52
HDPE #2	280,179.10	292.45	1,030.35	987,125.72

Combined Population Strata

Material Type	Population Costs	Population Tons	Statewide Cost per Ton
Aluminum	$37,093,346.02	65,103.62	**$569.76**
Glass	26,836,684.49	196,272.52	**136.73**
PET #1	45,956,361.55	102,962.84	**446.34**
HDPE #2	2,660,124.54	3,005.08	**885.21**

Minority Materials

Material Type	2018 Cost/Ton	5.63% Increase	2020 Cost/Ton
PVC #3	$1,318.18	$74.21	$1,392.39
LDPE #4	1,880.50	105.87	1,986.37
PP #5	1,687.06	94.98	1,782.04
PS #6	1,044.99	58.83	1,103.82
Other #7	1,144.95	64.46	1,209.41
Bi-Metal	1,056.35	59.47	1,115.82

Error Rates and Confidence Intervals for Costs per Ton

The California Beverage Container Recycling and Litter Reduction Act (AB 2020, Margolin, Chapter 1290), California Public Resources Code, Division 12.1, Chapter 4, Section 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 (California Code of Regulations (CCR), Title 14, Division 2, Chapter 5, section 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 CI and then add oversample, it would be more statistically accurate to set the CI higher, at 90 percent. The sample size was developed based on 2018 cost survey results. Only after the survey was complete could it be determined whether the actual specifications of a 90 percent CI and the target of a 10 percent error rate were met.

The analysis of the final data shows for the tenth time, the processing fee cost survey met and exceeded all prior statistical requirements (the 2002–2018 surveys of recycler also met and exceeded these requirements). In all cases the error rate was below 10 percent. The error rate at the 90 percent CI for each of the four relevant materials is provided in **Exhibit 2-5.** For comparison, Exhibit 2-5 also provides the error rates at the 90 percent CI for each of the four (or five or six) relevant material types from the 2002–2018 processing fee cost surveys.[8]

The 2020 cost survey generally achieved a similar high degree of statistical confidence as the nine previous cost surveys. This degree of accuracy reflects the deep 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.

---

[8] The bi-metal error rate at the 90 percent CI 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 the team utilized a random sample (rather than a census) for Other #7, and thus the first time that the team calculated error rates for this plastic resin. The team again utilized a random sample for Other #7 in the 2008 cost survey. For the 2010, 2012, 2014, 2016, 2018, and 2020 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
Sample Error Rates for Processing Fee Recyclers, by Material Type (2002 through 2020)

Material Type	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**5.80%**	7.52%	6.71%	5.86%	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass	**7.91%**	6.88%	7.80%	6.49%	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1	**5.29%**	7.40%	6.11%	6.23%	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2	**8.29%**	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	N/A	6.89%	8.31%	9.83%	7.57%
6. PVC #3	N/A	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	N/A	100% Sample	100% Sample	100% Sample	100% Sample
8. PP #5	N/A	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	N/A	100% Sample	100% Sample	100% Sample	100% Sample
10. Other #7	N/A	N/A	N/A	N/A	N/A	N/A	9.53%	9.95%	100% Sample	100% Sample

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. Finally, in 2020, HDPE #2 cost per ton increased by 5.63 percent.

Exhibit 2-6 provides a summary comparison of the number of surveyed sites for each material type for the cost surveys from 2002-2020. The stratified random sample for this 2020 processing fee cost survey was slightly lower than the prior cost survey.

Exhibit 2-6
Summary Comparison of Number of Surveyed Sites for Processing Fee Recyclers (2002-2020)

Material Type	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	146	154	143	151	151	129	116	123	117	136
2. Glass	142	152	137	151	147	128	112	121	115	131
3. PET #1	146	153	140	151	148	129	115	122	115	132
4. HDPE #2	138	150	136	146	144	127	110	118	108	119
5. Bi-Metal	N/A	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	N/A	11	12	14	23
7. LDPE #4	N/A	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	N/A	21	14	12	11
9. PS #6	N/A	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	N/A	40	40	67	49

C. 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 35 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 2-7 provides the historical cost per ton results for all nineteen years in which recycler cost surveys were conducted.

Exhibit 2-8 provides the cost per ton results from 2002 to 2020. These costs per ton reflect actual dollar values for the years in which they were determined and thus have not been adjusted for inflation. As compared to 2018, the 2020 cost per ton results for aluminum decreased 9 percent, glass increased 3 percent, PET #1 decreased 11 percent, and HDPE increased 6 percent. As compared to 2018 recycling volumes, the 2020 recycling volumes for aluminum decreased 2 percent, glass decreased 15 percent, PET #1 decreased 5 percent, and HDPE decreased 21 percent.

Exhibit 2-9 provides a comparison of CPI-adjusted costs per ton from 2002 to 2020 for aluminum, glass, PET #1, and HDPE #2 using the U.S. Department of Labor, Bureau of Labor Statistics, West Urban Consumer Price Index (CPI).[9]

[9] Source: http://www.dof.ca.gov/Forecasting/Economics/Indicators/Inflation/

Exhibit 2-7
Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton (1987 through 2020)

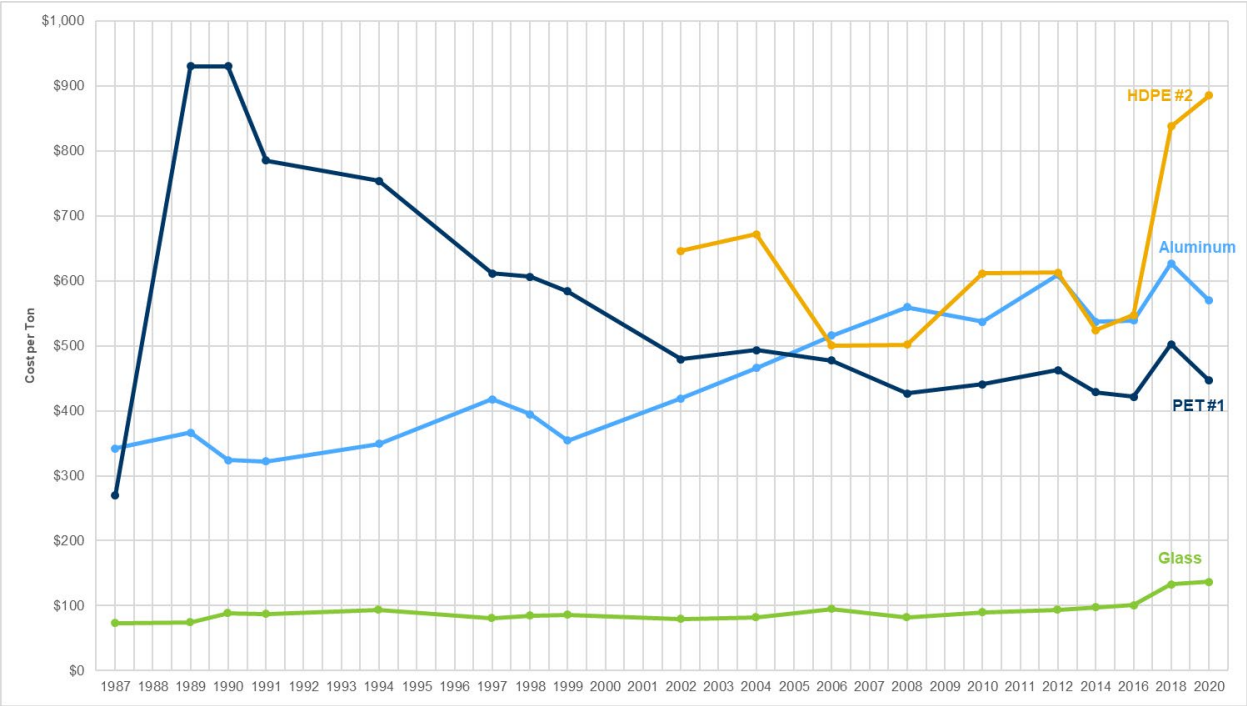
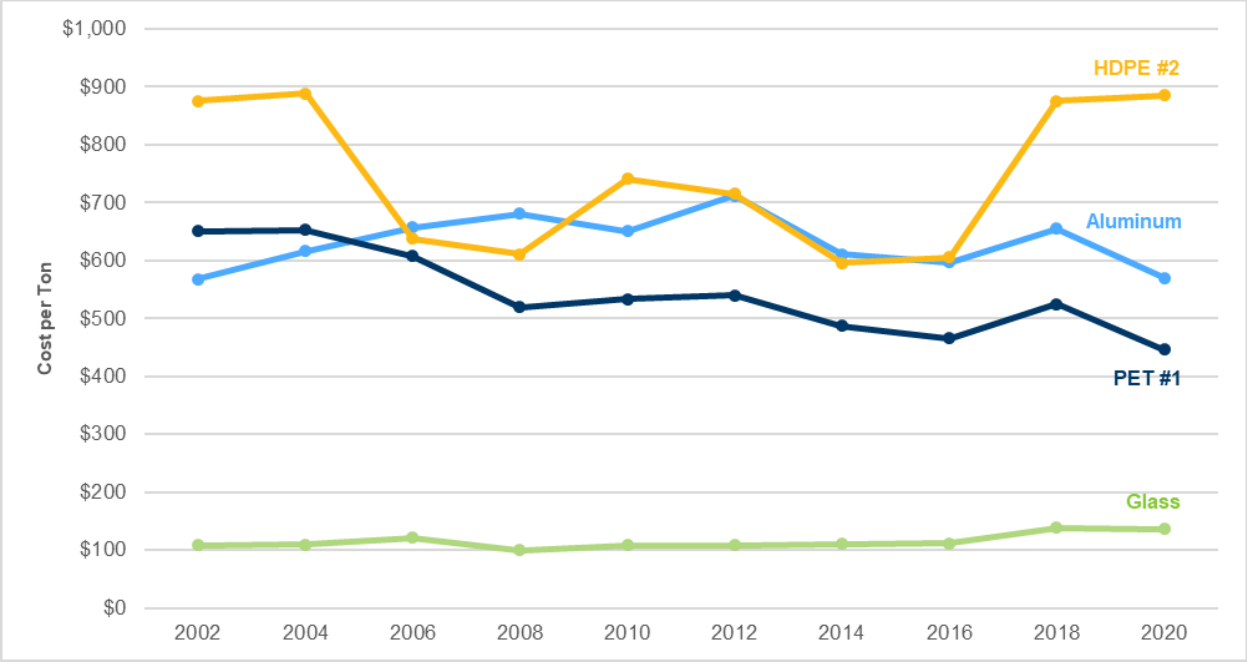


Exhibit 2-8
Historical Statewide Costs per Ton (Without Reasonable Financial Return) (2002 through 2020)

Material Type	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**$569.76**	$626.61	$539.11	$537.29	$609.81	$537.06	$559.23	$516.13	$465.90	$418.95
2. Glass	**136.73**	132.68	101.04	97.50	92.88	89.76	81.60	94.98	82.45	79.81
3. PET #1	**446.34**	502.44	421.30	428.55	462.79	440.61	426.76	477.73	493.31	479.63
4. HDPE #2	**885.21**	838.00	547.11	524.23	612.50	611.62	501.67	500.64	671.73	645.91
5. Bi-Metal	**1,115.82**	1,056.35	689.66	660.65	771.88	770.80	632.22	883.55	607.03	508.18
6. PVC #3	**1,392.39**	1,318.18	860.60	824.65	963.49	962.14	789.16	731.37	1,583.72	1,064.52
7. LDPE #4	**1,986.37**	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	**1,782.04**	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	**1,103.82**	1,044.99	682.24	653.74	763.80	762.73	625.60	623.11	3,051.82	6,137.30
10. Other #7	**1,209.41**	1,144.95	747.50	716.27	836.86	835.69	685.44	741.93	1,264.47	759.32

Exhibit 2-9
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002 through 2020)



Aluminum

The aluminum cost per ton results decreased roughly 9 percent from $626.61 cost per ton in 2018 to $569.76 cost per ton in 2020. In 2020, the processing fee recycler population recycled 65,104 tons of aluminum down from 66,714 tons recycled in 2018. 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 2020 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 previous survey years. However, the decrease in the cost per ton to recycle aluminum coupled with volatile scrap market conditions in 2020 indicate a decline in potential profits from aluminum for recyclers. In 2020, aluminum made up nearly 18 percent of tons of CRV material recycled by the population, roughly a 1.5 percentage point increase from 2018.

Glass

The glass cost per ton results increased 3 percent from $132.68 cost per ton in 2018 to $136.73 cost per ton in 2020. The results reflect a continued trend of increased glass costs since 2008, resulting in a cost per ton over $100 for the third time. In 2020, total glass volumes, at 196,273 tons, were lower compared to all the other survey years. Glass volumes continued to decline between 2018 to 2020, compared to the stabilized levels between 2014 and 2016, following a large decrease between 2012 and 2014. Average tons of recycled glass per recycler slightly decreased from 342 tons in 2018 to 337 tons in 2020. In 2020, glass made up its lowest historical percent share of CRV material recycled at 53 percent. In 2018, glass made up 56 percent of tons of CRV material recycled, compared to a high of 68 percent in 2002.

PET #1

The PET #1 cost per ton results decreased 11 percent from $502.44 cost per ton in 2018 to $446.34 cost per ton in 2020. For PET #1, the costs have generally fluctuated year to year within a relatively narrow band (e.g., from its lowest $421 per ton in 2016 to its highest $502 per ton in 2018). Tons of PET #1 recycled decreased 5 percent from 2018 to 2020. On a per-recycler basis, average tons recycled per year increased to the highest level yet, from approximately 107 tons in 2012 and 2014, 160 tons in 2018, to 177 tons in 2020. In 2020, PET #1 made up its greatest share of CRV materials recycled, at 28 percent, an increase of two percentage points from 2018.

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 became a mainstream, established business. The historical decline of PET #1 cost per ton also is likely due to significant increases in tons recycled. The 2020 PET #1 cost per ton results are slightly lower than the average of all the cost per ton results from combined surveys (2002 to 2020 average is $457 cost per ton).

HDPE #2

The HDPE #2 cost per ton results increased 5.6 percent from $838 cost per ton 2018 to $885 cost per ton in 2020. In 2018, 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 continuing to increase HDPE costs per ton is that HDPE overall volumes and tons per recycler both decreased in 2020. Tons of HDPE #2 declined 21 percent between 2016 and 2018, the lowest level since 2002. Tons of HDPE #2 continued to decline, by 11 percent, from 2018 to 2020.

Bi-Metal and Plastics #3 to #7

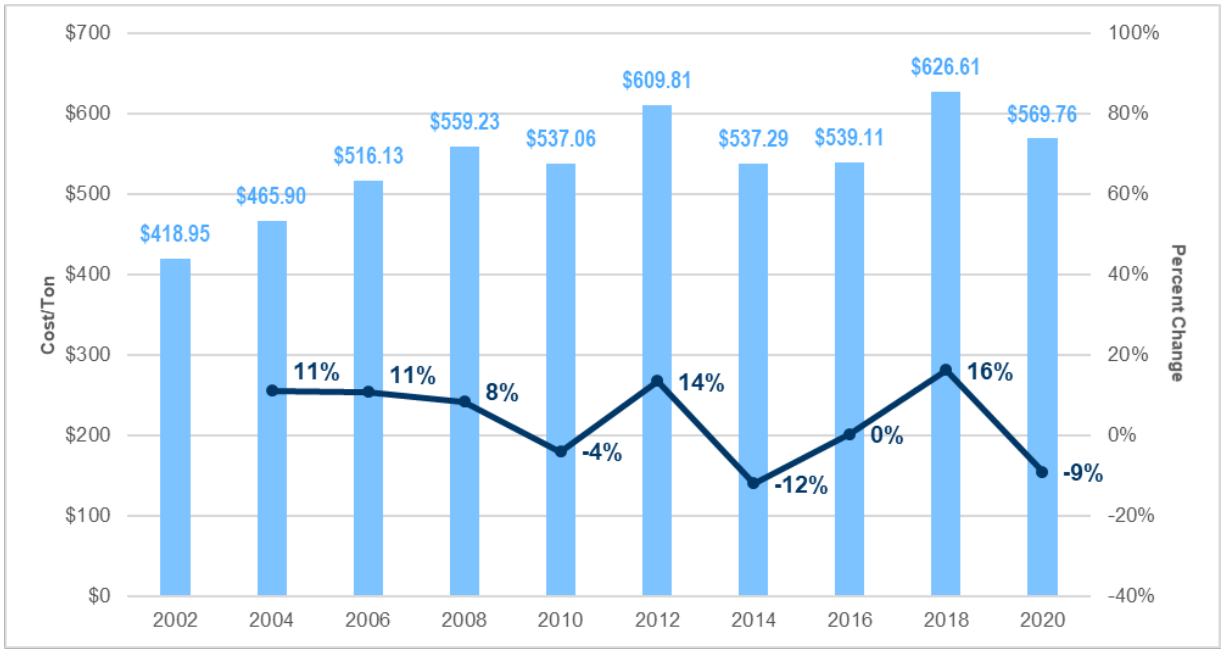
This is the sixth cost survey that the cost per ton for bi-metal and plastics #3 to #7 was indexed to the percentage change in HDPE #2 cost per ton. SB 1357 provides that CalRecycle shall adjust the costs of recycling for material types that make up less than five percent of the total number of containers 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 2020, HDPE #2 made up only 0.45 percent of all beverage containers recycled. In total, bi-metal and plastics #3 through #7 made up 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 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 5.63 percent increase in HDPE #2 between 2018 and 2020. Thus, for the 2020 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 5.63 percent.

D. Comparison of 2002-2020 Cost per Ton Results for Aluminum, Glass, PET #1, and HDPE #2

Exhibits 2-10, 2-11, 2-12, and **2-13** provide comparisons of the processing fee recycler costs per ton and recycling tons over the last ten cost surveys, for the four majority material types. The percent figures, next to each column and on the secondary axis, show the percentage change from the previous two years.

Exhibit 2-10
Aluminum Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)



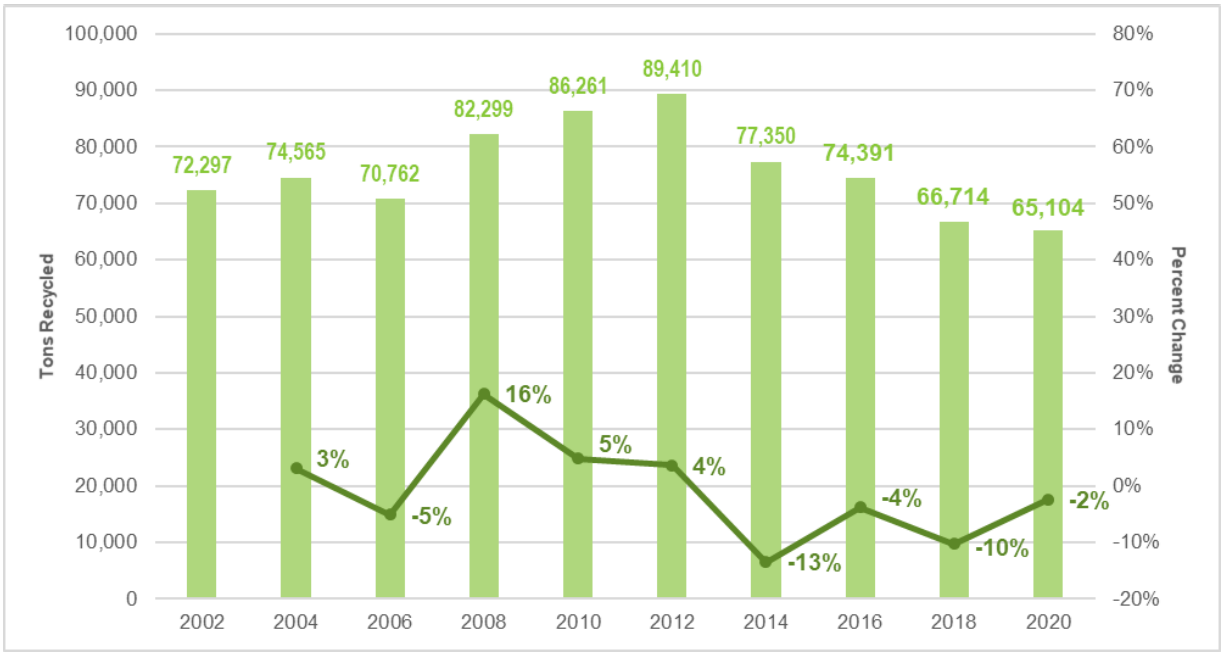
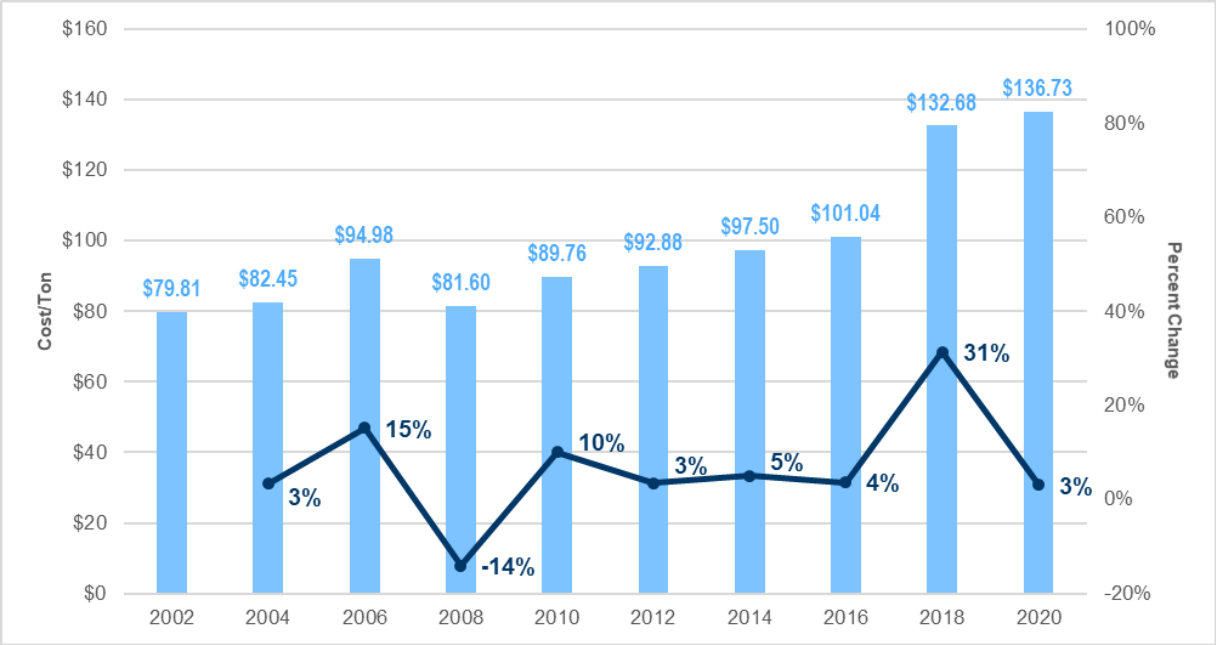


Exhibit 2-11
Glass Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)



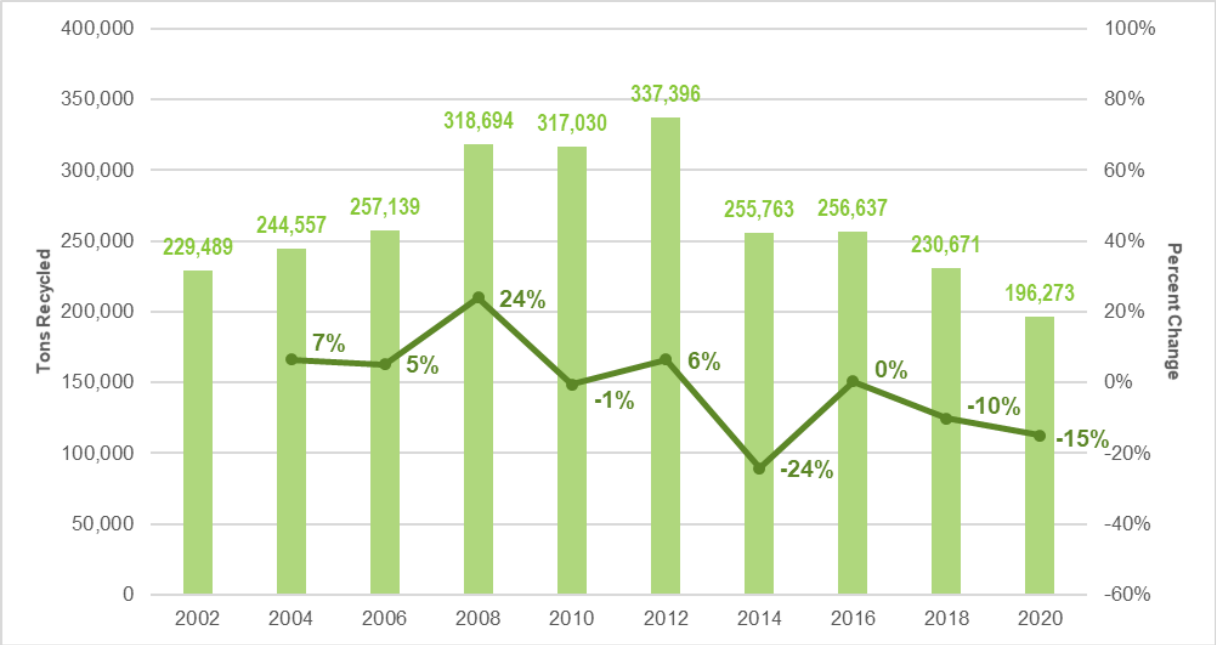
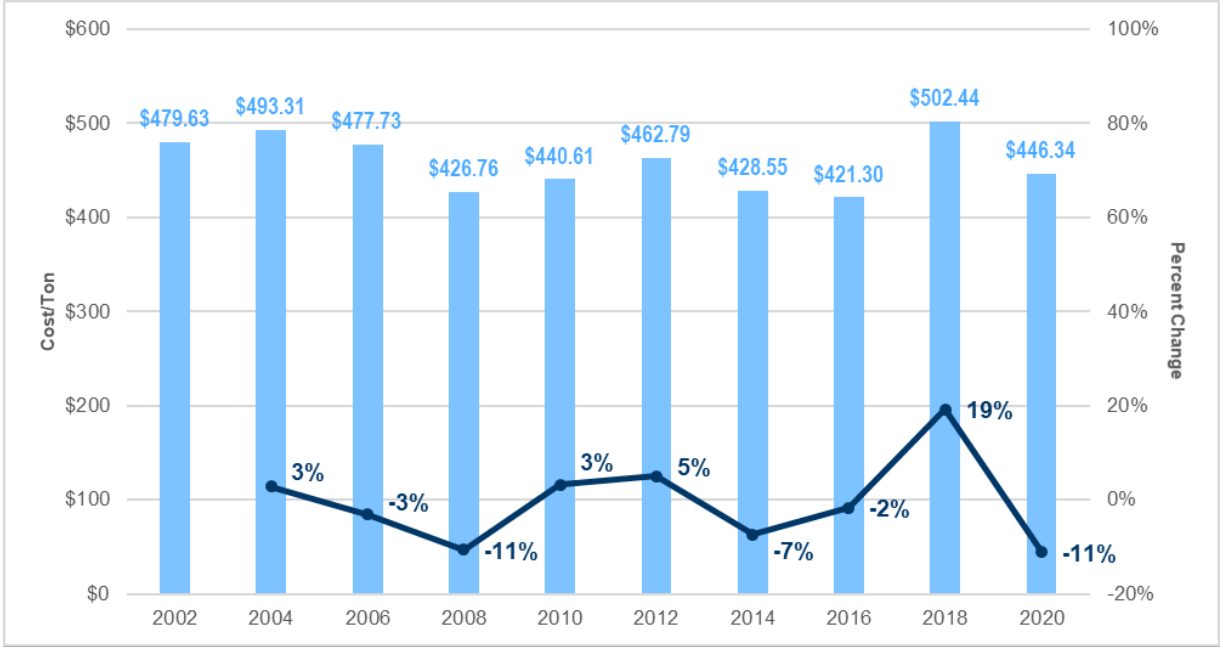


Exhibit 2-12
PET #1 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)



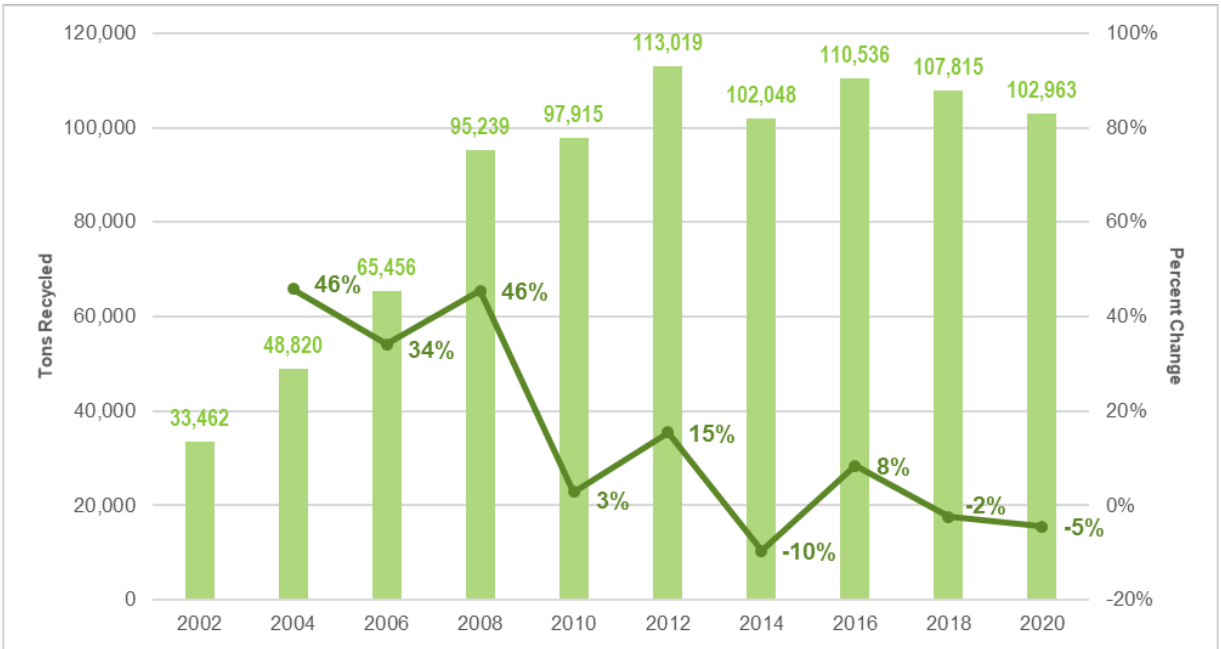
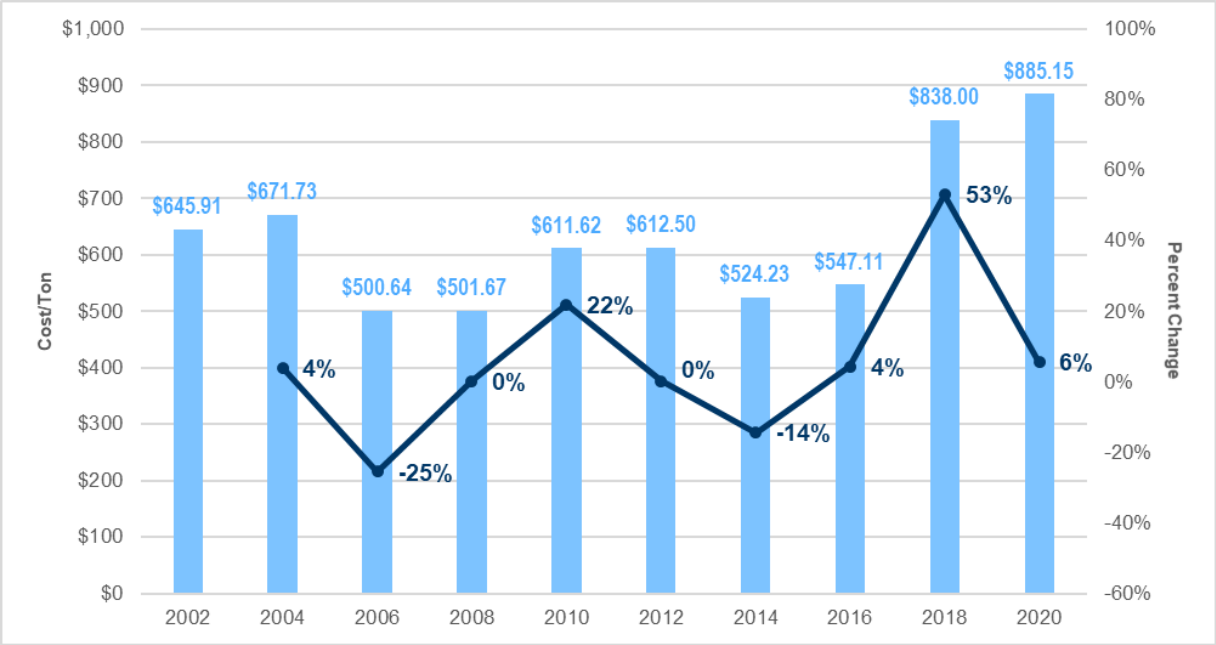
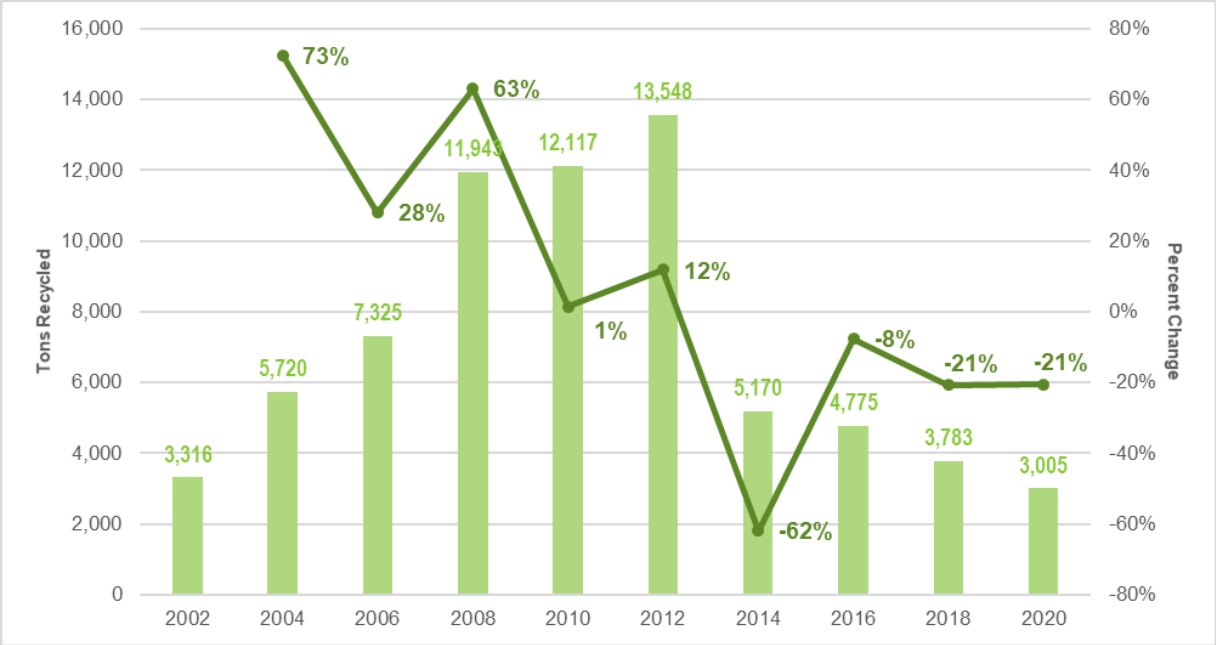


Exhibit 2-13
HDPE #2 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)

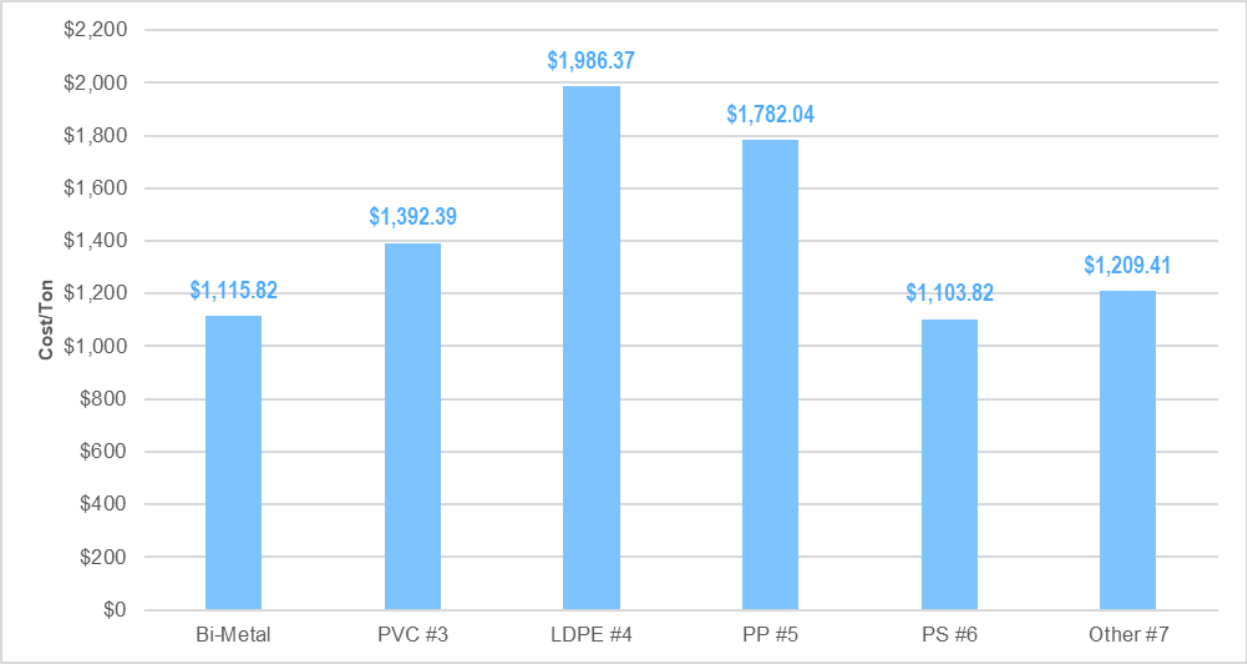




E. Cost per Ton Results for Six Minority Material Types

Exhibit 2-14 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 six surveys the cost per ton for these minority materials is based on the change in cost per ton for HDPE #2. Based on the 2020 survey results, costs per ton for each of these materials increased 5.6 percent as compared to their 2018 cost per ton.

Exhibit 2-14
Processing Fee Recycler 2020 Costs per Ton for Bi-Metal and Plastics #3 to #7



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. *Changes in Recycling Center Population Dynamics*
B. *Comparison of Total Costs, Total Tons, and Total Containers Recycled*
C. *Comparison of Population Size, Recycling Tons, Costs, and Payments by Strata*
D. *Changes in Number of Recyclers and Recycled Tons*
E. *Cost Category Comparison*
F. *Changes in Labor Costs*
G. *Changes in Transportation Costs*
H. *Summary of Processing Fee Cost Analyses.*

A. 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 stratum of the population. **Exhibit 3-1** 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 3-1
Example Calculation of 2020 Statewide, Weighted-Average Cost per Ton for Glass

Strata	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton[10]
1	24,998.66	$ 3,103,494.27	$124.15
2	18,598.08	2,416,076.57	129.91
3	17,488.45	2,663,718.27	152.31
Sample Total	61,085.19	$8,183,289.11	$133.97

Strata[11]	Population Glass Tons	Population Glass Cost	Population Cost per Ton
1	54,075.58	$6,713,483.10	n/a
2	68,518.50	8,901,238.34	n/a
3	73,678.44	11,221,963.56	n/a
Sample Total	196,272.52	$26,836,685.00	$136.73[12]

Exhibit 3-2 provides the weighted-average cost per ton by strata for glass, aluminum, PET #1, and HDPE #2 for 2018 and 2020, and the percent change between 2018 and 2020. The most apparent trend in cost per ton by strata between the two years is the decrease in cost per ton for stratum 3 consistently across glass, aluminum, PET #1, and HDPE #2. The cost per ton for stratum 1 increased across two material types (glass and HDPE #2). The cost per ton for stratum 2 increased across three material types between 2018 and 2020 (glass, aluminum, and HDPE #2). Overall, glass and HDPE #2 resulted in the greatest variations between 2018 and 2020 across strata.

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

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

[12] A statewide, weighted-average result of $136.73 per ton, calculated by dividing total population glass costs by total population glass tons.

Exhibit 3-2
Comparison of Cost per Ton by Material Type and Strata Between 2018 and 2020

Glass

Strata	2020	2018	% Change
1	$124.15	$100.09	24%
2	129.91	101.39	28%
3	152.31	175.97	-13%

Aluminum

Strata	2020	2018	% Change
1	$461.64	$503.25	-8%
2	557.49	540.20	3%
3	678.88	757.23	-10%

PET #1

Strata	2020	2018	% Change
1	$383.34	$404.28	-5%
2	412.55	422.07	-2%
3	545.36	636.49	-14%

HDPE #2

Strata	2020	2018	% Change
1	$920.90	$713.22	29%
2	809.02	661.39	22%
3	958.05	1,064.99	-10%

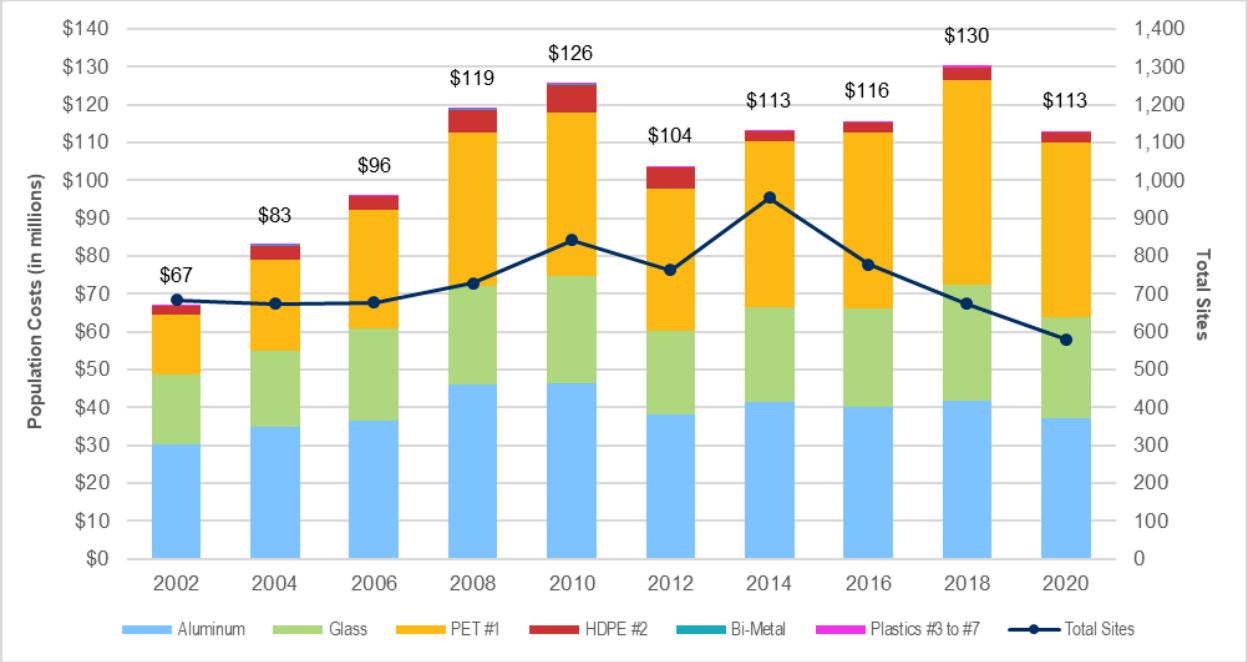
For all four material types, there were large decreases in weighted average cost per ton for stratum 3. During the 2018 to 2020 period, there were also a significant number of small recyclers that closed. The combination of challenging market conditions, COVID-19, and higher relative operating costs of small recyclers appears to have taken a toll on small recyclers, leaving the stronger small recyclers that are relatively more efficient to survive. This may help explain the decrease in cost per ton in all material types for stratum 3 recyclers.

B. *Comparison of Total Costs, Total Tons, and Total Containers Recycled*

To verify the observations about CRV material costs, we compared the change in total population costs, and change in total population volumes (tons and containers), from 2002-2020.

Exhibit 3-3 illustrates population costs[13] from 2002-2020. The Exhibit illustrates increasing total costs and number of recycling centers between 2002 and 2010, a shift in 2012, then generally increasing costs and decreasing number of recycling centers to 2020. 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. Between 2012 and 2014, total costs increased 9 percent. Between 2014 and 2016 total costs increased by 2 percent. Between 2016 and 2018, total costs increased by approximately 12 percent. Finally, between 2018 and 2020, total costs decreased approximately 13 percent.

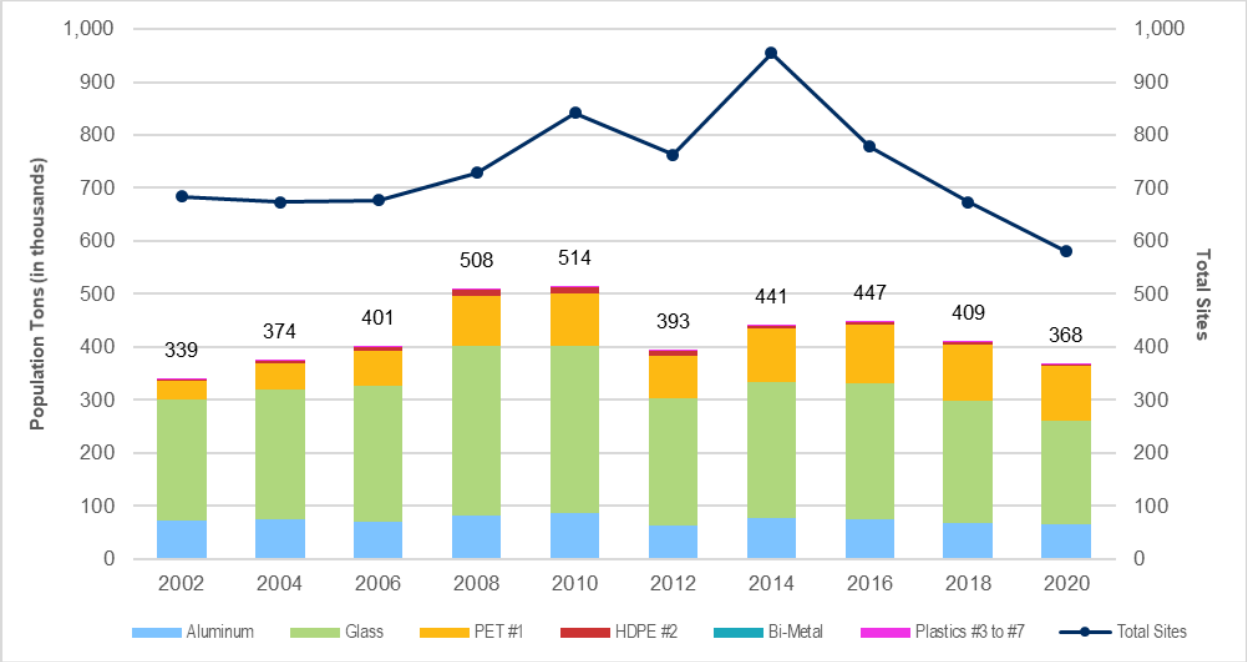
Exhibit 3-3
Total Population Costs for Processing Fee Recyclers (2002 to 2020)



[13] The 2012 population cost represents a reduced population (269 investigated recyclers were removed for 2012).

Exhibit 3-4 illustrates the changes in population tons[14] from 2002-2020. Like total costs, total tons increased between 2002 and 2010, reset in 2012 (with a reduced population), and then generally decreased through 2020. 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. 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. Finally, between 2018 and 2020, total tons decreased by approximately 10 percent.

Exhibit 3-4
Total Population Tons for Processing Fee Recyclers (2002 to 2020)



[14] The 2012 population tons represents a reduced population (269 investigated recyclers were removed for 2012).

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

In 2020, the percentage of glass decreased by 3 percentage points (53 percent for glass) and the percent for aluminum and PET #1 both increased by 2 percentage points (18 percent for aluminum and 28 percent for PET #1). All other materials, including HDPE made up approximately 1 percent of total population tons for recyclers.

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

Exhibit 3-5 through **3-9** provide the number of sites and tons per strata, for the four major material types from 2002-2020. 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 and for 2020 it excludes 30 investigated recycler sites. The tables illustrate substantial shifts over time in the number of recyclers, size of recyclers, and tons of material recycled. Like the last survey, Crowe continued to utilize a PET-based strata definition reflective of the current recycling marketplace. Crowe did, however, change the strata tonnage parameters, which contributed to the changes in the number of sites per strata between 2016, 2018, and 2020. Crowe did not find a material impact in changing the strata tonnage parameters and provide further details within this section.

Examining results by 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, with even lower levels in 2020 than seen in 2002. Glass tonnage is more evenly distributed across strata then previously when stratum 1 sites handled the majority of material. Today, stratum 3 sites handle the majority of glass tons.
- PET#1 tons recycled has increased significantly since 2002. However, PET #1 tons recycled has declined over the past four years since its peak in 2016.
- HDPE #2 tonnage increased up until 2012, but declined between 2012 and 2014, and continued to decline from 2016 to 2020[15], and in 2020 was the lowest level since 2002.

[15] The significant reduction in HDPE #2 tons recycled for each stratum 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 3-5
Total 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	174	390	468	1,032
2014	132	396	469	997
2016	162	308	308	778
2018	53	125	496	674
2020	58	131	392	581

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	288,271	201,672	63,869	553,812
2014	208,716	210,381	65,760	484,857
2016	231,186	165,589	49,564	446,339
2018	103,885	133,394	171,706	408,985
2020	109,271	126,716	131,356	367,344

Note: 2012 is the full population of processing fee recyclers. 2014 is the full population of processing fee recyclers. 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers. 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers. 2020 is the survey population of processing fee recyclers, which excludes 30 investigated recyclers.

Exhibit 3-6
Aluminum 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	174	389	465	1,028
2014	132	396	467	995
2016	162	308	308	778
2018	53	125	496	674
2020	58	131	391	580

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	36,871	35,763	16,776	89,410
2014	30,060	37,835	15,969	83,864
2016	36,844	27,640	9,907	74,391
2018	17,200	20,023	29,491	66,714
2020	20,856	21,201	23,047	65,104

Note: 2012 is the full population of processing fee recyclers. 2014 is the full population of processing fee recyclers. 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers. 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers. 2020 is the survey population of processing fee recyclers, which excludes 30 investigated recyclers.

Exhibit 3-7
Glass 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	174	390	446	1,010
2014	132	396	443	971
2016	161	306	291	758
2018	53	125	478	656
2020	58	131	371	560

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	189,465	116,798	31,133	337,396
2014	132,334	119,758	32,956	285,049
2016	132,920	95,976	27,637	256,637
2018	56,177	76,728	97,728	230,672
2020	54,076	68,518	73,678	196,273

Note: 2012 is the full population of processing fee recyclers. 2014 is the full population of processing fee recyclers. 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers. 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers. 2020 is the survey population of processing fee recyclers, which excludes 30 investigated recyclers.

Exhibit 3-8
PET #1 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	174	390	454	1,018
2014	132	394	456	982
2016	162	308	291	758
2018	53	125	485	663
2020	58	131	385	574

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	54,282	43,995	14,742	113,019
2014	44,079	50,064	16,099	110,243
2016	59,190	39,978	11,367	110,535
2018	29,786	35,145	42,885	107,816
2020	33,666	35,697	33,600	102,963

Note: 2012 is the full population of processing fee recyclers. 2014 is the full population of processing fee recyclers. 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers. 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers. 2020 is the survey population of processing fee recyclers, which excludes 30 investigated recyclers.

Exhibit 3-9
HDPE #2 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	173	385	420	978
2014	130	389	420	939
2016	159	301	280	740
2018	53	125	469	647
2020	58	130	353	541

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	7,422	4,948	1,178	13,548
2014	2,242	2,723	735	5,700
2016	2,232	1,994	548	4,775
2018	722	1,498	1,563	3,783
2020	674	1,301	1,030	3,005

Note: 2012 is the full population of processing fee recyclers. 2014 is the full population of processing fee recyclers. 2016 is the survey population of processing fee recyclers, which excludes seven investigated recyclers. 2018 is the survey population of processing fee recyclers, which excludes 31 investigated recyclers. 2020 is the survey population of processing fee recyclers, which excludes 30 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 3-10, 3-11, 3-12,** and **3-13** illustrate the 2020 costs per ton and survey population size by strata for aluminum, glass, PET #1, and HDPE #2.

These figures illustrate the following key findings:

- Except for 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, strata 1 and 2 sites were below the statewide, weighted-average cost per ton, except for HDPE #2 in which strata 1 and 3 were both above the statewide, weight-average cost per ton in 2020.

Comparing recycling volumes and cost contributions, by strata, to the statewide weighted-average cost per ton between 2012, 2014, 2016, 2018, and 2020 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 2020, the cost per ton results cannot be directly compared between strata though this does not impact the overall cost per ton results.

Exhibit 3-10
Aluminum Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)

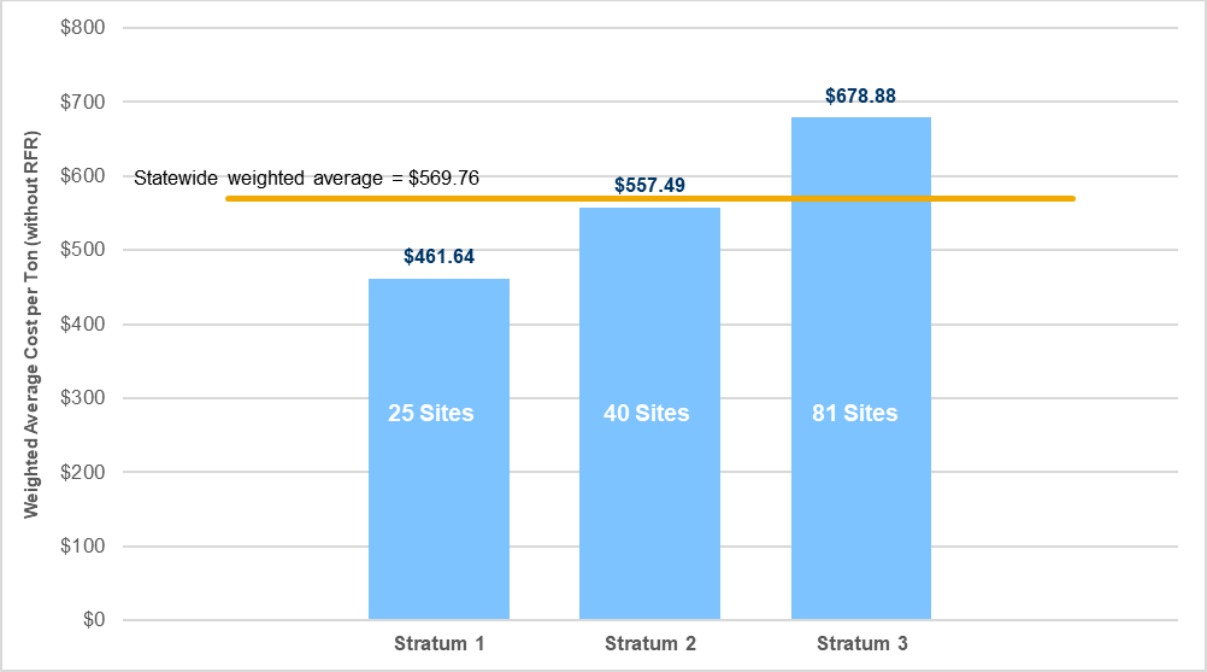


Exhibit 3-11
Glass Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)

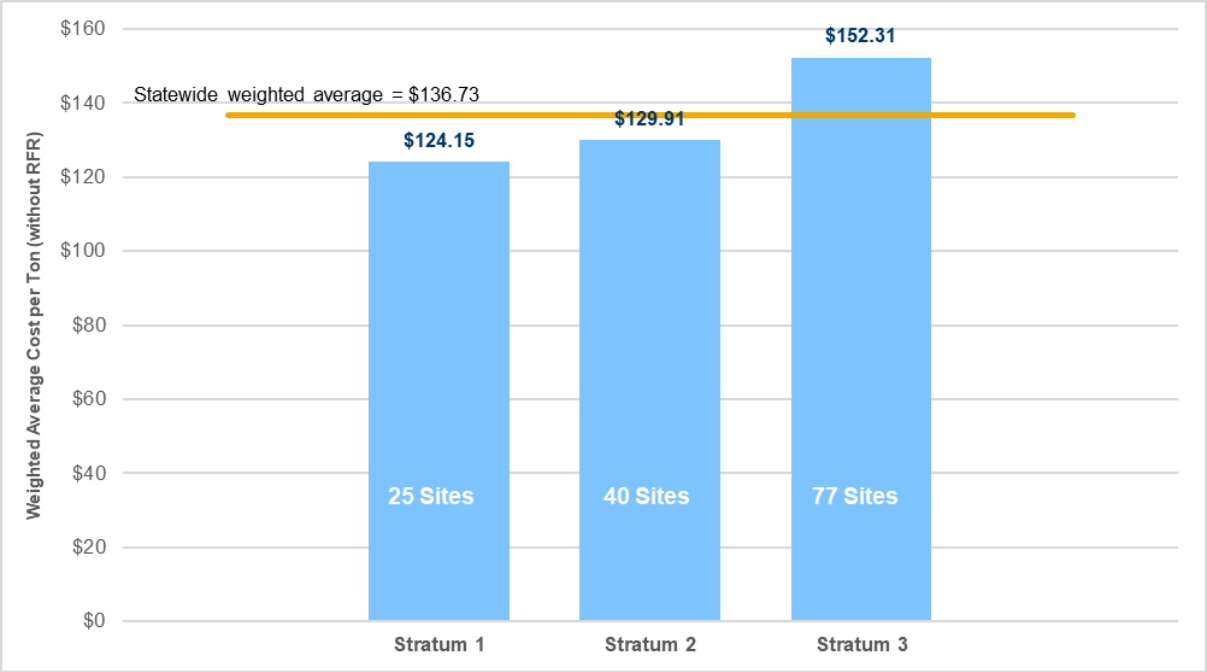


Exhibit 3-12
PET #1 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)

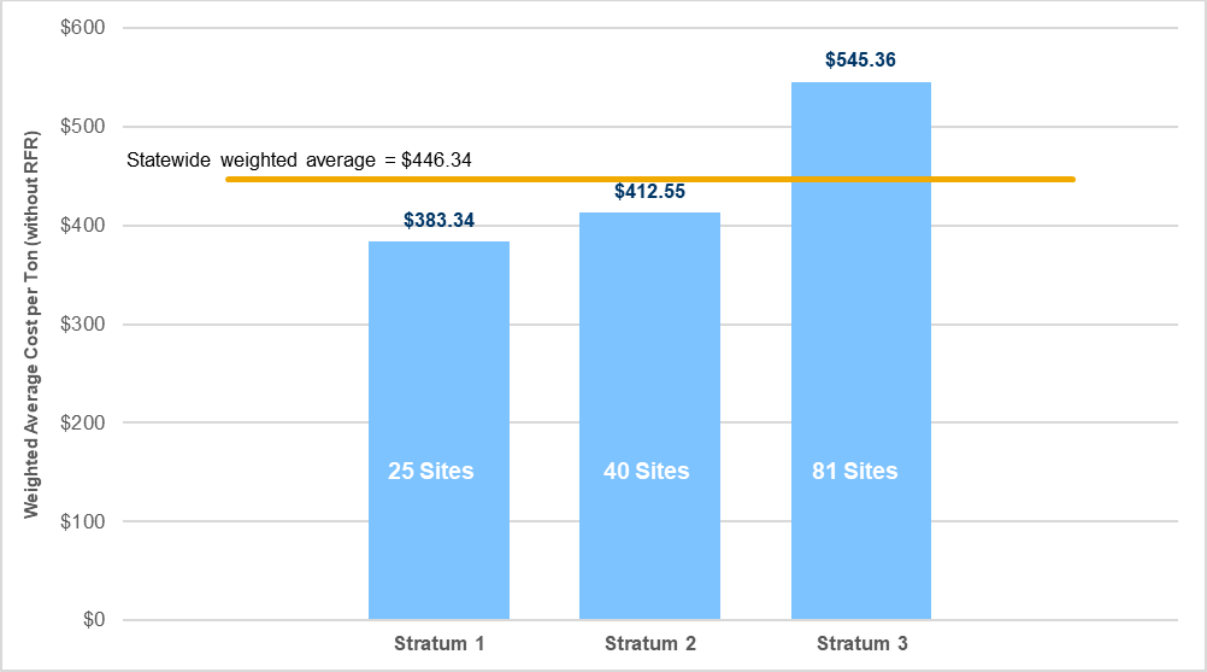
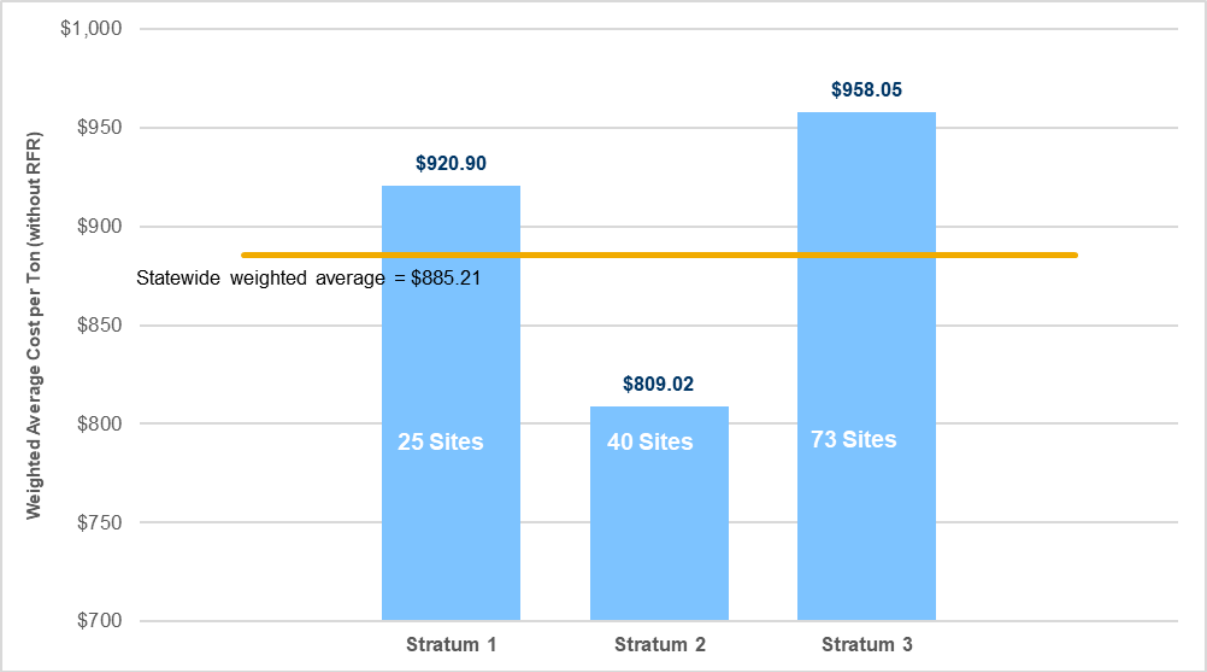


Exhibit 3-13
HDPE #2 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)



Exhibits 3-14, 3-15, and **3-16** illustrate the percent of population tons recycled by each stratum and the percent of total population costs by each stratum for 2012, 2014, 2016, 2018, and 2020. 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 strata 1 and 2 recyclers. In both 2018 and 2020 the proportion of costs and tons by strata were relatively even as compared to prior survey years and reasonably consistent over the two years.

Exhibit 3-14 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 stratum 3 and declined for strata 1 and 2. In general, lower-cost per ton strata 1 and 2 recyclers contributed proportionately less to the statewide, weighted-average cost per ton in 2020. Conversely, higher-cost per ton stratum 3 recyclers contributed more to the statewide, weighted-average cost per ton – although less than in 2018.

Exhibit 3-15 illustrates the same data for aluminum. For aluminum, the shifts in tons and costs between stratum 1 to strata 2 and 3 also occurred, to a similar extent. In 2020, strata 1 and 2 both accounted for roughly 32 percent of aluminum volume and contributed a slightly lower 26 percent and 31 percent to costs. Stratum 3 accounted for 35 percent of aluminum volume and 42 percent of aluminum costs.

Exhibit 3-16 illustrates the same data PET #1. For PET #1, the shifts in tons and costs between strata 1 and 2 to stratum 3 also occurred, to a similar extent. In 2020, stratum 1 accounted for 33 percent of PET #1 volume, and 28 percent of costs. Stratum 3 accounted for 33 percent of volume and 40 percent of costs. Stratum 2 accounted for 35 percent of volume, and a slightly lower 32 percent of costs.

Exhibit 3-14
Percent of Population Glass Tons Recycled and Percent of Glass Total Costs – 2012 to 2020

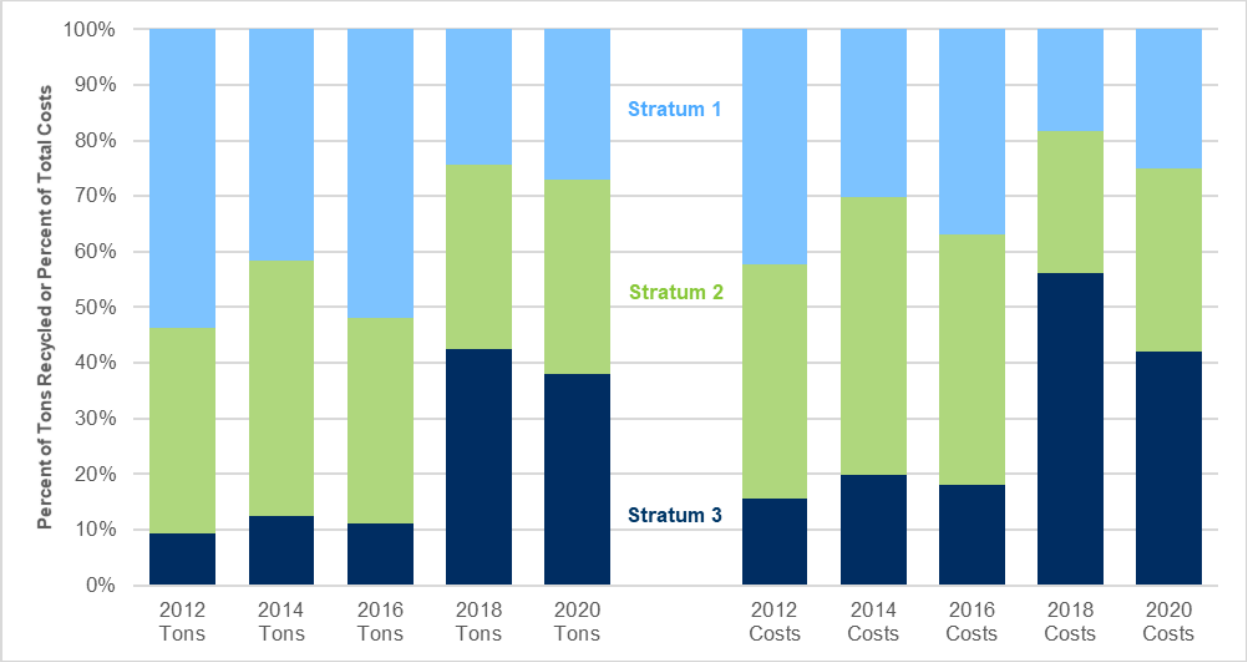


Exhibit 3-15
Percent of Population Aluminum Tons Recycled and Percent of Aluminum Total Costs – 2012 to 2020

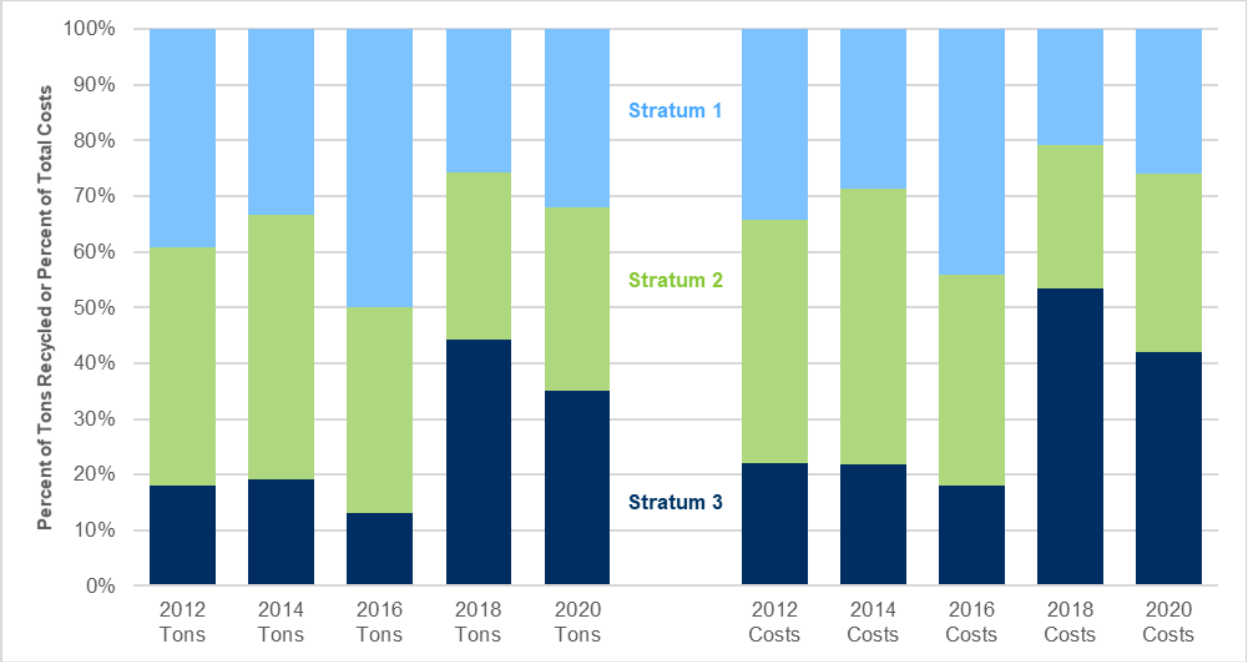
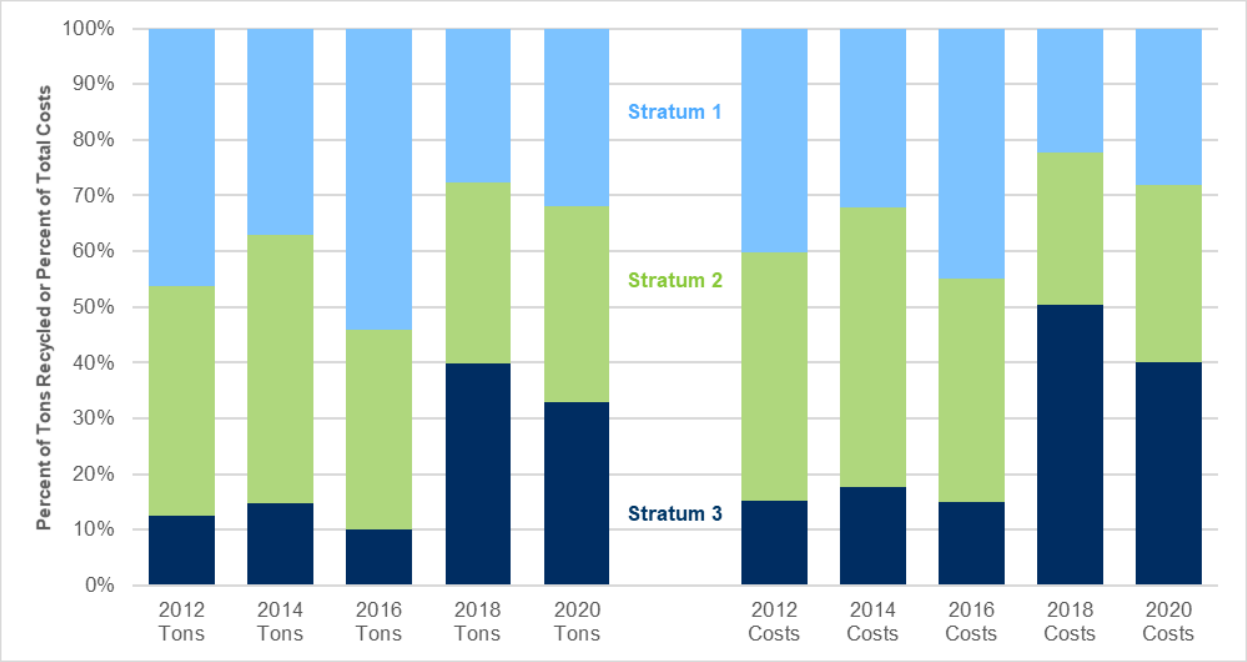


Exhibit 3-16
Percent of Population PET #1 Tons Recycled and Percent of PET #1 Total Costs – 2012 to 2020



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, Crowe presents 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, Crowe examines the impact of these changes on cost per ton results.

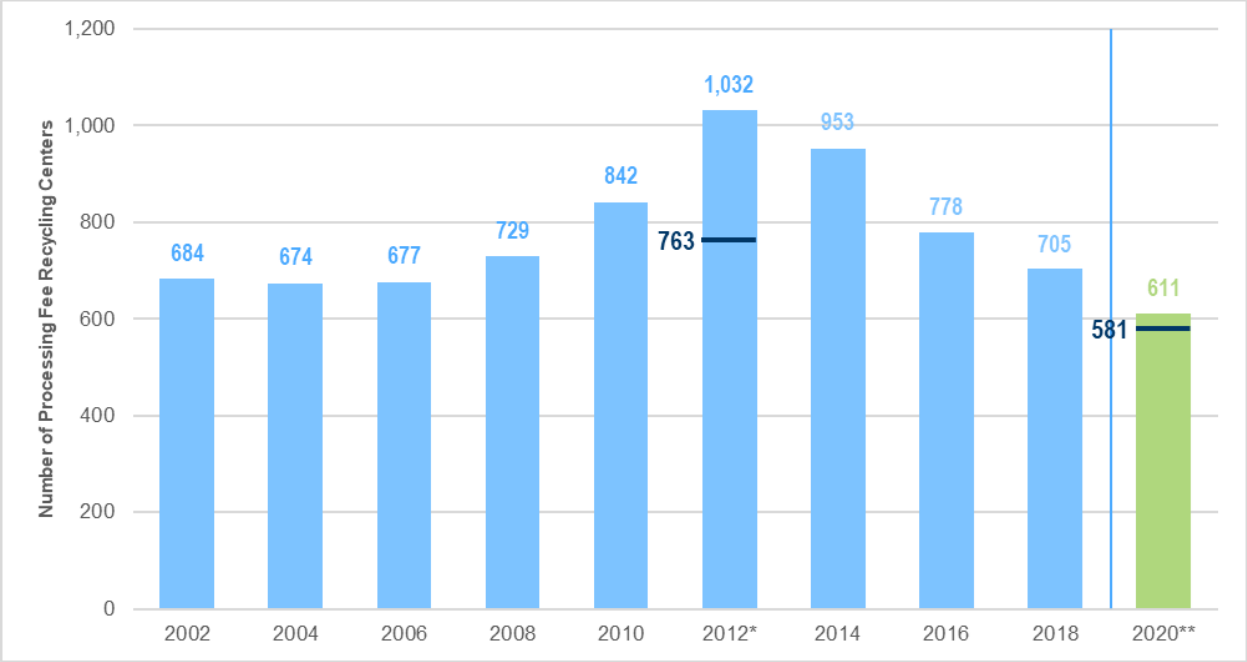
Historical Trends in Population Number of Recyclers

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 3-17 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. Finally, between 2018 and 2020, the number of recycling centers declined by 13 percent.

The overall 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 611 PF population recyclers in 2020 is lower than any other year since 2002. The continuing decrease in number of processing fee recyclers from the full population in 2012 to 2014 to 2016 is also likely a correction from the significant growth in population between 2010 and 2012.

Exhibit 3-17
2002-2020 Number of Processing Fee Recycling Centers



Note: 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 subsequent years, Crowe removed only the RCs that were under investigation by CalRecycle for major violations (between 7 and 42 recyclers). There were 30 PF Recyclers being investigated for major violations in 2020. These were removed from the survey population (581 recyclers).

Average Tons Recycled per Recycling Center

Between 2018 and 2020, recycler productivity (i.e., average tons recycled by RC) increased for the third time since 2008. Recycler productivity increases generally result in lower costs per ton, as recyclers gain efficiency. The 2020 statewide processing fee recycler cost per ton results indicate recyclers continue to gain efficiencies due to a continued decline in the recycler population. In total, between 2018 and 2020, the average tons per RC of glass remained nearly unchanged, aluminum increased 13 percent, and PET #1 increased 10 percent.

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 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 2020, total tons of material recycled decreased, as did the number of RCs. The result is more tons of material recycled per RC.

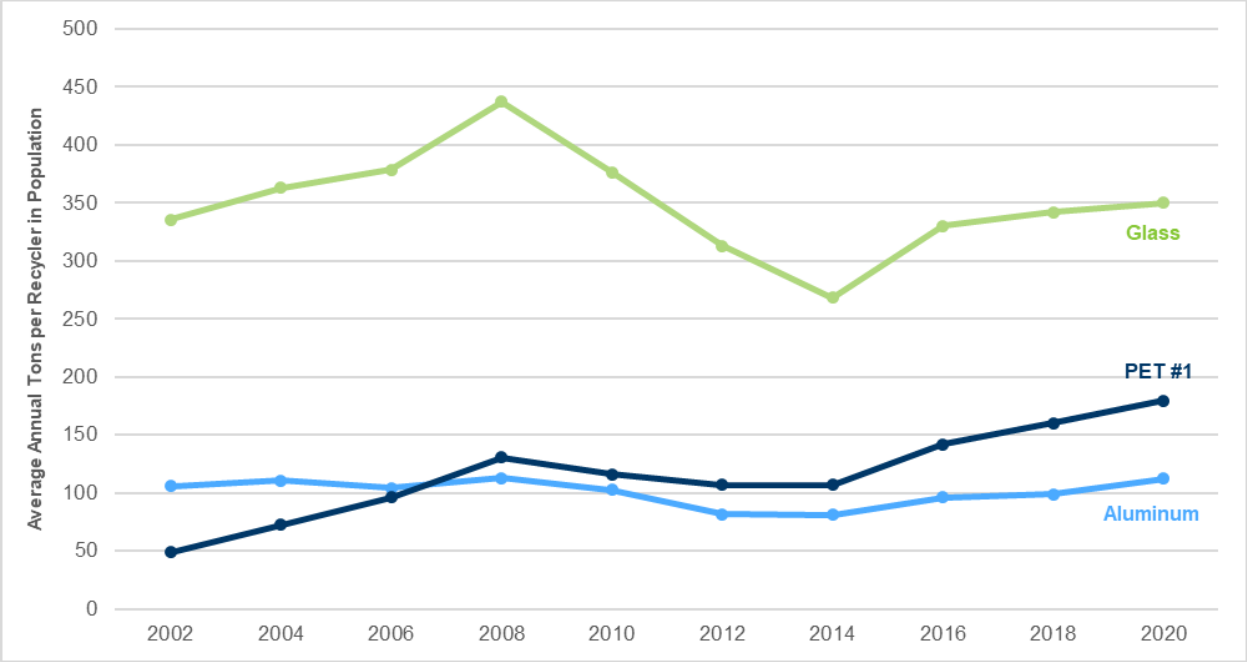
Exhibit 3-18 provides the average tons of aluminum, glass, and PET #1 recycled per RC for each cost survey year, 2002 through 2020. Each cost survey year's data point is the quotient determined by dividing population tons recycled by the number of RCs in the population. For 2012, the team used the average tons recycled by the survey sample (reduced) population; however, 2012 average tons recycled were very similar between the reduced and full population.

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 3-18. Between 2016 and 2018, average glass tons increased to 330 and 342 per recycler, similar to the 2012 average. Between 2018 and 2020, average glass tons remained nearly unchanged.

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. Between 2018 and 2020, average aluminum tons increased nearly 15 percent from 99 tons per recycler to 112 tons per recycler.

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. Between 2018 and 2020, PET #1 increased to 179 average tons per recycler – the highest average annual tons per recycler in the last 20 years. The combination of a slight five (5) percent decrease in PET #1 total recycling volumes and a reduced number of recyclers between 2018 and 2020 resulted to an increase in average tons of PET #1 recycled per RC to 179. In total, between 2018 and 2020, the average tons per RC of aluminum and PET #1 increased significantly and glass remained nearly unchanged.

Exhibit 3-18
Average Tons of Aluminum, Glass, and PET #1 Recycled per Processing Fee Recycler (2002 to 2020, every 2 years)

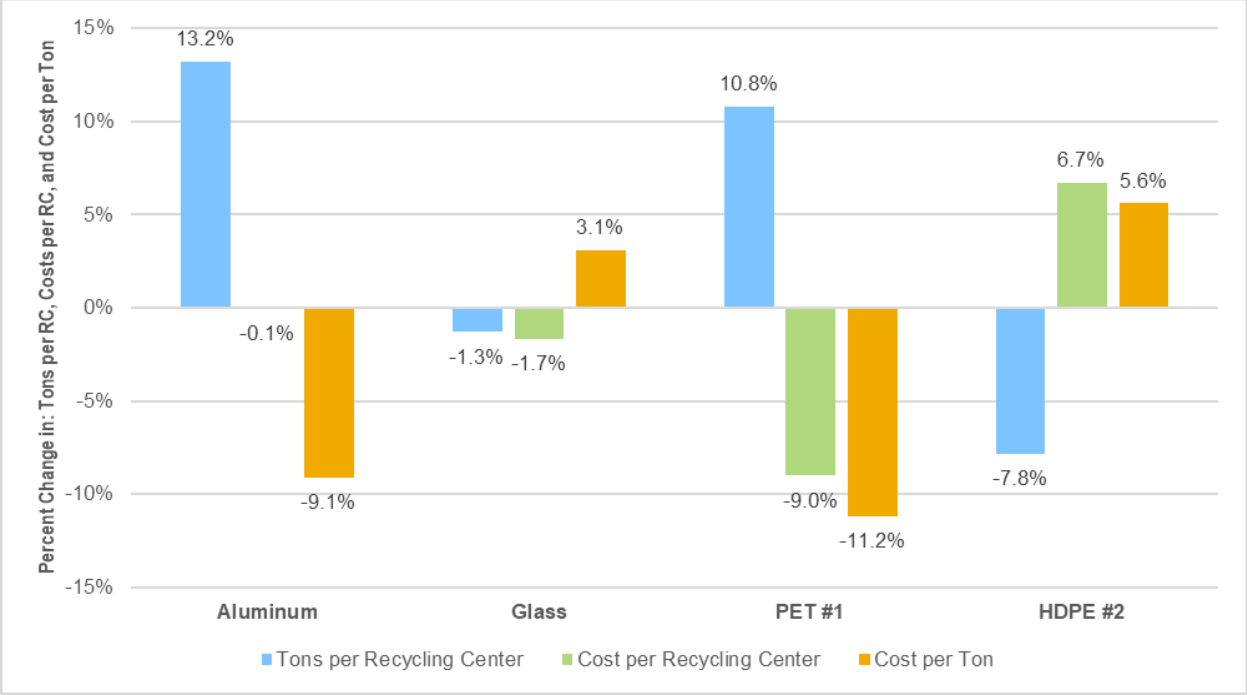


Change in Tons per RC, Costs per RC, and Cost per Ton

Exhibit 3-19 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 2018 and 2020, PF for PF recycler population for aluminum, glass, PET #1, and HDPE #2. For aluminum and PET #1, average recycling center productivity (measured as tons recycled per RC) increased, with the average cost per RC decreasing dramatically for PET #1. For glass and HDPE #2, average recycling center productivity decreased due a decrease in volumes and increase in costs as compared to 2018, resulting in an increase in cost per ton.

The cost per ton is a simple algebraic result of the cost per ton calculation: cost per ton = costs ÷ tons. As compared to the 2018 cost survey results, the 2020 tons (the denominator in the equation) for all materials was down. 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.

Exhibit 3-19
Percent Change in Tons per Recycler, Costs per Recycler, and Statewide, Weighted-Average Processing Fee Recycler Cost per Ton (2018 to 2020)



The 2020 statewide aluminum cost per ton is 9 percent lower than the 2018 statewide recycler cost per ton. Between 2018 and 2020, average aluminum tons recycled per recycling center increased 13 percent, while costs per recycling center remained relatively the same over the same period. This was one of the factors that led to a decrease in aluminum cost per ton.

The 2020 statewide glass cost per ton is 3 percent higher than the 2018 statewide recycler cost per ton. Between 2018 and 2020, average glass tons recycled per recycling center decreased slightly as costs per recycling center decreased a slightly greater amount over the same period, which is one reason why glass cost per ton increased slightly.

The 2020 statewide recycler PET #1 cost per ton is 11 percent lower than the 2018 statewide PET #1 cost per ton. Between 2018 and 2020, the average tons PET #1 per recycling center increased 10 percent, while costs per recycling center decreased 9 percent over the same period. This was one of the factors that led to a decrease in PET #1 cost per ton.

The 2020 statewide recycler HDPE #2 cost per ton is 5 percent higher than the 2018 statewide HDPE #2 cost per ton. Between 2018 and 2020, the average tons HDPE #2 per recycling center decreased 8 percent, while costs per recycling center increased 7 percent, over the same period. This was one of the factors that led to an increase in HDPE #2 cost per ton.

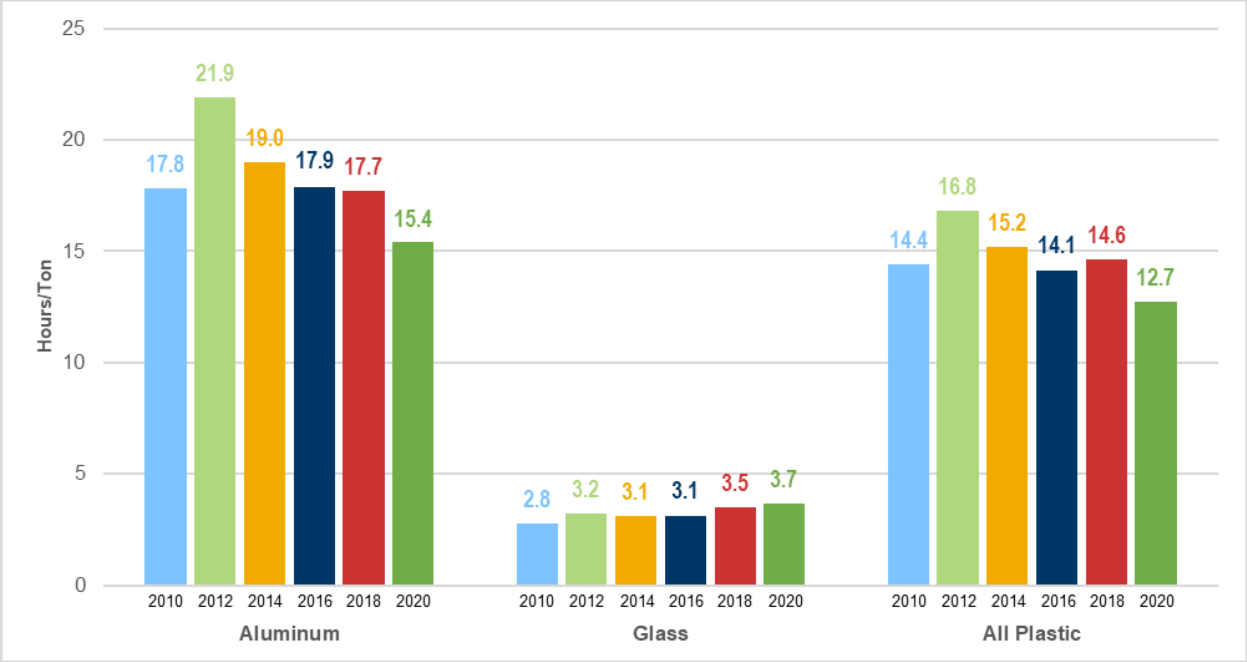
Labor Hours per Ton Recycled

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. Crowe calculated and compared the average PF for PF recycler labor hours allocated per ton of aluminum, glass, and plastic[16] recycled, for the 2010, 2012, 2014, 2016, 2018, and 2020 surveys. **Exhibit 3-20** shows the labor hours allocated per ton of material recycled. On average, the labor hours required to handle one ton of CRV Glass slightly increased from 2018 to 2020. On the other hand, the labors hours required to handle one ton of aluminum and plastics decreased around 2 hours per ton in 2020. Both are lower than the 2010 average labor hours per ton for aluminum and plastic.

---

[16] The analysis of labor hours per ton includes data available for plastic, rather than for PET #1, because of the cost survey methodology. Crowe combines 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. Crowe also uses 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.

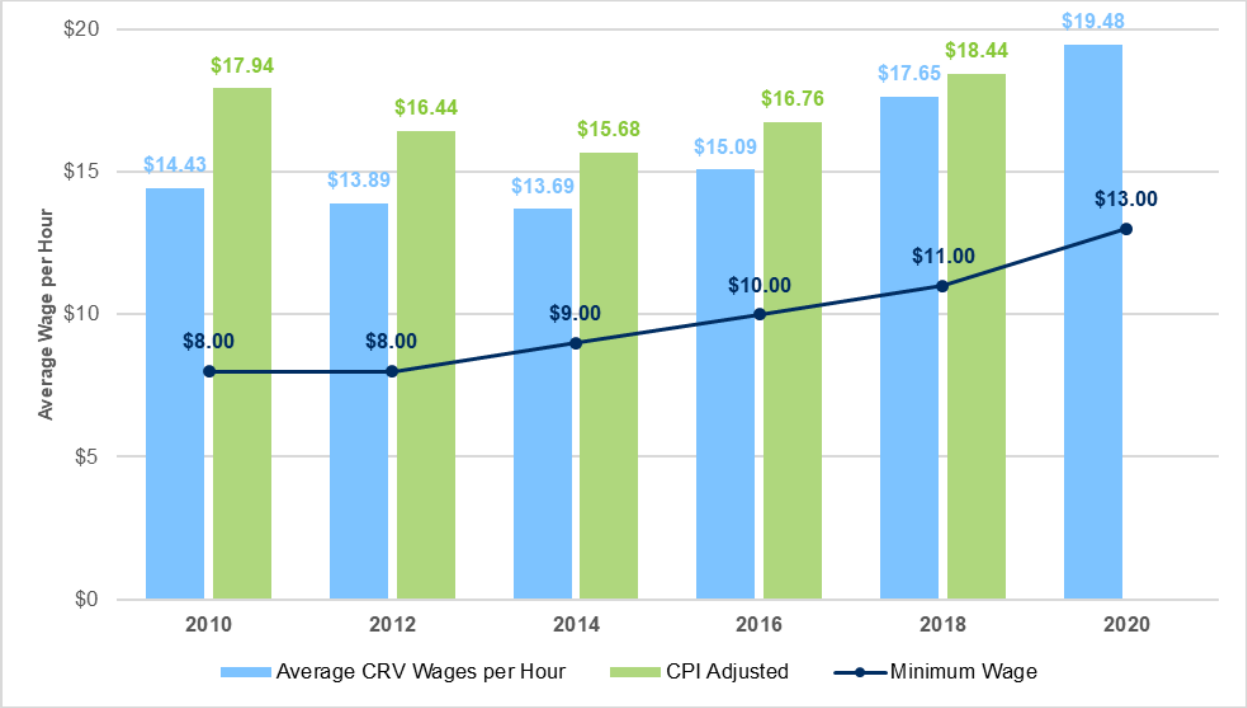
Exhibit 3-20
2010 to 2020 Sampled Processing Fee Recyclers Average Labor Hours per Ton of Aluminum, Glass, and All Plastic Recycled



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. The cost survey does distinguish time spent waiting for CRV customers. All time is allocated to CRV materials, non-CRV materials, or other business.

Exhibit 3-21 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. 2020 average labor wages per hour increased since the last 2018 cost survey and have been the highest since 2010 even with the CPI adjustment. The average recycler wage per hour (including owners, supervisors, and laborers) increased 10 percent between 2018 and 2020, from $17.65 per hour to $19.48 per hour. The change in average recycler wage per hour from 2018 to 2020 is roughly 5 percent after adjusting by the CPI, which is less than the increase in minimum wage from 2018 to 2020.

Exhibit 3-21
2010 to 2020 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 decreases between 2020 and 2018, Crowe 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 sampled RCs. They do not consider costs by strata or recycling tons per site, they simply reflect an average category cost per RC for the 154 RCs surveyed as part of the 2018 cost survey and the 146 RCs surveyed as part of the 2020 cost survey.

Exhibit 3-22 provides the cost category comparison between 2020 and 2018, which includes a CPI adjustment for 2018.

Exhibit 3-22
Comparison of Average Processing Fee Recycler Category Costs (2018 and 2020)

Cost Category	2020 (n=146)	% of CRV Costs	2018 (n=154)	% of CRV Costs	CPI Adjusted 2018	% Change 2018 (adj.) to 2020
Direct Labor	$131,957	53.0%	$134,989	51.9%	$141,036	-6%
Indirect Labor	$18,439	7.4%	$20,745	8.0%	$21,674	-15%
General Business Overhead	$14,905	6.0%	$18,248	7.0%	$19,065	-22%
Transportation	$16,014	6.4%	$17,171	6.6%	$17,940	-11%
Rent	$31,717	12.7%	$27,634	10.6%	$28,872	10%
Depreciation	$4,701	1.9%	$4,931	1.9%	$5,152	-9%
Property Tax	$1,132	0.5%	$1,220	0.5%	$1,275	-11%
Utilities	$7,459	3.0%	$7,734	3.0%	$8,080	-8%
Supplies	$7,555	3.0%	$6,365	2.4%	$6,650	14%
Fuel	$1,402	0.6%	$2,027	0.8%	$2,118	-34%
Insurance	$4,990	2.0%	$5,530	2.1%	$5,778	-14%
Interest	$598	0.2%	$1,388	0.5%	$1,450	-59%
Maintenance	$8,232	3.3%	$11,902	4.6%	$12,435	-34%
Total CRV Costs per Site	**$249,102**	**100.0%**	**$259,884**	**100.0%**	**$271,527**	**-8%**

The CPI adjustment between 2018 and 2020 was 4.5 percent.[17] This comparison illustrates several key points:

- Average CRV costs per RC decreased by 8 percent (4 percent without an inflation adjustment), which directly contributes to the decrease in cost per ton if volumes were held equal. This decrease is consistent with the overall decrease in cost per ton results.
- The percent of CRV costs, by category, were very similar between the two years. For example, direct labor represented 53 percent of CRV costs in 2020 and 52 percent in 2018.
- 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 (~7 to 8 percent)
  - Transportation (~6 percent)
  - General business overhead (GBO) (administrative costs, fees, etc.) (~6 to 7 percent)
- All cost categories decreased except for rent and supplies.
- The cost categories with the greatest dollar decrease between 2020 and 2018, accounting for 86 percent of the decrease, were (ordered from greatest to least):
  - Direct labor
  - Maintenance
  - GBO
  - Transportation
- The decrease in labor was the largest single factor, accounting for 35 percent of the decrease.
- Maintenance and GBO had the next greatest dollar decrease, each accounting for 16 percent of the decrease.

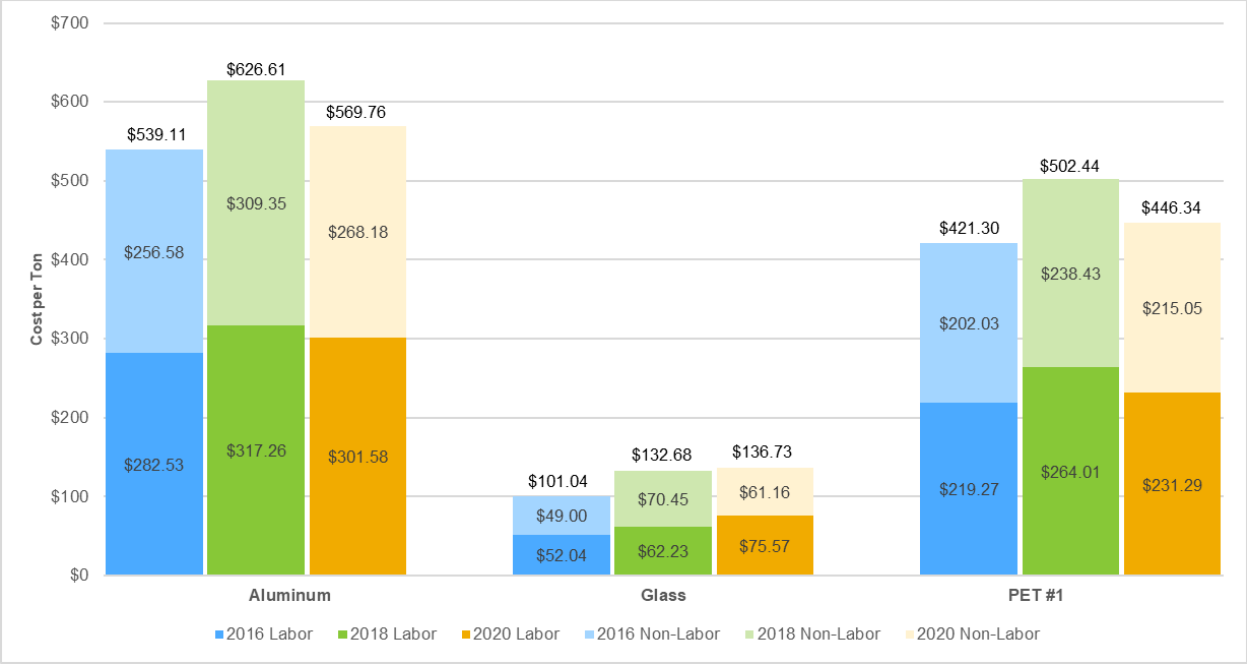
[17] U.S. Department of Labor, Bureau of Labor Statistics, West Urban Consumer Price Index (as of Oct 2021): https://data.bls.gov/timeseries/CUUR0400SA0?amp%253bdata_tool=XGtable&output_view=data&include_graphs=true

Labor and Non-Labor Costs

Crowe also determined the labor and non-labor portions of cost per ton for the 2016, 2018, and 2020 cost surveys, and compared how the two cost components changed between the three surveys. **Exhibit 3-23** 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 the survey methodology.

The two analyses presented above provide considerable confidence in the sample design and cost survey labor allocation methodologies that were the basis of the 2020 cost per ton results. The results also demonstrate a consistency in the cost survey labor allocation methodology between the 2016, 2018, and 2020 cost surveys.

Exhibit 3-23
2016, 2018, and 2020 Sampled Processing Fee Recyclers
Labor and Non-Labor Costs per Ton



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 decreases for aluminum and PET #1 between 2018 and 2020. In the analyses below, 2020 labor costs are not adjusted by CPI, rather they are a straight dollar comparison across the two survey years. A CPI adjustment would increase 2018 costs by 4.5 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, Crowe 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 affected the changes in overall costs in 2020 compared to 2018:
    - Decreased hours handling aluminum and plastic materials. For both DYL and AOL labor, there were lower hours per ton, which contributes to lower overall costs for aluminum and plastic.
    - Slightly increased hours handling glass materials. For both DYL and AOL labor, there were slightly higher hours per ton, which contributes to higher overall costs for glass.

- Factors that led to lower labor costs:
    - Lower average wages per recycler. Average CRV wages per recycler decreased 2 percent between 2018 and 2020, indicating the increased tons per recycler likely outweighs the increases in overall wages per hour. Wages per recycler for aluminum were nearly flat with an increase of one percent, a slightly higher increase of 4 percent for glass, and a decrease of 8 percent for plastic. The significant decrease for plastics compared to aluminum and glass is consistent with the 9 percent decrease in average PET costs per recycler.
    - Low wage sites. The number of low wage sites or sites below the minimum wage nearly doubled between 2018 and 2020, which contributes to lower overall costs.

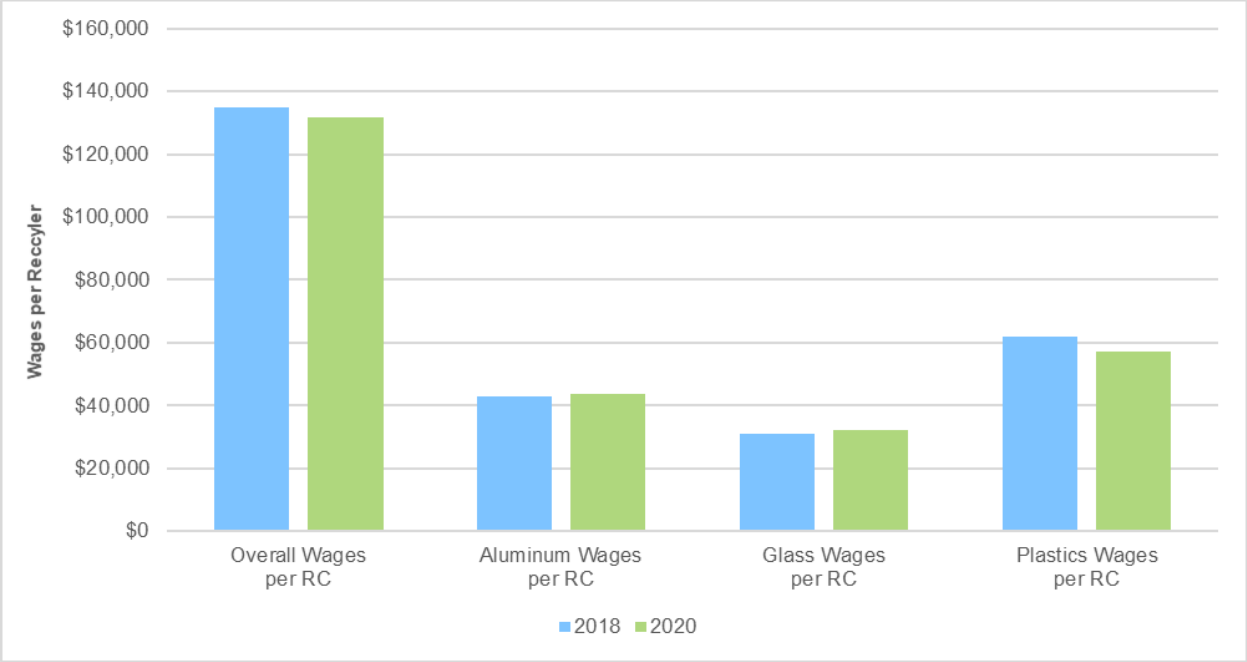
- Factors that did not lead to lower labor costs:
    - Higher CRV hourly wages. Weighted-average CRV hourly wages increased overall and by strata between 2018 and 2020, likely driven by the 13 percent (LA County) to 18 percent (statewide) increases in minimum wage between 2018 and 2020.

- Labor allocations. There were not significant changes in the allocation of CRV hours between material types or hours per ton by material type. In fact, overall hour allocations between CRV and non-CRV remained the same between 2018 and 2020.
- High wage sites. There were a small number of sites with relatively high owner wages (profits); though the number of higher wage sites increased between 2018 and 2020, the range of high wages diminished, likely contributing to a minor share of total costs.

Average Labor Costs per Recycler

Crowe calculated average labor costs per recycler by summing CRV labor costs across all RCs in the survey sample and dividing by the number of sampled recyclers. **Exhibit 3-24** provides a summary of average labor costs per recycler for aluminum, glass, and plastics. Average labor costs were nearly flat for aluminum with a one percent increase, a slight increase of 4 percent for glass, and a decrease of 8 percent for plastics. The 8 percent decrease for plastics was enough to result in the overall wage decrease of 2 percent between 2018 and 2020. The significant decrease for plastics compared to aluminum and glass is consistent with the 9 percent decrease in average PET costs per recycler.

Exhibit 3-24
Comparison of Average CRV Wages per Recycler (2018 and 2020)



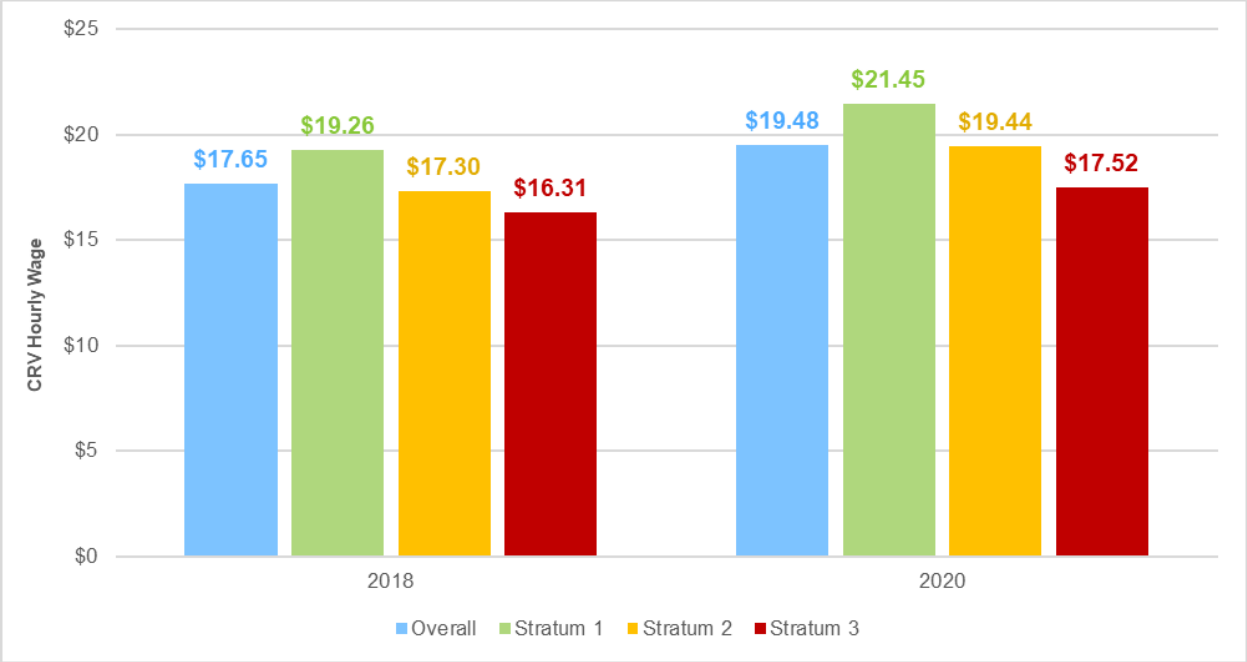
CRV Hourly Wages

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 3-25** provides a summary of CRV hourly wages. 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 over 50 percent of the cost of CRV recycling.

CRV hourly wages increased 10 percent between 2018 and 2020. Considering that California minimum wage increased 18 percent between 2018 and 2020, and CPI could account for a 4.5 percent increase, the 10 percent seems reasonable. Across strata, the greatest increase was in stratum 2, with a 12 percent increase. Though the hourly wages increased, the cost per ton for aluminum and PET decreased likely due to greater efficiency outweighing the higher labor costs.

To provide context, at 2,080 hours annually, $19.48 per hour is equivalent to $40,524 gross annual income. In 2020, the median household income in California was $78,696. The 2020 per capita income was $38,655. (Source: U.S. Census, American Community Survey: https://www.census.gov/programs-surveys/acs/). The California Poverty Measure for a family of four, slightly higher than the federal poverty level, was about $35,600 in 2020 (Source: Public Policy Institute of California (https://www.ppic.org/publication/poverty-in-california/).

Exhibit 3-25
Comparison of CRV Hourly Wages Overall and by Strata (2018 and 2020)



Increases in DYL, AOL, and Overall Wage per Hour

Consistent with the weighted-average increase in CRV hourly wage, the simple average of overall hourly wages increased across all strata. For strata 1 and 3, the simple average of hourly AOL wages decreased from 2018 to 2020. 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 3-26** provides a comparison of average hourly wages by strata and overall.

Exhibit 3-26
Comparison of DYL, AOL, and Overall Wage per Hour (2018 and 2020)

Average DYL per Hour

Strata	2018	2020	% Change
1	$15.63	$17.05	9%
2	16.43	16.72	2%
3	14.67	16.41	12%

Average AOL per Hour

Strata	2018	2020	% Change
1	$54.18	$45.77	-16%
2	32.83	39.67	21%
3	29.98	28.42	-5%

Average Overall Wage per Hour

Strata	2018	2020	% Change
1	$21.44	$23.69	10%
2	19.05	20.13	6%
3	17.56	18.38	5%

On average, CRV and non-CRV DYL hours make up over 80 percent of RC hours. The remaining less than 20 percent of RC hours are AOL. The increase in overall average DYL and AOL per hour from 2018 to 2020 were similar at around 8 to 9 percentage points. The increase in overall average wage per hour between 2018 and 2020 is close to 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, team members heard that low wage businesses such as recycling centers must respond to increases in minimum wage to compete for workers. Recyclers noted that increases in wages were in part, to compete with increased unemployment benefits that occurred during the COVID-19 pandemic. This could help explain why average hourly DYL increased, whereas the average hourly AOL decreased for both strata 1 and 3 sites from 2018 to 2020.

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 18 percent, from $11 per hour in 2018 to $13 per hour in 2020. Los Angeles County's minimum wage increased 13 percent between 2018 and 2020. Approximately one-third of surveyed processing fee recyclers in 2018 and 2020 were in LA County. As a result, increases in hourly wages in LA County sites has a significant impact on overall labor costs. However, because the increase in LA county was less than non-LA counties in 2020, it is likely that this did not contribute greatly to higher labor costs.

As **Exhibit 3-27** illustrates, LA County DYL increased 6 percent between 2018 and 2020, while non-LA County DYL increased 10 percent. Average DYL in non-LA County sites was over $1.00 per hour higher than LA County sites in 2018, and over $0.51 cents higher than LA County in 2020. AOL hourly wages also increased more significantly in LA County than the remainder of the state. However, overall, LA County wages per hour were still slightly less than the rest of the state. One reason for this could be that LA county wages are already higher than non-LA county wages, making it more difficult for recyclers in this area to further increase wages. As noted above, these data reflect a simple average wage per hour and include non-CRV and other business wages.

Exhibit 3-27
Comparison of Los Angeles County and non-Los Angeles County DYL, AOL, and Overall Wage per Hour (2018 and 2020)

Wage Category	LA County 2018 (n=56)	LA County 2020 (n=46)	LA County % Change	Non-LA County 2018 (n=98)	Non-LA County 2020 (n=100)	Non-LA County % Change
Minimum Wage	$13.25	$15.00	13%	$11.00	$13.00	18%
Direct Yard Labor (DYL)	$15.38	$16.25	6%	$15.26	$16.76	10%
All Other Labor (AOL)	$31.59	$42.87	36%	$37.03	$30.62	-17%
Overall Wage per Hour	$18.42	$18.89	3%	$18.79	$20.17	7%

Increases in Low Wage Recycling Centers

One of the challenges inherent in 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 two business categories represent a large share of the survey population – 78 percent in 2020. Over the last several years, Crowe has 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 down cost per ton. 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 2018 and in 2020. **Exhibit 3-28** illustrates that there was a significant increase in the number of surveyed recycling centers with overall average hourly wages that were less than minimum wage between 2018 and 2020. Between the two years, there was a 2x increase to the percentage of processing fee recyclers below minimum wage. Although it is difficult to determine the extent of the impact, this is one factor that would lead to a decrease in CRV costs per ton. The increase in low wage recycling centers seems at first glance to be inconsistent with the overall increase in CRV hourly wages. The increase in minimum wage could be a factor as well.

Exhibit 3-28
Comparison of Low Wage Recycling Centers (2018 and 2020)

Category	2018 (n=154)	2020 (n=146)
California Minimum Wage	$11.00	$13.00
Number of Surveyed PF Recyclers < Minimum Wage	14	26
Percent of Surveyed Sites < Minimum Wage	9%	18%
Range of Hourly Wages < Minimum Wage	$0.00 to $10.84	$2.25 to $12.95

A contributing factor to the increase in low-wage sites may be the spike of recycling centers closures that occurred in 2019 and 2020. Crowe's preliminary analyses indicate that the reduction in survey population recycling centers between 2018 and 2020 was primarily due a reduction of stratum 3 recyclers. **Exhibit 3-29** provides a comparison of the 2018 survey population of 674 recycling centers by strata using 2020 cost survey strata definitions to the 2020 survey population of 581 recycling centers by strata using the same 2020 cost survey strata definitions.

The proportion of large stratum 1 recyclers and mid-size stratum 2 recyclers of total recyclers increased between a factor of 1.2 to 1.3 times in 2020 compared to 2018, and the proportion of small stratum 3 recyclers decreased by a factor of 0.9 (a 10 percent decrease) for processing fee recyclers. The decrease in the proportion of the smaller stratum 3 recyclers contributes to lower overall costs. 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 Crowe can complete the field visit to the site. One hypothesis that is consistent with the findings is that many of these closures were small, not-profitable recycling centers. Unique to 2020 was the COVID-19 pandemic, which may have caused extra financial stress for smaller, stratum 3 recyclers, compounding the already large decrease between the 2018 and 2020 survey populations.

Exhibit 3-29
Comparison of Survey Population RCs by Strata using 2020 Strata Definitions (2018 and 2020)

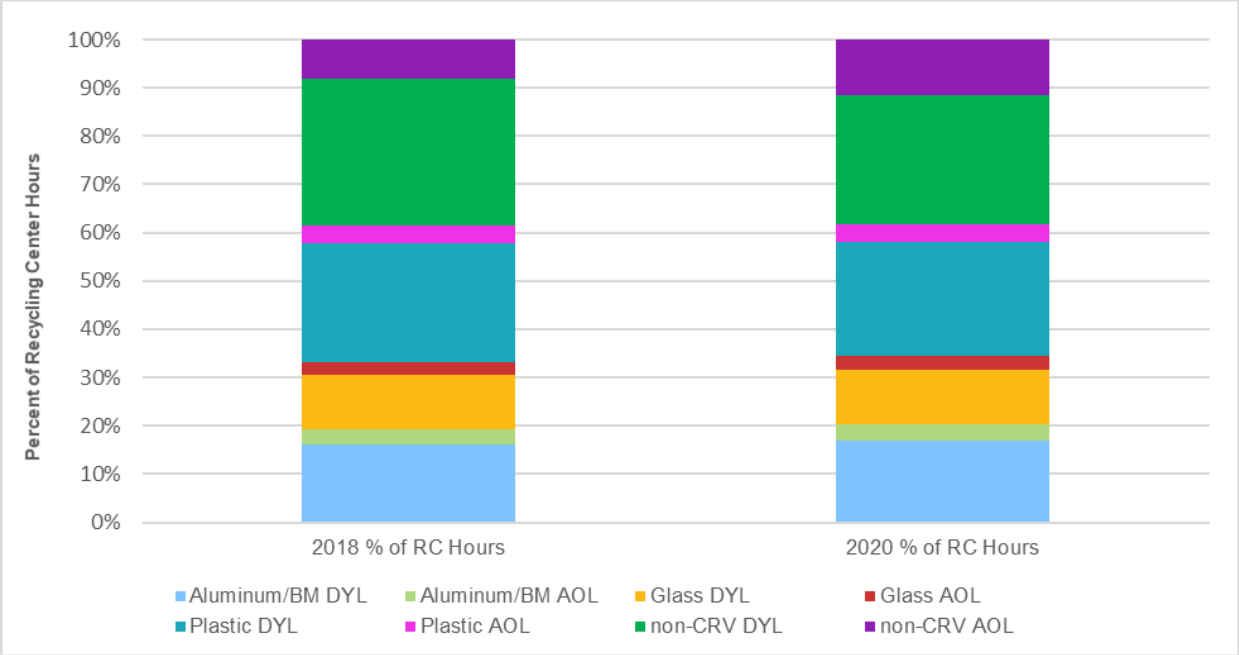
Strata Number and Definition	2018 Survey Population	2018 Proportion	2020 Survey Population	2020 Proportion	Change in Proportion	Direction of Change
Stratum 1: >=400 tons PET	53	8%	58	10%	1.3x	Increase
Stratum 2: 200 tons to <400 tons PET	125	19%	131	23%	1.2x	Increase
Stratum 3: <200 tons PET	496	74%	392	67%	0.9x	Decrease
Total	**674**		**581**			

Labor Allocations

Determining the cost per ton by material type depends on labor allocations at the recycler level. Crowe recognizes that it is difficult for recyclers to allocate labor hours across non-CRV, CRV, and CRV material types. Crowe has extensive experience conducting thousands of recycling center cost surveys and labor allocations to help recyclers through this process. Because this process is not straightforward, Crowe evaluated whether the changes in costs per ton between 2018 and 2020 were a result of allocating more (or less) labor hours to CRV materials. Crowe analyzed total labor hours by category across the 2018 and 2020 surveyed recyclers, comparing percent of recycling center hours by various categories, illustrated in **Exhibit 3-30.**

As **Exhibit 3-30** illustrates, there were not significant changes in the allocation of CRV hours between material types or hours per ton by material type between surveyed processing fee recyclers in 2018 and 2020. Additionally, the percent of hours allocated to non-CRV activity did not change between 2018 and 2020; however, the split between non-CRV DYL and AOL shifted towards greater AOL in 2020.

Exhibit 3-30
Percent of Recycling Center Labor Hours by Activity (2018 and 2020)

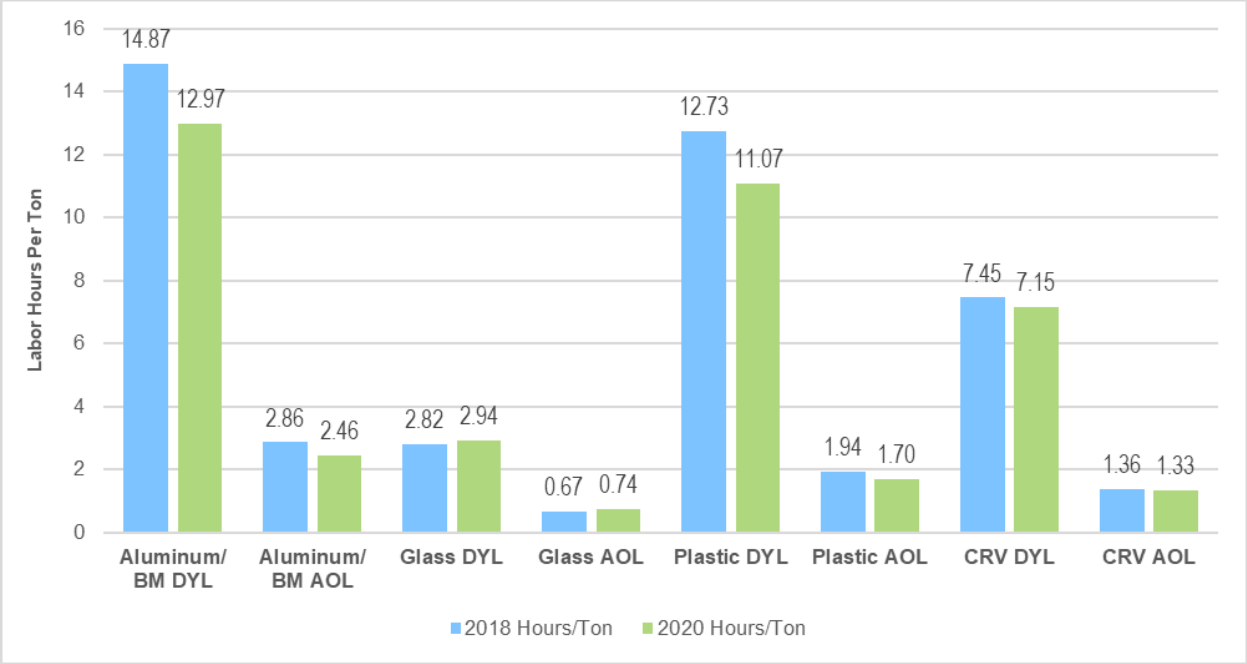


Decreased Hours Handling CRV Materials

Building on the labor hour analysis, Crowe calculated average labor hours per ton by material type based on survey sample hours by category and survey sample tons for each material type. Crowe excluded bi-metal tons, which reflect only 0.3 percent of aluminum/bi-metal total tons in 2020. For plastic, Crowe included PET and HDPE tons (HDPE represents 0.4 percent of total plastic tons).

Exhibit 3-31 illustrates that labor hours per ton decreased between 2018 and 2020 across all materials and labor categories, with the exception of glass DYL and glass AOL. As noted previously, the decrease in labor hours per ton for aluminum and plastic contribute to the lower aluminum and PET costs per ton. The increase in labor hours per ton for glass AOL and DYL may help explain the increase in glass cost per ton between 2018 and 2020.

Exhibit 3-31
Labor Hours per Ton CRV Material by Activity (2018 and 2020)



High Wage Sites

To determine whether higher profits/owner wages were a factor in the change in cost per ton, Crowe evaluated sites with the highest AOL wages per hour for the two-survey samples. In two prior surveys (2006 and 2008), high scrap prices (for aluminum and scrap metals) drove up owner wages significantly. Strong market conditions were not in place in 2020. For comparison, Crowe considered whether the changes in higher AOL wages per hour might have been a factor in the cost per ton changes between 2018 and 2020. To evaluate this, Crowe compared high AOL wage sites for 2018 and 2020. 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 20 percent of total recycler hours.

For this analysis, Crowe focused on recycling centers with high AOL wages of over $100 per hour to give us an indication of whether high profits (or lack thereof) were impacting cost per ton. In 2020, the number of recycling centers with AOL wages over $100 per hour nearly doubled, increasing from 4 to 7. However, the range of AOL wages per hours decreased from, $444.42 at the highest in 2018 to $280.65 in 2020. Comparing the average AOL wage per hour for all the high wage sites in 2018 and 2020, the recycling sites in 2018 have a higher AOL average hourly wage.

Owner's Wages

As part of this report, Crowe analyzed the owner's profitability (i.e., income) from survey years 2016, 2018, and 2020. In 2016, 80 sites of 143 surveyed had available owner's incomes. In 2018 and 2020, Crowe had a sample of 101 sites with owner's wages out of 155 and 146, respectively. Below lists a summary of the key findings from the owner's profitability analysis:

- Factors that directly impact costs:
    - Owner's wages as a percent of total CRV costs have decreased from 31 to 24 percent from 2018 to 2020 for all RC's (a 22 percent reduction in the share of costs attributed to owners), with most of the decrease attributed to the significant decrease in owner's wages for stratum 3 recyclers.
    - Average cost per ton for sites with owners earning under the poverty level across 2016 to 2020 were lower than the statewide average costs. As labor costs generally make up half of a recycler's overall CRV costs, profitability could significantly impact costs, especially for recyclers for which the owner contributes a large portion of the recycler's overall hours. Sites with owners earning under the poverty level are not profitable and likely have low costs, but likely also low volumes. There are many dynamics that influence costs, however, should these low profit recyclers close, volumes may be shifted to other, more, or less, efficient recyclers.

- Factors that provide insight to the state of recycling centers:
    - The percentage of tons associated with recyclers with owners who earn below the poverty level decreased from 31 to 24 percent between 2016 and 2018 and down to 18 percent in 2020. A similar trend is seen with the percent of owners earning below the poverty level which decreased from 44 to 36 percent between 2016 and 2018 and down to 33 percent in 2020. These decreases indicate that low-wage recyclers are likely no longer operating.
    - Stratum 3 recyclers had the highest share of recyclers with owner's earning both under the minimum wage and under the poverty level, which further validates that larger sites are generally more profitable.
    - For sites with owner's income below the California poverty level, the hourly rates for owners were far below the hourly rates of employees and overall hourly rates. Thus, owners of these sites were making less than their employees.
    - 64 percent of RCs with owners earning below poverty level decertified within two years after the 2016 survey and 17 percent after the 2018 survey. There were none that closed from the 2020 survey, but this is likely due to the time lag between closure and actual decertification. Overall, this indicates that recyclers earnings below the poverty level have a high chance of decertifying.
    - The non-owner average hourly rate for 2020 increased by 5 to 13 percent as compared to 2018, depending on strata. This made the non-owner average hourly rate between 50 to 70 percent above the 2020 minimum wage, or $19.40 to $22.13 per hour. This is consistent with the narrative that during the pandemic, recyclers had difficulty competing with unemployment benefits and many times, were forced to raise their rates to retain or attract employees.

Percent of owner's CRV wages as a share of total CRV costs is the greatest for stratum 3 sites, however it has been rapidly decreasing over the past four years from 74 percent in 2016 to 30 percent in 2020. Overall, the percent of owner's wage stayed flat between 2016 and 2018, then decreased from 31 percent to 24 percent in 2020. Between 2018 and 2020, owner's profitability for recyclers of all sizes decreased with stratum 3 decreasing the most. Lower owner profitability would contribute to lower costs.

Exhibit 3-32 displays the percent of owners under the minimum wage by strata from 2016 to 2020. For greater accuracy, Crowe stratified the data by jurisdiction (e.g., statewide minimum wage, Los Angeles County). There are a large portion of RC's located in Los Angeles County, which has a 5 to 15 percent difference from the statewide minimum wage, depending on the year. Stratum 3 recyclers had the highest proportion of RCs with owners earning under the minimum wage across all three years. Stratum 2 remained relatively consistent across 2016 to 2020 for percent of owners under the minimum wage and stratum 1 had a significant decrease from 2016 to 2018 before coming back up slightly in 2020.

Exhibit 3-32
Proportion of RCs with Owner Income Under Minimum Wage by Strata (2016-2020)

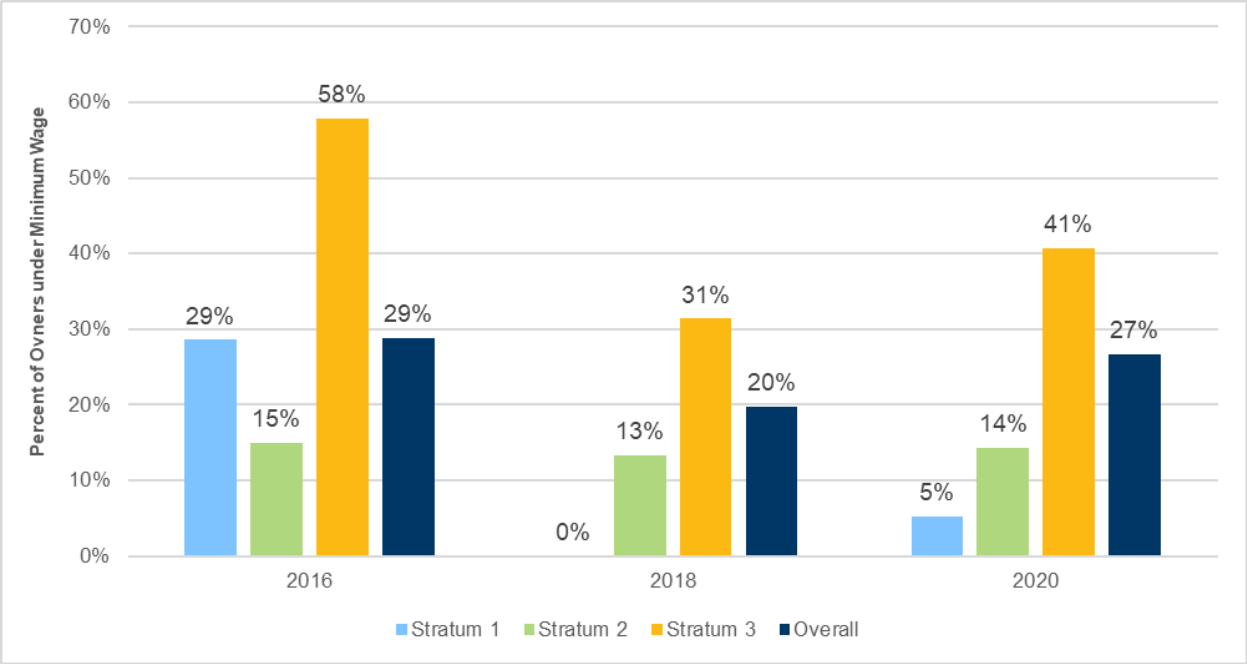
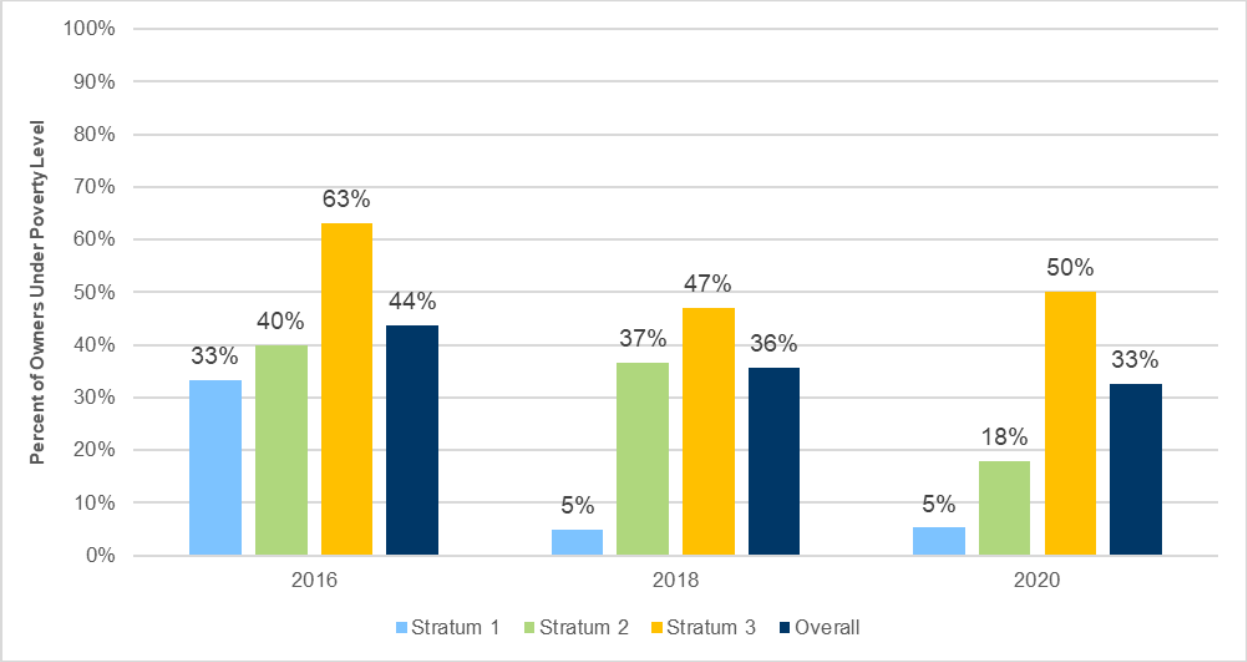


Exhibit 3-33 shows the percent of owners earning under the poverty level[18] by strata. The poverty level is for a family of four living in California. Stratum 3 recyclers have been disproportionately affected over the years with low owner's income. 50 percent of the small sized PF recycler's owners are earning below the poverty level, while only 5 percent of the large recycler owners are living below the poverty level. The income gap has grown significantly between small and large recyclers. This disparity is likely due to economies of scale since expenses flatten out or are reduced when the operations increase in output and size. There are less recyclers who are earning under the poverty level as compared to past survey years. This could be due to stronger, profitable recyclers stay in business and expand, while those who are unprofitable end up closing down.

Exhibit 3-33
Percent of Owners Earning Under the Poverty Level by Strata (2016-2020)



[18] Poverty in California. Public Policy Institute of California. July 2021. https://www.ppic.org/publication/poverty-in-california/

G. Changes in Transportation Costs

Crowe analyzed CRV transportation costs to gain a better understanding of how transportation impacted the changes in cost per ton between 2018 to 2020. Transportation decreased in 2020 but was still one of the larger category contributors to 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 between the two years, 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 seven (7) percent of total CRV costs for PF recyclers, a slight decrease from 2018 which was eight (8) percent.

Exhibit 3-34 provides a comparison between diesel retail price per gallon[19] and average transportation costs per recycling center from 2010 to 2020. From 2018 to 2020, average transportation costs per recycling center decreased 9 percent while diesel prices decreased 13 percent.

Exhibit 3-35 shows a comparison between 2018 and 2020 for transportation cost per ton for PF recyclers. Overall, the transportation cost per ton decreased 2 percent between 2018 and 2020. There are more varied differences within strata with the largest difference with stratum 1, with a 23 percent decrease in transportation cost per ton. Stratum 2 transportation cost per ton increased 36 percent, and stratum 3 recyclers decreased by 16 percent.

[19] 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 3-34
Comparison of Average Transportation Cost per Surveyed Recycling Center and Diesel Prices (2010 through 2020)

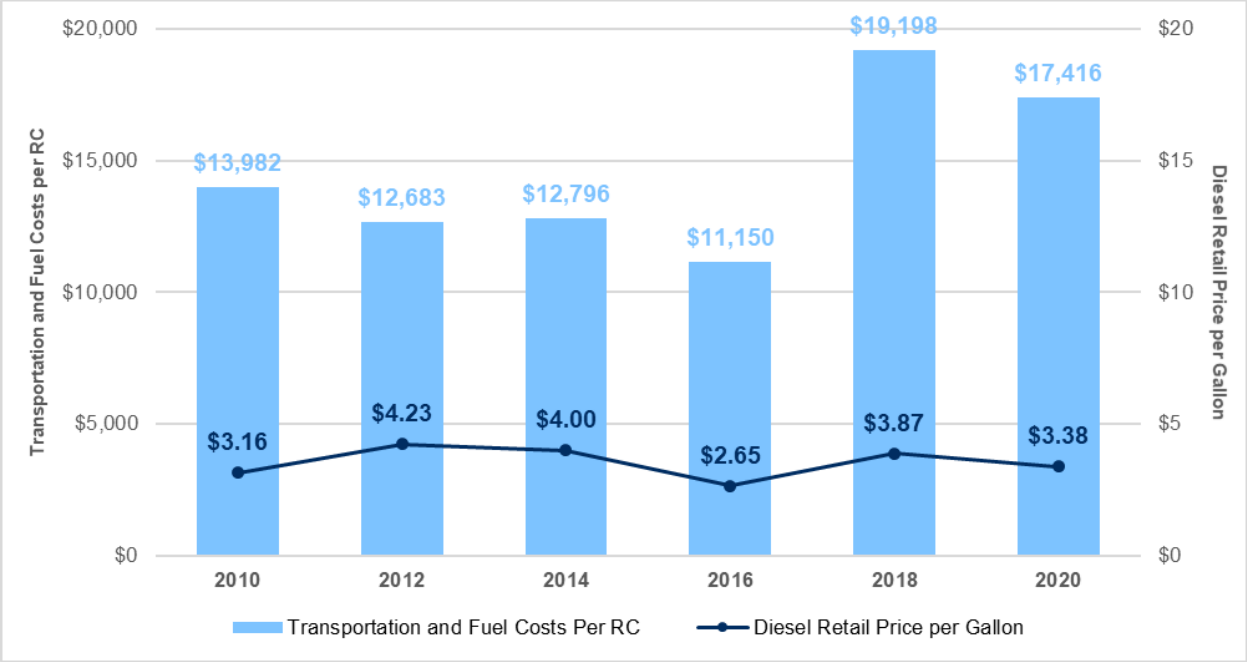


Exhibit 3-35
Transportation Cost per Ton (2018 and 2020)

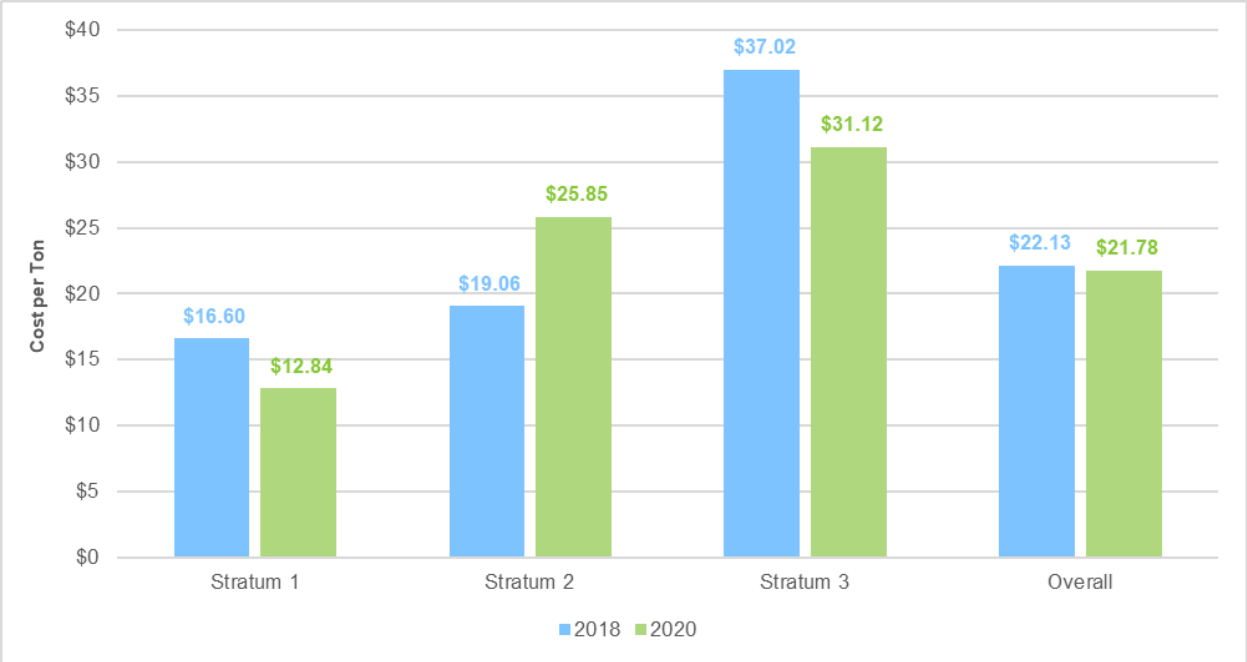


Exhibit 3-36 shows the average RC cost per ton for aluminum, glass, and PET #1, broken out by different hauling methods: self-hauling, third-party, processor scrap value deduction, and payment to processor. The lowest cost per ton is associated with processor pick-up with a scrap value deduction, as 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 costliest transportation methods were third-party hauler for aluminum and plastics, and self-hauling for glass. 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.

Exhibit 3-36
2020 Aluminum, Glass, and Plastic Average Cost Per Ton, by Hauling Method

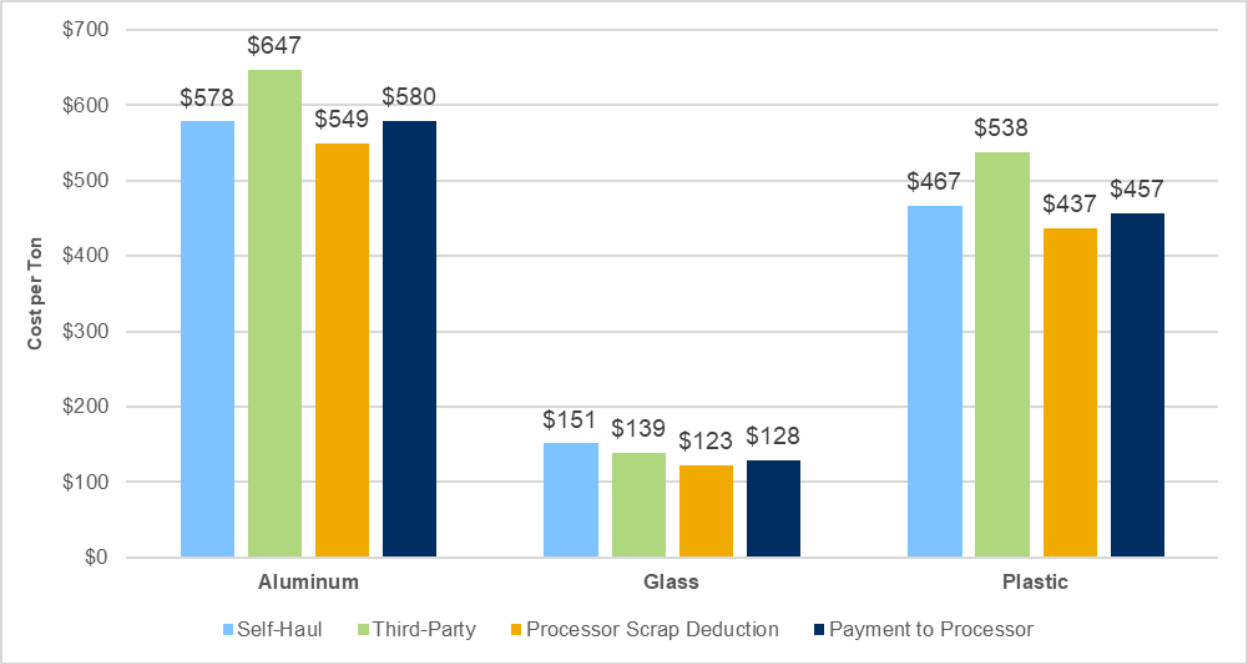
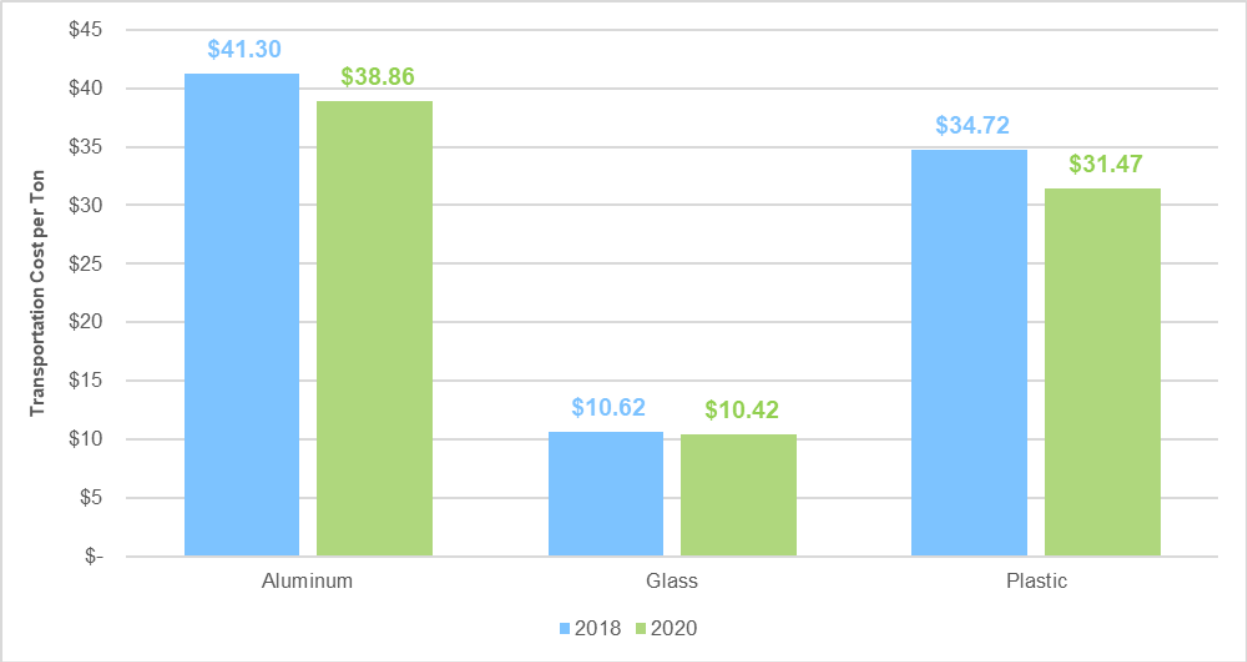


Exhibit 3-37 shows a comparison between 2018 and 2020 for transportation cost per ton for aluminum, glass, and plastic. Transportation cost per ton was calculated by taking the sum of transportation and fuel costs divided by the total tons for each material for the 2018 and 2020 survey samples. The results show that transportation cost per ton for all materials decreased, with aluminum and plastic experiencing the largest change. Overall, there was a decrease in transportation cost per ton across all material types. Plastics decreased the most with a decrease of 9 percent, followed a decrease of 6 percent for aluminum/bi-metal, and then a slight decrease of 2 percent for glass. The larger decrease for plastic is consistent with the overall cost per ton results.

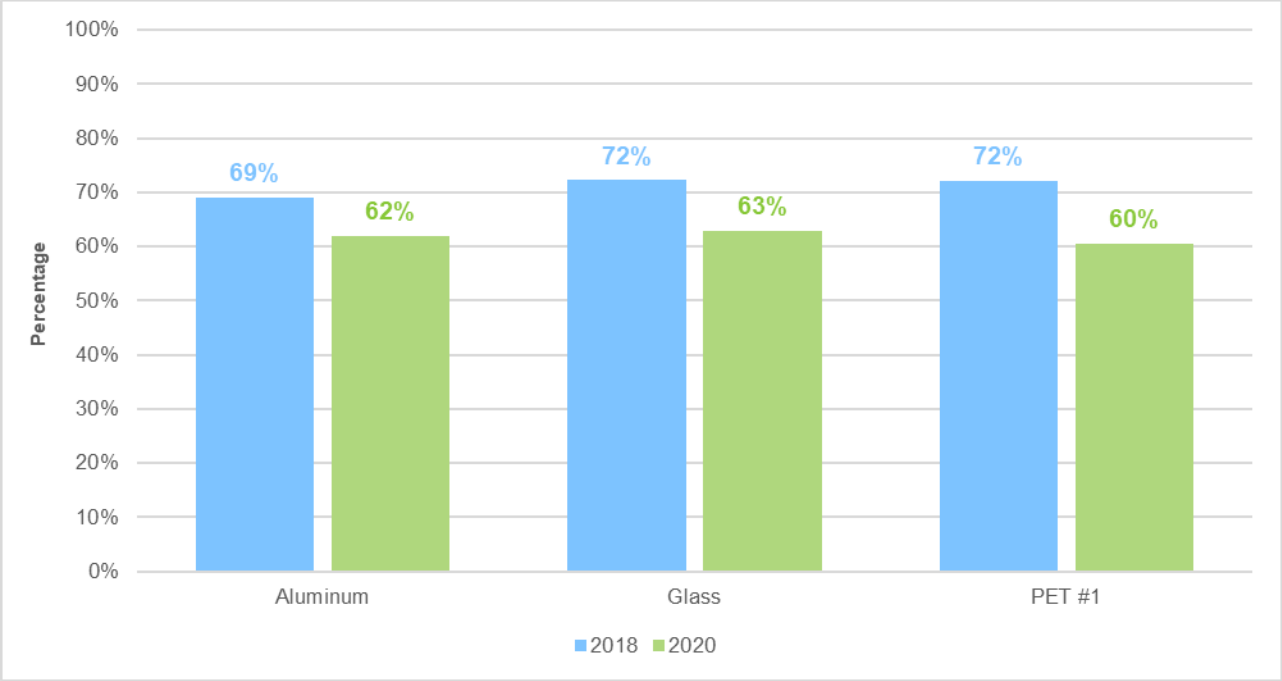
Exhibit 3-37
2018 vs 2020 – Aluminum, Glass, and Plastic Transportation Cost Per Ton



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

Exhibit 3-38 shows a comparison between 2018 and 2020 for the percent of recyclers that utilize scrap value deduction. The percentages are out of the recyclers that have a processor pick-up material, roughly one third of the total PF recyclers for both years. For all materials, the rate of scrap value deduction decreased 7 to 12 percentage points to about 60 percent (decreases range between 10 to 16 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. The moderately lower use of scrap value deduction in 2020 compared to 2018 indicates that changes in scrap value deduction contributed to higher, rather than lower costs.

Exhibit 3-38
2018 vs 2020 – Aluminum, Glass, and PET #1 Transportation with Scrap Value Deduction



H. Summary of Processing Fee Cost Analyses

Overall, the change in cost per ton between 2018 and 2020 was significant. Crowe's analyses identify a combination of factors that may be impacting recycling costs. The cost per ton for aluminum and PET #1 decreased, as compared to 2018. The cost per ton for glass and HDPE #2 increased, as compared to 2018. Many factors combine to influence recycling center costs, tons, and cost per ton, both upward and downward.

Between 2018 and 2020 there was a reduction in the overall survey population of PF recycling centers, and to a lesser extent, a decrease in the total tons of CRV material recycled. This combination alone could suggest a possible decrease in cost per ton between 2018 and 2020. The analysis of 2018 and 2020 cost survey data identifies six factors appear to have that contributed to changes in costs per ton between 2018 and 2020. The six factors are:

- The average number of tons per recyclers increased significantly while average costs per recycler were either flat or decreased. The number for aluminum increased by 13.2 percent and PET #1 increased 10.8 percent. Average costs per recycler did not change for aluminum and decreased 9 percent for PET #1. In general, higher volume recyclers are more efficient and have lower costs per ton. Increasing the amount of material moving through a recycler means workers are more productive, handling more tons per hour. This increased efficiency and ultimately contributes to overall lower costs per ton.
- The proportion of surveyed recycling centers with average hourly wages below minimum wage roughly doubled, which was likely due to a higher percentage of owners making low to no profit as sole proprietors and partnerships. Lower wages contribute to lower recycling costs.
- The 13 percent decrease in diesel fuel prices between 2018 and 2020 contributed to lower transportation costs, which contributed to lower overall costs (note: changes in scrap value deduction did not contribute to lower costs since it decreased between 2018 and 2020; also, the changes in hauling method did not contribute to lower costs).
- The proportion of small stratum 3 recyclers slightly decreased when using 2020 strata definitions, which indicates the recycler population as a whole is shifting to lower cost, strata 1 and 2, recyclers.
- The proportion of owner's CRV wages (owner income/profitability) of total CRV costs decreased from 31 to 24 percent between 2018 and 2020.[20] A lower proportion of owner profitability would contribute to lower costs.

[20] Comparison made for recyclers with available owner's income data only, which was 80 of 154 sampled recyclers for 2018, and 101 of 146 sampled recyclers for 2020.

- For glass and HDPE #2, average tons per recycler were steady (glass), or decreased slightly (HDPE). This is likely the largest contributor to the increase in costs per ton for these materials. The increased costs per ton for glass and HDPE #2 likely reflect general operating cost increases between 2018 and 2020 – increases that were counteracted by higher volumes per recycler for aluminum and PET #1.

The factors that decreased costs per ton for aluminum and PET #1 were significant enough to overcome the 4.5 percent increase in Consumer Price Index (CPI) from 2018 to 2020, the 13 to 18 percent increase in minimum wage, and a decrease in the proportion of recyclers utilizing a scrap value deduction. Crowe provide an analysis of potential impacts of COVID-19 in Section 4 of this report.

4. Macroeconomic Factors and Implications

This section provides an overview of key macroeconomic factors that help explain the overall environment recyclers operated in over the last two years. First, a general summary of COVID-19 impacts to recyclers' operations that surveyors identified during Crowe's on-site visits. Second, a detailed overview of additional analyses conducted to estimate the fiscal impact of fluctuating market dynamics and other fiscal pressures on recyclers' "bottom line". This section is organized as follows:

A. COVID-19 Impacts
B. Scrap Market Dynamics.

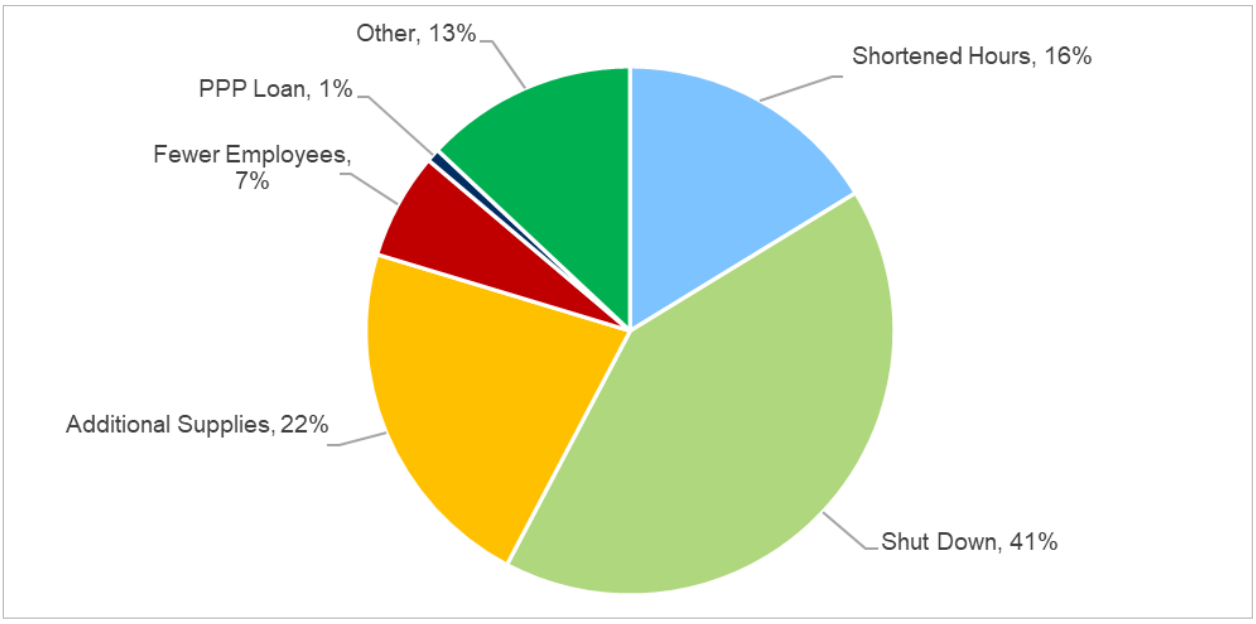
A. COVID-19 Impacts

Approximately two-thirds of the 146 PF recyclers surveyed identified COVID-19 impacts to their business in 2020. These sites cited the following factors as COVID-19 impacts:

- Shutdowns
- Shortened hours
- Fewer employees
- Additional supplies
- PPP loans and other

Exhibit 4-1 illustrates a summary of the COVID-19 impacts by factor. Shutdowns account for most reported COVID-19 impacts, followed by additional supplies, and shortened hours. "Other" COVID-19 impacts, which made up around 13 percent of sites with reported COVID-19 changes, included factors such as volume changes, pre-sorting requirements, higher turnover rates, or switching processors.

Exhibit 4-1
Summary of COVID-19 Impacts



Shutdowns

The stay-at-home orders and shutdowns affected recyclers differently. In California, recyclers were deemed as essential under the "Essential Critical Infrastructure Workers" document released by the Governor. However, general restrictions and overall COVID-19 guidance was largely left up to individual counties. In some cases, recyclers received quick approvals to operate during the quarantine, only shutting down for a few days or not at all. In other cases, recyclers stayed closed for several weeks to months due to severe outbreaks.

From the 146 PF sites surveyed in this report, about one third stated they had to shut down for a period of time. Of those that shut down, they were closed an average of 6.8 weeks, mostly during the beginning of the pandemic starting in mid-March 2020. In many cases, ceasing operations for a few weeks to months forced recyclers to operate with greater efficiency during re-opening as customers would hold onto materials and take them with fewer trips. On the other hand, a few sites surveyed had closed operations completely after shutting down a few months. They were likely sites that were on the verge of closure already.

Shortened Hours

In addition to shutdowns, several recyclers noted changes in their operating hours in 2020, largely due to the pandemic. On April 23, 2020, the California Governor released executive order N-54-20 which suspended the requirement for recycling centers to operate a minimum number of hours per week or remain open during specific periods of time. Following this, in June of 2020, the Governor released N-70-20 to extend the suspension for 60 more days, allowing recycling centers to shorten their operating hours during the pandemic.

During the 2020 survey, several recyclers cited shorter operation hours, with earlier closures, later opening times, or reducing days of operations. With less business hours, recyclers likely became more efficient with reduced downtime as customers brought in nearly the same amount of material (as evidenced by a slight decline in population volumes) in a compressed timeframe.

Fewer Employees and High Turnover

Of the recyclers that identified COVID-19 impacts, about a quarter mentioned having fewer employees, difficulty keeping staff, or higher turnover rates than usual during the year. In many cases, recyclers cited that it was hard to compete with the increased unemployment benefits that rose during and after forced shutdowns. To attract future employees or retain their current employees, many recyclers noted having to increase hourly wages beyond minimum wage, which would increase labor costs.

The results from the cost survey show that overall CRV hourly wages increased from 2018 to 2020 by ten percent. Though much of this could be contributed to the increase in minimum wage, the pressure created by the increased unemployment benefits during the pandemic likely impacted wages. Non-owner hourly rates show an increase between 5 and 13 percent, depending on strata, for selected RCs with owner's incomes below the poverty line from 2018 to 2020. This made the non-owner average hourly rate between 50 to 70 percent above the 2020 minimum wage, or $19.40 to $22.13 per hour. Despite increased hourly rates, overall direct labor costs, decreased slightly by 2 percent from 2018 to 2020, which could likely speak to the fewer employees, reduced owner income, shortened hours, and site shutdowns.

Additional Supplies

Many, if not all, recyclers had to purchase additional supplies as a response to the COVID-19 pandemic even if they did not explicitly notify the survey team. Some examples of the additional supplies purchased were items such as hand sanitizer, face masks, gloves, physical barriers such as plastic or wooden screens, hand-washing stations, caution tape, and signs. Recyclers still had to purchase additional supplies to operate in the new COVID-19 environment. Average supply costs increased, although this has relatively little effect on overall costs.

Social Distancing and Pre-Sorting

Additional COVID-19 impacts included social distancing requirements and pre-sorting. Many, if not all, recyclers required their customers to practice social distancing while in the yard or waiting in line. Some even indicated they moved their employees to altered positions for COVID-19 specific tasks, such as parking attendants or greeters to help space out customers while they waited or to manage the increased flow of customers during the months following re-opening. To make dropping off material more efficient/less time consuming, many recyclers started requiring customers to pre-sort their materials prior to arriving at the site. This likely helped increase labor efficiency and decrease costs as sites could service more customers and therefore handle more materials in a shorter amount of time.

Volume Changes

Lastly, recyclers indicated that COVID-19 may have influenced changes in their volumes during the year. For some, recyclers saw their volumes decrease steeply during the lockdown and then increase dramatically after restrictions softened as customers held onto their materials during stay-at-home orders and then came with bigger loads later in the year. Others noted greater volumes in 2020 because their competitors or other close-by recycling sites shut down or closed, increasing their own customer base. While others stated decreases in volumes due to bar closures and general inactivity.

The population volumes show that overall tons redeemed decreased slightly from 2018 to 2020, primarily due to a decrease in tons redeemed by stratum 3 recyclers. This can likely be attributed to the decrease in number of stratum 3 recyclers from 2018 to 2020.

B. Scrap Market Dynamics

Crowe conducted additional analysis of the 2020 survey results to estimate how scrap market dynamics during the last two "pandemic" years impacted recyclers' profitability. Specifically interested in identifying if recyclers' costs were adequately covered by estimated revenues generated from a combination of scrap income and processing payments over the last two calendar years. To conduct this analysis, Crowe utilized a combination of the 2020 cost per ton results presented in *Section 2* of this report along with historical and current scrap value per ton data[21] to calculate the estimated fiscal impact of 2020 and 2021 scrap market values for the Program's primary materials – aluminum, PET #1, glass, and HDPE #2.

Summary of Results

- In 2020, the results indicate recyclers' estimated costs were greater than their estimated revenues signaling recyclers, on average, were not profitable in 2020 due to inadequate coverage from aluminum scrap revenues and processing payments and reduced scrap revenues from PET #1 and HDPE #2.
- In 2021, the results indicate recyclers' estimated costs were lower than their estimated revenues signaling recyclers, on average, were profitable due to higher than adequate coverage from aluminum scrap revenues and processing payments from glass.
- The combined 2020 and 2021 results indicate 108 percent of recyclers' costs were covered signaling recyclers' profitability was slightly lower than the 10 percent reasonable financial return (RFR) applied to processing payments.

Scrap Values Per Ton

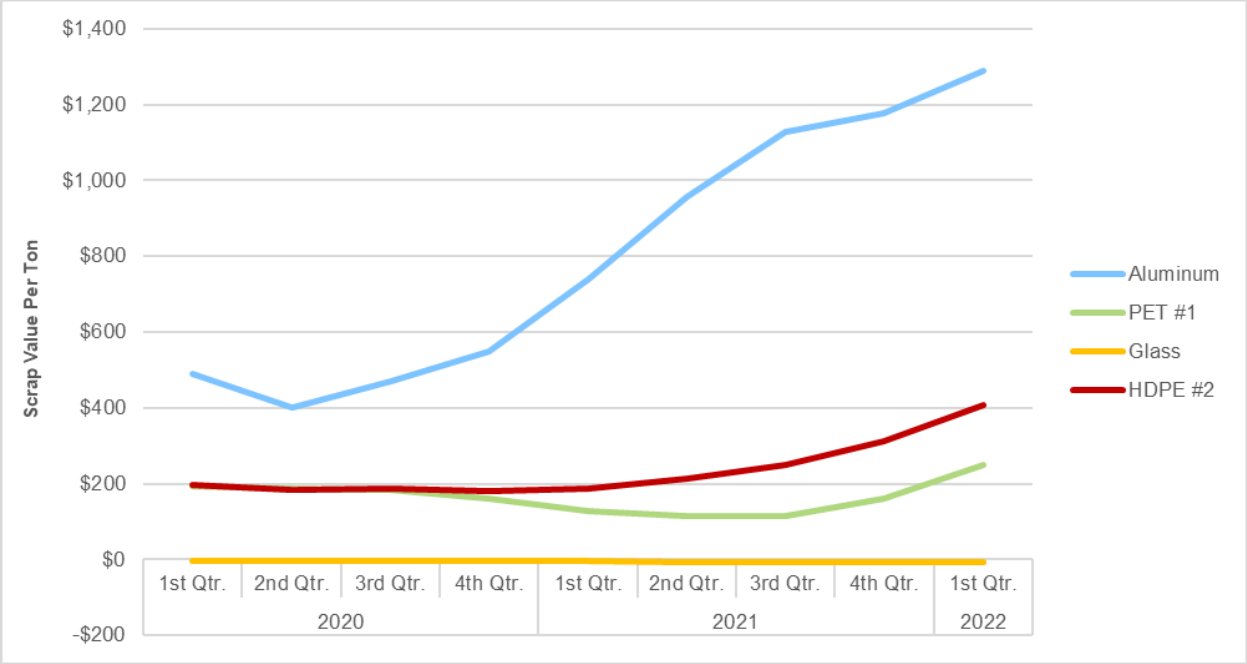
Fluctuations in scrap values per ton over the last two calendar years have varied by material type, as shown in **Exhibit 4-2.** From the first quarter of 2020 to the first quarter of 2022, aluminum tripled in value, PET #1 increased nearly 30 percent, glass remained valueless, and HDPE #2 doubled in value. These fluctuations signal an improvement in scrap market values for aluminum, PET #1, and HDPE #2, but expound the volatile scrap market conditions recyclers experienced in 2020 and 2021.

In 2020, aluminum averaged $477 per ton in value, PET#1 averaged $182 per ton in value, and HDPE #2 averaged $187 per ton in value. In 2021, aluminum averaged $1,000 per ton in value, PET#1 averaged $130 per ton in value, and HDPE #2 averaged $240 per ton in value. Finally, in the first quarter of 2022, aluminum averaged $1,290 per ton in value, PET#1 averaged $250 per ton in value, and HDPE #2 averaged $408 per ton in value.

---

[21] Crowe utilized CalRecycle's scrap value per ton data for PET #1, glass, and HDPE#2 to conduct this analysis, and utilized Secondary Materials Market's scrap value per pound data for aluminum.

Exhibit 4-2
Quarterly Scrap Value Per Ton – Aluminum, PET #1, Glass, and HDPE #2 (2020 through 2022)



Processing Payments Per Ton

The Program's processing payments to recyclers for PET #1, glass, HDPE #2, and minority materials account for fluctuations in scrap values. In general, the following trend applies: when scrap values increase, then processing payments decrease, and when scrap values decrease, then processing payments increase.

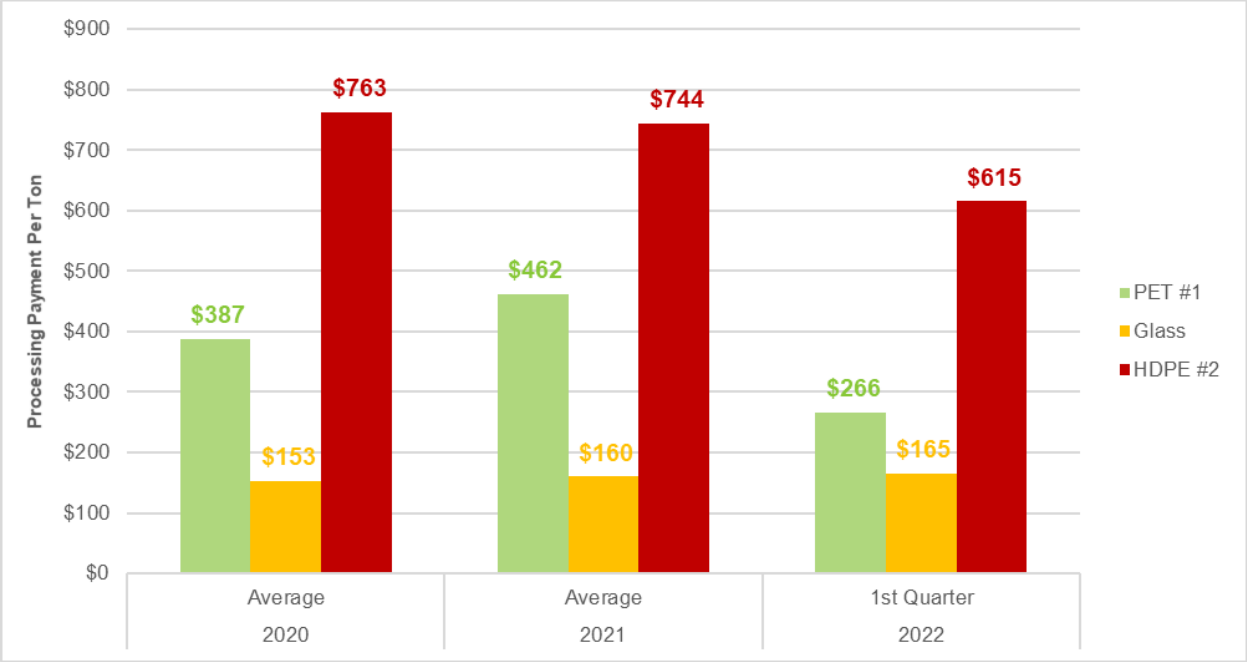
The processing payment is defined as the difference between the statewide, weighted-average cost of recycling (as determined by the cost survey), multiplied by a COLA and a reasonable financial return (RFR), and the average scrap value paid to recyclers (for the period October through September of the previous year). The processing payment is paid by CalRecycle to processors, who then pass the payment on to recyclers, based on the weight of material redeemed. The equation is as follows:

Processing Payment = (Cost of Recycling × COLA × Reasonable Financial Return) – (Scrap Value)

In 2020, processing payments for PET #1, glass, and HDPE #2 were relatively stable for the first three quarters due to stabilization in scrap value prices for these materials. Beginning in the fourth quarter of 2020 through the third quarter of 2021, PET #1's scrap value per ton decreased at varying rates per quarter resulting in general increases to processing payment per ton during this timeframe. Beginning in the first quarter of 2021, HDPE #2's scrap value per ton increased resulting in a decrease in processing payment per ton through the year.

Exhibit 4-3 provides a comparison of annual average PET #1, glass, and HDPE #2 processing payments per ton in 2020 and 2021 compared with the first quarter of 2022. PET #1 average annual processing payments increased from $387 per ton in 2020 to $462 per ton in 2021, an increase of nearly 20 percent, and decreased to $266 in the first quarter of 2022. Glass average annual processing payments increased from $153 per ton in 2020 to $160 in 2021 and increased to $165 in the first quarter of 2022. HDPE #2 average annual processing payments decreased from $763 per ton in 2020 to $744 per ton in 2021 and decreased to $615 in the first quarter of 2022.

Exhibit 4-3
Average Processing Payment Per Ton – PET #1, Glass, and HDPE #2 (2020 through 2022)



Estimated Revenues and Costs

Crowe calculated recyclers' estimated revenues and costs to determine how variability in scrap values in 2020 and 2021 impacted their "bottom line". Crowe averaged the strata's 2020 tonnage (aluminum, glass, PET #1, and HDPE #2) as a basis to identify potential differences in profitability between large, medium, and small recyclers. Below is a summary of additional details related to how Crowe calculated estimated revenues and costs in 2020 and 2021 by strata as part of the analysis:

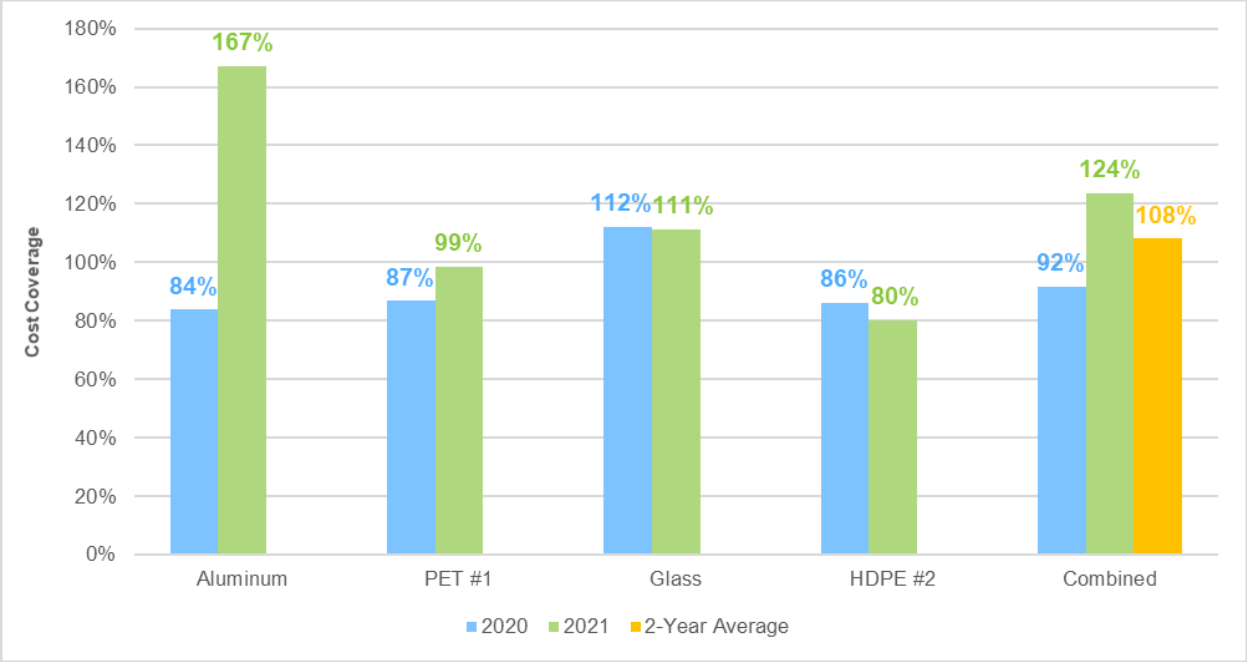
- **Calculation of estimated revenues:** In combination with 2020 tonnage, Crowe utilized the 2020 and 2021 average annual processing payments per ton for PET#1, glass, HDPE #2 to calculate estimated revenues generated from these materials. Crowe also utilized the 2020 and 2021 average scrap value per ton for aluminum to calculate estimated revenues generated from aluminum in 2020 and 2021.

- **Calculation of estimated costs:** In combination with 2020 tonnage, Crowe utilized the 2020 survey cost per ton results for aluminum, PET #1, glass, and HDPE #2 to calculate estimated costs for recyclers in 2020. Crowe then utilized CPI-adjusted 2020 cost per ton results for aluminum, PET #1, glass, and HDPE #2 to calculate estimated costs for recyclers in 2021.

In 2020, the results indicate recyclers' estimated costs were greater than their estimated revenues signaling, on average, recyclers were not profitable in 2020 due to inadequate coverage from aluminum, PET #1, and HDPE #2 revenues. Conversely, in 2021, the results indicate recyclers' estimated costs were lower than their estimated revenues signaling, on average, recyclers were profitable due to higher than adequate coverage from aluminum and glass revenues.

Exhibit 4-4 provides a summary comparison of cost coverage by material type (aluminum, PET #1, glass, and HDPE #2) in calendar 2020 and 2021 based on estimated revenues and costs for all strata. In 2020, approximately 92 percent of recyclers' costs were covered by their estimated revenues indicating likely deficits in profits. In 2021, roughly 124 percent of recyclers' costs were covered by their estimated revenues indicating that recyclers were likely profitable in 2021. Combining 2020 and 2021 results indicate 108 percent of recyclers' costs were covered indicating a profitability slightly lower than the 10 percent RFR applied to processing payments.

Exhibit 4-4
Comparison of Cost Coverage by Material Type (2020 and 2021)



5. Processing Payments and Processing Fees

In this section, Crowe describes how processing payments and processing fees are calculated. Crowe then compares current and historical processing payments and processing fees based on survey results from 2004 to 2020 and examine 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 California Beverage Container Recycling and Litter Reduction Act (AB 2020, Margolin, Chapter 1290, Division 12.1, Chapter 4, Section14575(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 COLA. This cost is used in the processing payment and processing fee calculations. **Exhibit 5-1** 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 Regulations specify 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, 2022 processing payment calculation also includes a COLA of 5.1 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 aligns the survey year to the year in which processing payment and processing fees are applied. The cost data for the January 1, 2022 processing payments and fees is from 2020 and the scrap value is based on average scrap values from October 1, 2020 through September 30, 2021. 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 aligns the cost data with the processing payment and processing fee period.

Exhibit 5-1
Historical Reasonable Financial Return Values (1991 to 2022)

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%

Year	Reasonable Financial Return
2014	4.10%
2015	2.81%
2016	0.92%
2017	-5.85%
2018 Nonrural	11.5%
2018 Rural	16.6%
2019 Nonrural	11.5
2019 Rural	16.6
2020	10.00%
2021	10.00%
2022	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 processing fees was that each container type should cover its own cost of recycling 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. The processing fee would then, 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 COLA and the RFR, and the average scrap value paid to recyclers (for the period October through September of the previous year). The equation is as follows:

Processing Payment = (Cost of Recycling × COLA × Reasonable Financial Return) – (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 CalRecycle, 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, Assembly Bill 28 (Jackson, Chapter 753, Statutes of 2003) established the current system whereby unredeemed funds, when available, are used to subsidize the processing fee by a minimum of 35 percent, up to 90 percent, depending on the recycling rate (and availability of funds).

Under current statutory requirements, the processing fee for a given container type is equal to a specified percentage of the processing payment, depending on the recycling rate in the previous fiscal year, as shown in **Exhibit 5-2.** 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 5-3 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 5-4 provides the per ton processing payments for recyclers, effective January 1, 2022.

Exhibit 5-5 is a copy of the 2022 Processing Fees notice, published by CalRecycle on December 20, 2021. The Exhibit provides components of the processing payment calculations, as well as the processing payments per ton and per pound, and the processing fees per container. Exhibit 5-5 also documents the California Public Resources Code, Division 12.1, Chapter 4, Section 14575(f) requirement to reduce in the processing fee for glass and PET #1.

Exhibit 5-2
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 5-3
Processing Fee Reduction Factors for January 1, 2022

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 5-4
January 1, 2022 Processing Payments

Material	Processing Payment
Glass	$165.32
PET #1	265.58
HDPE #2	615.27
PVC #3	1,609.73
LDPE #4	2,296.17
PP #5	$2,048.81
PS #6	1,266.52
Other #7	1,395.28
Bi-Metal	1,289.09

Exhibit 5-5
Processing Fees Public Notice (December 20, 2021)

Table 1 - 2022 Processing Fees (Effective January 1, 2022)

	Glass	PET	HDPE	Vinyl	LDPE	PP	PS	Other	Bimetal
Cost of Recycling per Ton with Reasonable Financial Return & COLA	$ 158.07	$ 516.01	$ 1,023.40	$ 1,609.74	$ 2,296.44	$ 2,060.21	$ 1,276.12	$ 1,398.20	$ 1,290.00
Scrap Value per Ton	-$7.25	$ 250.43	$ 408.13	$ 0.01	$ 0.27	$ 11.40	$ 9.60	$ 2.92	$ 0.91
Processing Payment Per Ton Redeemed	$ 165.32	$ 265.58	$ 615.27	$ 1,609.73	$ 2,296.17	$ 2,048.81	$ 1,266.52	$ 1,395.28	$ 1,289.09
Processing Payment Per Pound Redeemed	**$ 0.08266**	**$ 0.13279**	**$ 0.30763**	**$ 0.80487**	**$ 1.14808**	**$ 1.02441**	**$ 0.63326**	**$ 0.69764**	**$ 0.64455**
Containers Per Pound	$ 2.03	$ 24.40	$ 7.50	$ 9.70	$ 41.60	$ 10.90	$ 106.80	$ 3.10	$ 7.80
Manufacturers' Percentage of Processing Payment	12%	11%	14%	65%	65%	65%	65%	65%	65%
Processing Fee Pursuant to Section 14575(f)	$ 0.00489	$ 0.00060	$ 0.00574	$ 0.05393	$ 0.01794	$ 0.06109	$ 0.00385	$ 0.14628	$ 0.05371
Section 14575(j) Processing Fee Reduction	$ 0.00063	$ 0.00015	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Processing Fee to be Paid by Beverage Manufacturers	**$ 0.00426**	**$ 0.00045**	**$ 0.00574**	**$ 0.05393**	**$ 0.01794**	**$ 0.06109**	**$ 0.00385**	**$ 0.14628**	**$ 0.05371**

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, 2022, processing payments and fees, the average scrap value used for the calculation covers the period from October 1, 2020, to September 30, 2021.

California Code of Regulations, Title 14, Division 2, Chapter 5, Section 2955 of the California Code of Regulations specifies how CalRecycle shall conduct the scrap value survey. CalRecycle surveys all certified processors each month using a standard form, the Scrap Value Purchases Survey Form. Processors are required to complete the form and submit it to CalRecycle by the tenth 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, 2020, through September 30, 2021, are shown in **Exhibit 5-6.** These were the values used for the January 1, 2022, processing payment and processing fee calculations.

Exhibit 5-6
Statewide Average Scrap Values for the January 1, 2022, Processing Payment and Processing Fee Calculations

Material	Scrap Value (per Ton)
1. Aluminum	$1,371.46
2. Glass	(7.25)
3. PET #1	250.43
4. HDPE #2	408.13
5. Bi-Metal	0.91
6. PVC #3	$0.01
7. LDPE #4	0.27
8. PP #5	11.40
9. PS #6	9.60
10. Other #7	2.92

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 5-7** compares the processing payments for the nine relevant material types for the years following the ten most recent cost surveys (i.e., for the January 1, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2020 and 2022 processing payments to recyclers).

Exhibit 5-8 compares the percent change in the processing payment per ton between each succeeding cost survey.

Exhibit 5-7
Comparison of Processing Payments (per Ton) (2004-2022)

Material Type	2004	2006	2008	2010	2012	2014	2016	2018 Nonrural (NR)	2018 Rural (R)	2020	2022
1. Glass	$74.52	$83.68	$94.52	$66.87	$88.26	$94.72	$101.07	$119.96	$125.26	$153.00	**$165.32**
2. PET #1	330.41	226.39	197.68	249.44	0.00	117.26	165.96	250.88	272.99	378.14	**265.58**
3. HDPE #2	510.62	402.65	216.33	207.77	289.94	317.56	183.01	420.44	449.15	755.38	**615.27**
4. Bi-Metal	519.70	629.54	920.47	654.52	797.66	801.93	624.03	775.37	811.56	1,196.10	**1,289.09**
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	**1,609.73**
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	**2,296.17**
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	**2,048.81**
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	**1,266.52**
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	**1,395.28**

Note: Includes the proportional reduction required due to insufficient funds.

Exhibit 5-8
Comparison of the Percent Change in Processing Payments (per Ton) (2004-2022)

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	2020 to 2022
1. Glass	12%	13%	-29%	32%	7%	7%	19%	24%	27%	**8%**
2. PET #1	-31%	-13%	26%	-100%	n/a	42%	51%	64%	50%	**-30%**
3. HDPE #2	-21%	-46%	-4%	40%	10%	-42%	130%	145%	79%	**-19%**
4. Bi-Metal	21%	46%	-29%	22%	1%	-22%	24%	30%	54%	**8%**
5. PVC #3	54%	-54%	10%	18%	9%	-21%	-9%	-4%	93%	**8%**
6. LDPE #4	-55%	27%	-38%	5%	1%	-7%	19%	25%	51%	**8%**
7. PP #5	-55%	21%	28%	21%	-6%	-13%	16%	21%	52%	**9%**
8. PS #6	-51%	-72%	-25%	21%	-2%	-27%	26%	33%	65%	**8%**
9. Other #7	65%	-46%	5%	16%	2%	-17%	21%	27%	51%	**8%**

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. PET #1 and HDPE #2 processing payments to recyclers decreased between 2020 and 2022 due to an increase in scrap values for each material coupled with the cost per ton results detailed in Section 2 of this report (i.e., 11 percent decrease in PET per ton costs and 5.6 percent increase in HDPE #2 per ton costs). Processing payments for all minority materials increased roughly eight to nine percent.

Processing fees are paid by beverage manufacturers on each beverage container sold. **Exhibit 5-9** compares the per container processing fees from 2004-2022.

Exhibit 5-10 compares the percent change in the per container processing fees between each succeeding cost survey.

Exhibit 5-9
Comparison of Processing Fees (per Container) (2004-2022)

Material Type	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022
1. Glass	$0.00181	$0.00229	$0.00240	$0.01373	$0.00237	$0.00182	$0.00232	$0.00283	$0.00375	**$0.00426**
2. PET #1	0.00167	0.00159	0.00072	0.00569	0.00000	0.00016	0.00024	0.00045	0.00066	**0.00045**
3. HDPE #2	0.01042	0.00503	0.00216	0.01821	0.00213	0.00215	0.00140	0.00384	0.00602	**0.00574**
4. Bi-Metal	0.02194	0.02557	0.04825	0.04526	0.04470	0.03671	0.03027	0.03457	0.04799	**0.05371**
5. PVC #3	0.03578	0.05501	0.02525	0.02768	0.01194	0.03895	0.00755	0.02248	0.05014	**0.05393**
6. LDPE #4	0.03153	0.01181	0.01691	0.00982	0.01082	0.01017	0.00924	0.01124	0.01696	**0.01794**
7. PP #5	0.07468	0.0248	0.09013	0.10857	0.04727	0.04505	0.05765	0.04912	0.05573	**0.06109**
8. PS #6	0.0293	0.01437	0.00507	0.00176	0.00227	0.00223	0.00166	0.00206	0.00348	**0.00385**
9. Other #7	0.0216	0.03664	0.04217	0.05009	0.07353	0.08660	0.07173	0.08716	0.13610	**0.14628**

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

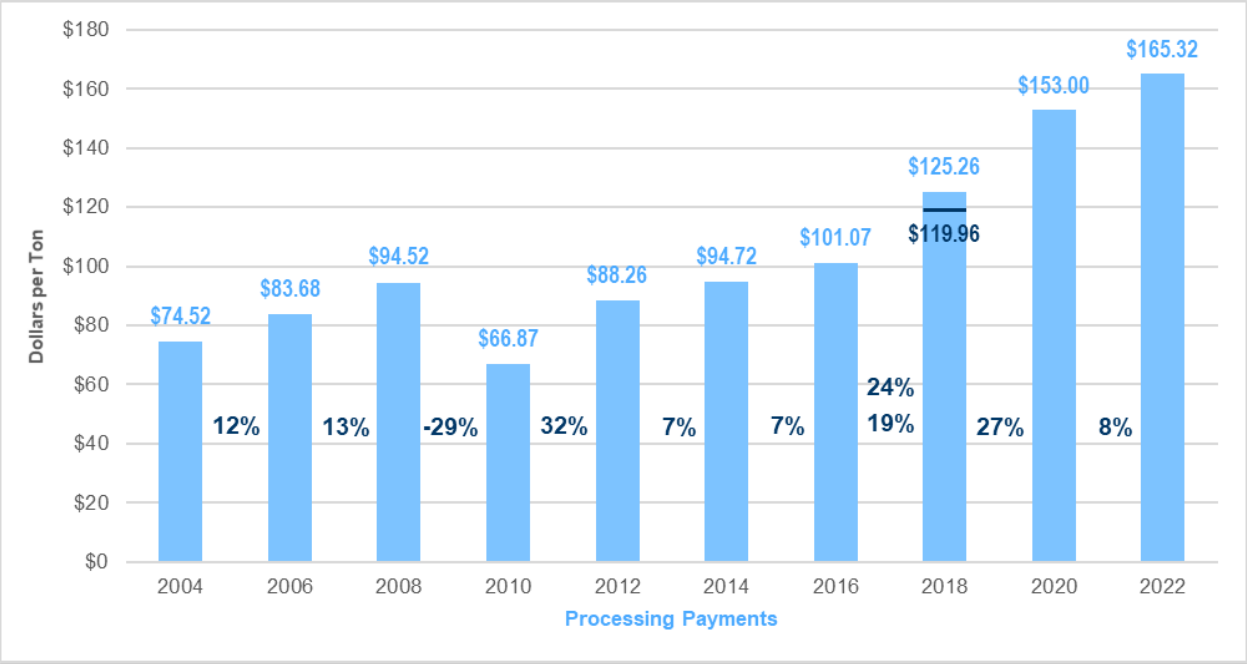
Exhibit 5-10
Comparison of the Percent Change in Processing Fees (per Container) (2004-2022)

Material Type	2004 to 2006	2006 to 2008	2008 to 2010	2010 to 2012	2012 to 2014	2014 to 2016	2016 to 2018	2018 to 2020	2020 to 2022
1. Glass	27%	5%	472%	-83%	-23%	27%	22%	33%	**14%**
2. PET #1	-5%	-55%	690%	-100%	n/a	50%	88%	47%	**-32%**
3. HDPE #2	-52%	-57%	743%	-88%	1%	-35%	174%	57%	**-5%**
4. Bi-Metal	17%	89%	-6%	-1%	-18%	-18%	14%	39%	**12%**
5. PVC #3	54%	-54%	10%	-57%	226%	-81%	198%	123%	**8%**
6. LDPE #4	-63%	43%	-42%	10%	-6%	-9%	22%	51%	**6%**
7. PP #5	-67%	263%	20%	-56%	-5%	28%	-15%	13%	**10%**
8. PS #6	-51%	-65%	-65%	29%	-2%	-26%	24%	69%	**11%**
9. Other #7	70%	15%	19%	47%	18%	-17%	22%	56%	**7%**

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 California Public Resources Code, Division 12.1, Chapter 4, 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.

Exhibits 5-11, 5-12, and **5-13** compare the processing payments and processing fees for 2004 to 2022 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 5-11
Comparison of Glass Processing Payments and Processing Fees (2004-2022)



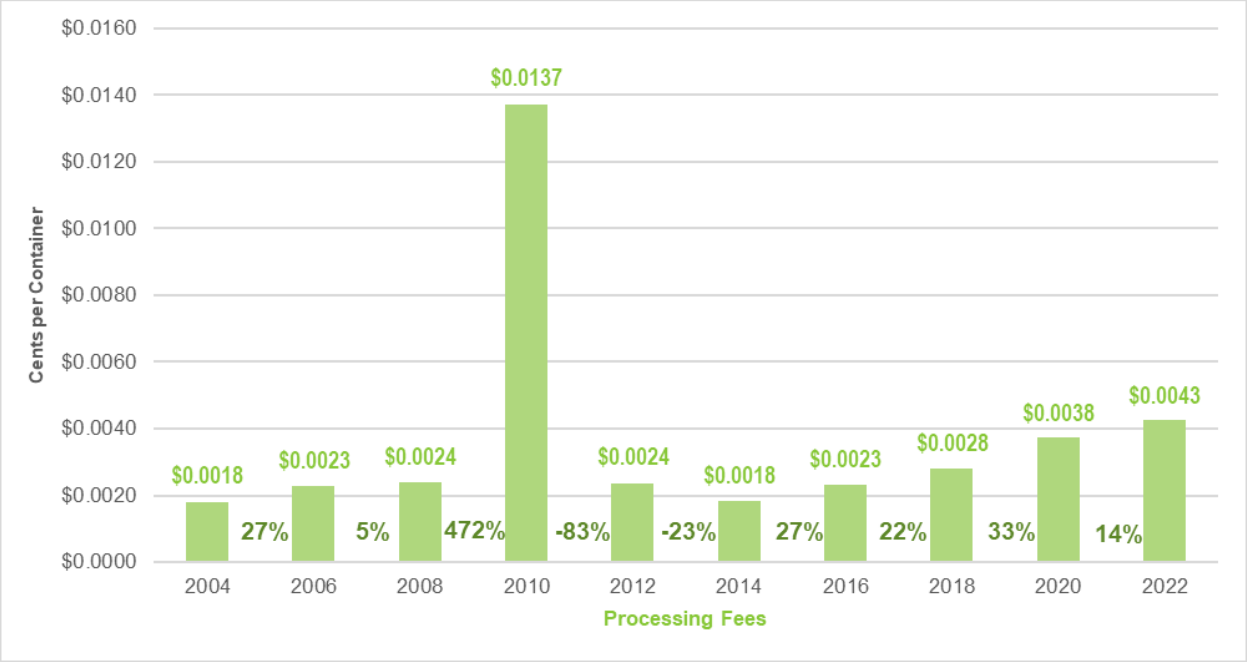
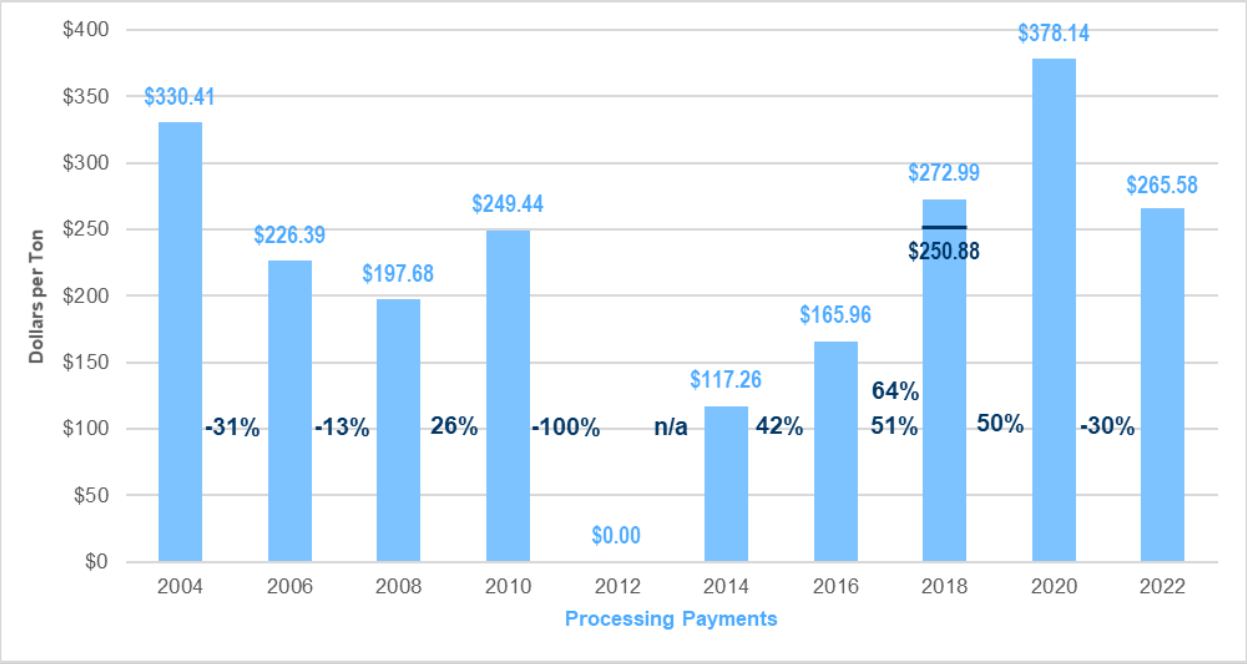


Exhibit 5-12
Comparison of PET #1 Processing Payments and Processing Fees (2004-2022)



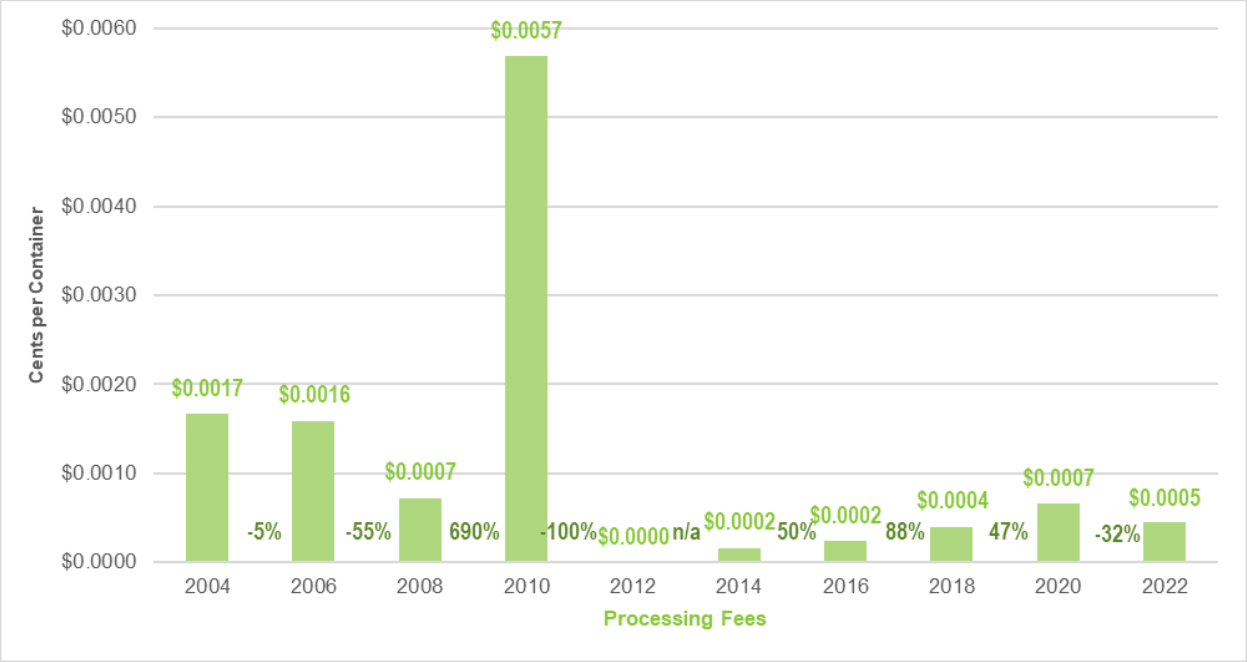
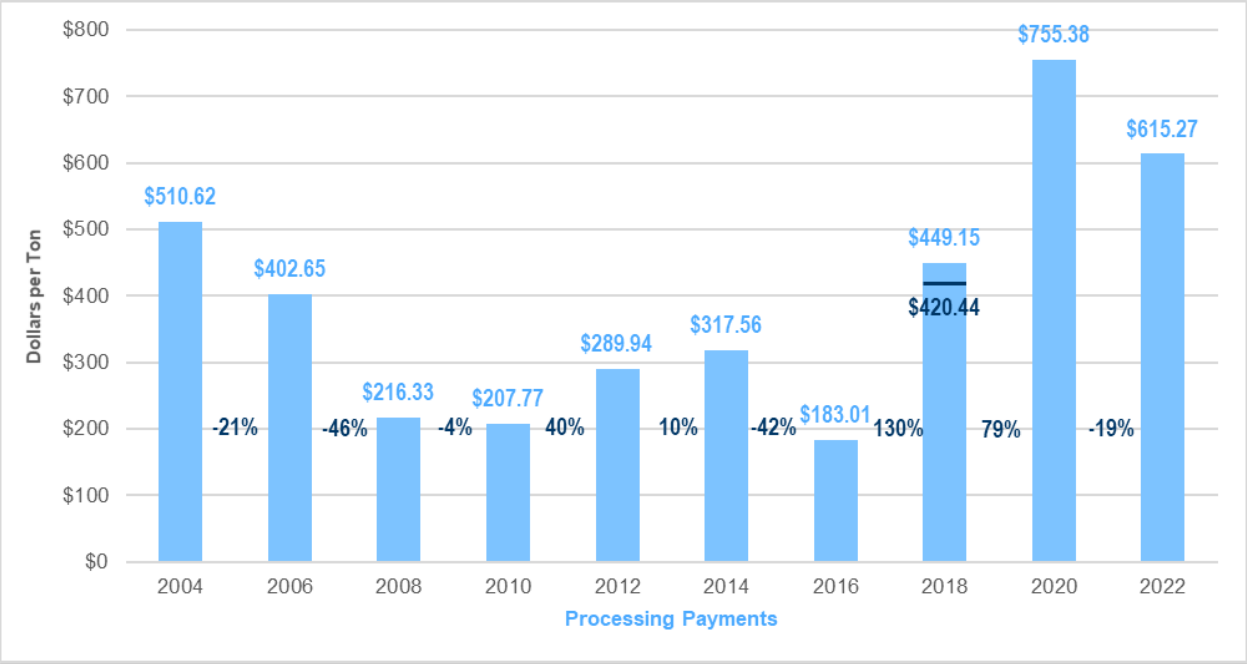
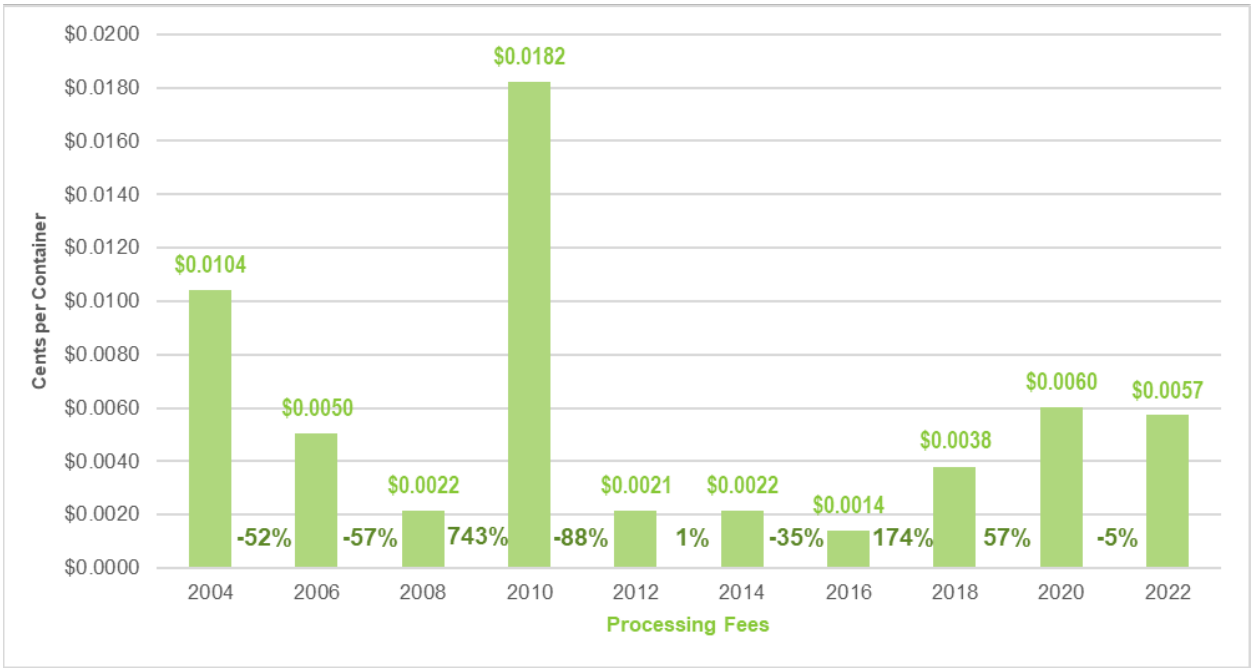


Exhibit 5-13
Comparison of HDPE #2 Processing Payments and Processing Fees (2004-2022)





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-3
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results (2002 through 2020)

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

Year	Aluminum	Glass	PET #1	HDPE #2
2008	$559.23	$81.60	$426.76	$501.67
2009	N/A	N/A	N/A	N/A
2010	$537.06	$89.76	$440.61	$611.62
2011	N/A	N/A	N/A	N/A
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
2020	$569.76	$136.73	$446.34	$885.21

Exhibit ES-4
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002 through 2020)

Year	Aluminum	Glass	PET #1	HDPE #2
2002	$568.34	$108.27	$650.66	$876.23
2004	$616.69	$109.13	$652.97	$889.13
2006	$657.16	$120.93	$608.27	$637.44
2008	$681.09	$99.38	$519.75	$610.98
2010	$650.77	$108.76	$533.90	$741.11
2012	$711.88	$108.43	$540.25	$715.02
2014	$610.51	$110.79	$486.95	$595.67
2016	$596.55	$111.81	$466.19	$605.40
2018	$654.68	$138.62	$524.95	$875.54
2020	$569.76	$136.73	$446.34	$885.21

Exhibit ES-7
Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton (1987 through 2020)

- 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	N/A
1989	$366.39	$74.84	$930.42	N/A
1990	$324.32	$88.69	$930.42	N/A
1991	$322.02	$86.98	$785.56	N/A
1994	$349.07	$93.75	$754.16	N/A
1997	$417.60	$81.09	$611.74	N/A
1998	$394.41	$84.85	$606.62	N/A
1999	$354.30	$86.25	$584.14	N/A
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
2020	$569.76	$136.73	$446.34	$885.21

Exhibit 1-4
Processing Fee and Handling Fee Cost Survey Sample (2020)

- 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 453 total unique PF and HF sites is broken down into 215 unique HF sites and 238 unique PF sites. For the 238 unique PF sites, it is further broken down into 146 unique PF for PF sites and 92 unique PF for HF sites. The 146 unique PF for PF sites is even further broken down into 111 unique PF for PF only sites and 35 non-unique PF for PF and PF for HF sites. These 35 non-unique PF for PF and PF for HF combined with the 92 unique PF for HF sites result in a total of 127 total PF for HF sites.

Exhibit 1-6
2020 Sampled Processing Fee Recyclers,
Distribution of Aluminum Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$100	1
$100–$200	4
$200–$300	10
$300–$400	13
$400–$500	27
$500–$600	18
$600–$700	28
$700–$800	14
$800–$900	8
$900–$1,000	1
$1,000–$1,100	4
$1,100–$1,200	3
$1,200–$1,300	1
$1,300–$1,400	0
$1,400–$1,500	0
$1,500–$1,600	3
$1,600–$1,700	2
$1,700–$1,800	0

Cost Per Ton	Number of Recyclers
$1,800–$1,900	1
$1,900–$2,000	0
$2,000–$2,100	3
$2,100–$2,200	0
$2,200–$2,300	0
>$2,300	5

Exhibit 1-7
2020 Sampled Processing Fee Recyclers,
Distribution of Glass Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$50	4
$50–$75	12
$75–$100	16
$100–$125	13
$125–$150	24
$150–$175	15
$175–$200	9
$200–$225	14
$225–$250	3
$250–$275	7
$275–$300	5
$300–$325	7
$325–$350	3
$350–$375	0
$375–$400	1
$400–$425	0
$425–$450	1
>$450	8

Exhibit 1-8
2020 Sampled Processing Fee Recyclers,
Distribution of PET #1 Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$100	5
$100–$200	25
$200–$300	27
$300–$400	27
$400–$500	22
$500–$600	15
$600–$700	7
$700–$800	4
$800–$900	1
$900–$1,000	1
$1,000–$1,100	0
$1,100–$1,200	1
$1,200–$1,300	0
$1,300–$1,400	1
$1,400–$1,500	1
$1,500–$1,600	1
$1,600–$1,700	3
$1,700–$1,800	0
$1,800–$1,900	0
$1,900–$2,000	0
$2,000–$2,100	1
>$2,100	4

Exhibit 1-9
2020 Sampled Processing Fee Recyclers,
Distribution of HDPE #2 Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$200	4
$200–$400	17
4300–$600	22
$600–$800	22
$800–$1,000	17
$1,000–$1,200	22
$1,200–$1,400	10
$1,400–$1,600	6
$1,600–$1,800	4
$1,800–$2,000	2
$2,000–$2,200	2
$2,200–$2,400	1
$2,400–$2,600	0
$2,600–$2,800	0
$2,800–$3,000	1
$3,000–$3,200	0
$3,200–$3,400	1
$3,400–$3,600	0
$3,600–$3,800	0
$3,800–$4,000	1
>$4,000	6

Exhibit 2-7
Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton (1987 through 2020)

- 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	N/A
1989	$366.39	$74.84	$930.42	N/A
1990	$324.32	$88.69	$930.42	N/A
1991	$322.02	$86.98	$785.56	N/A
1994	$349.07	$93.75	$754.16	N/A
1997	$417.60	$81.09	$611.74	N/A
1998	$394.41	$84.85	$606.62	N/A
1999	$354.30	$86.25	$584.14	N/A
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
2020	$569.76	$136.73	$446.34	$885.21

Exhibit 2-9
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002 through 2020)

Year	Aluminum	Glass	PET #1	HDPE #2
2002	$568.34	$108.27	$650.66	$876.23
2004	$616.69	$109.13	$652.97	$889.13
2006	$657.16	$120.93	$608.27	$637.44
2008	$681.09	$99.38	$519.75	$610.98
2010	$650.77	$108.76	$533.90	$741.11
2012	$711.88	$108.43	$540.25	$715.02
2014	$610.51	$110.79	$486.95	$595.67
2016	$596.55	$111.81	$466.19	$605.40
2018	$654.68	$138.62	$524.95	$875.54
2020	$569.76	$136.73	$446.34	$885.21

Exhibit 2-10
Aluminum Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)

Year	Cost/Ton	Percent Change
2002	$418.95	N/A
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%
2020	$569.76	-9%

Year	Tons Recycled	Percent Change
2002	72,297	N/A
2004	74,565	3%
2006	70,762	-5%
2008	82,299	16%
2010	86,261	5%
2012	89,410	4%
2014	77,350	-13%
2016	74,391	-4%
2018	66,714	-10%
2020	65,104	-2%

Exhibit 2-11
Glass Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)

Year	Cost/Ton	Percent Change
2002	$79.81	N/A
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%
2020	$136.73	3%

Year	Tons Recycled	Percent Change
2002	229,489	N/A
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%
2020	196,273	-15%

Exhibit 2-12
PET #1 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)

Year	Cost/Ton	Percent Change
2002	$479.63	N/A
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%
2020	$446.34	-11%

Year	Tons Recycled	Percent Change
2002	33,462	N/A
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%
2020	102,963	-5%

Exhibit 2-13
HDPE #2 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2020)

Year	Cost/Ton	Percent Change
2002	$645.91	N/A
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%
2020	$885.15	6%

Year	Tons Recycled	Percent Change
2002	3,316	N/A
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%
2020	3,005	-21%

Exhibit 2-14
Processing Fee Recycler 2020 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	Cost/Ton
Bi-Metal	$1,115.82
PVC #3	$1,392.39
LDPE #4	$1,986.37
PP #5	$1,782.04
PS #6	$1,103.82
Other #7	$1,209.41

Exhibit 3-3
Total Population Costs for Processing Fee Recyclers (2002 to 2020)

	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
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	$37,093,346
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	$26,836,684
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	$45,956,362
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	$2,660,125
Bi-Metal	$23,546	$53,874	$93,333	$143,305	$126,303	$100,930	$11,485	$123,170	$157,206	$147,555
Plastics #3 to #7	$5,405	$11,358	$21,820	$51,525	$115,964	$147,211	$196,907	$265,408	$388,410	$436,212
Total Sites	684	674	677	729	842	763	955	778	674	581
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	$113,130,284

Exhibit 3-4
Total Population Tons for Processing Fee Recyclers (2002 to 2020)

	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
Aluminum	72,297	74,656	70,762	82,299	86,261	62,374	77,350	74,391	66,714	65,104
Glass	229,489	244,557	257,139	318,697	317,030	239,837	255,763	256,637	230,671	196,273
PET #1	33,462	48,820	65,456	95,239	97,915	81,471	102,048	110,536	107,815	102,963
HDPE #2	3,316	5,720	7,325	11,943	12,117	9,053	5,170	4,775	3,783	3,005
Bi-Metal	46	89	106	227	164	131	155	178	149	132
Plastics #3 to #7	5	9	29	76	138	176	278	356	340	356
Total Sites	684	674	677	729	842	763	955	778	674	581
Total Tons	338,615	373,851	400,817	508,481	513,625	393,042	440,764	446,873	409,471	367,832

Exhibit 3-10
Aluminum Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)

	Costs per Ton	Sites
Stratum 1	$461.64	25
Stratum 2	$557.49	40
Stratum 3	$678.88	81
Statewide Average	$569.76	n/a

Exhibit 3-11
Glass Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)

	Costs per Ton	Sites
Stratum 1	$124.15	25
Stratum 2	$129.91	40
Stratum 3	$152.31	77
Statewide Average	$136.73	n/a

Exhibit 3-12
PET #1 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)

	Costs per Ton	Sites
Stratum 1	$383.34	25
Stratum 2	$412.55	40
Stratum 3	$545.36	81
Statewide Average	$446.34	n/a

Exhibit 3-13
HDPE #2 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2020)

	Costs per Ton	Sites
Stratum 1	$920.90	25
Stratum 2	$809.02	40
Stratum 3	$958.05	73
Statewide Average	$885.21	n/a

Exhibit 3-14
Percent of Population Glass Tons Recycled and Percent of Glass Total Costs – 2012 to 2020

	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2020 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs	2020 Costs
Stratum 1	54%	42%	52%	24%	27%	42%	30%	37%	18%	25%
Stratum 2	37%	46%	37%	33%	35%	42%	50%	45%	25%	33%
Stratum 3	9%	12%	11%	42%	38%	16%	20%	18%	56%	42%

Exhibit 3-15
Percent of Population Aluminum Tons Recycled and Percent of Aluminum Total Costs – 2012 to 2020

	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2020 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs	2020 Costs
Stratum 1	39%	33%	50%	26%	32%	34%	29%	44%	21%	26%
Stratum 2	43%	48%	37%	30%	33%	44%	49%	38%	26%	32%
Stratum 3	18%	19%	13%	44%	35%	22%	22%	18%	53%	42%

Exhibit 3-16
Percent of Population PET #1 Tons Recycled and Percent of PET #1 Total Costs – 2012 to 2020

	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2020 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs	2020 Costs
Stratum 1	46%	37%	54%	28%	32%	40%	32%	45%	22%	28%
Stratum 2	41%	48%	36%	33%	35%	45%	50%	40%	27%	32%
Stratum 3	12%	15%	10%	40%	33%	15%	18%	15%	50%	40%

Exhibit 3-17
2002-2020 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 2020. Below is a table describing the graph.

Year	Number
2002	684
2004	674
2006	677
2008	729
2010	842
2012	1,032
2014	955
2016	778
2018	705
2020	611

Exhibit 3-18
Average Tons of Aluminum, Glass, and PET #1 Recycled per Processing Fee Recycler (2002 to 2020, every 2 years)

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
2020	112	350	179

Exhibit 3-19
Percent Change in Tons per Recycler, Costs per Recycler, and Statewide, Weighted-Average Processing Fee Recycler Cost per Ton (2018 to 2020)

Year	Aluminum	Glass	PET #1	HDPE #2
Tons per Recycling Center	13.2%	-1.3%	10.8%	-7.8%
Cost per Recycling Center	-0.1%	-1.7%	-9.0%	6.7%
Cost per Ton	-9.1%	3.1%	-11.2%	5.6%

Exhibit 3-20
2010 to 2020 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
2020	15.4	3.7	12.7

Exhibit 3-21
2010 to 2020 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.

Year	Average CRV Wages per Hour	CPI Adjusted	Minimum Wage
2010	$14.43	$17.94	$8.00
2012	$13.89	$16.44	$8.00
2014	$13.69	$15.68	$9.00
2016	$15.09	$16.76	$10.00
2018	$17.65	$18.44	$11.00
2020	$19.48	N/A	$13.00

Exhibit 3-23
2016, 2018, and 2020 Sampled Processing Fee Recyclers Labor and Non-Labor Costs per Ton

Material	2016 Labor	2018 Labor	2020 Labor	2016 Non-Labor	2018 Non-Labor	2020 Non-Labor
Aluminum	$282.53	$317.26	$301.58	$256.58	$309.35	$268.18
Glass	$52.04	$62.23	$75.57	$49.00	$70.45	$61.16
PET #1	$219.27	$264.01	$231.29	$202.03	$238.43	$215.05

Exhibit 3-24
Comparison of Average CRV Wages per Recycler (2018 and 2020)

Year	Overall Wages per RC	Aluminum Wages per RC	Glass Wages per RC	Plastics Wages per RC
2018	$134,898	$43,008	$30,934	$61,759
2020	$131,957	$43,623	$32,222	$56,994

Exhibit 3-25
Comparison of CRV Hourly Wages Overall and by Strata (2018 and 2020)

Year	Overall	Stratum 1	Stratum 2	Stratum 3
2018	$17.65	$19.26	$17.30	$16.31
2020	$19.48	$21.45	$19.44	$17.52

Exhibit 3-30
Percent of Recycling Center Labor Hours by Activity (2018 and 2020)

Year	AL/ BM DYL	AL/ BM AOL	Glass DYL	Glass AOL	Plastic DYL	Plastic AOL	non-CRV DYL	non-CRV AOL
2018	16%	3%	11%	3%	25%	4%	30%	8%
2020	17%	3%	11%	3%	24%	4%	27%	11%

Exhibit 3-31
Labor Hours per Ton CRV Material by Activity (2018 and 2020)

Year	AL/ BM DYL	AL/ BM AOL	Glass DYL	Glass AOL	Plastic DYL	Plastic AOL	CRV DYL	CRV AOL
2018	14.87	2.86	2.82	0.67	12.73	1.94	7.45	1.36
2020	12.97	2.46	2.94	0.74	11.07	1.70	7.15	1.33

Exhibit 3-32
Proportion of RCs with Owner Income Under Minimum Wage by Strata (2016-2020)

Strata	2016	2018	2020
1	29%	0%	5%
2	15%	13%	14%
3	58%	31%	41%
Overall	29%	20%	27%

Exhibit 3-33
Percent of Owners Earning Under the Poverty Level by Strata (2016-2020)

Strata	2016	2018	2020
1	33%	5%	5%
2	40%	37%	18%
3	63%	47%	50%
Overall	44%	36%	33%

Exhibit 3-34
Comparison of Average Transportation Cost per Surveyed Recycling Center and Diesel Prices (2010 through 2020)

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
2020	$17,416	$3.38

Exhibit 3-35
Transportation Cost per Ton (2018 and 2020)

Year	Stratum 1	Stratum 2	Stratum 3	Overall
2018	$16.60	$19.06	$37.02	$22.13
2020	$12.84	$25.85	$31.12	$21.78

Exhibit 3-36
2020 Aluminum, Glass, and Plastic Average Cost Per Ton, by Hauling Method

Hauling Method	Aluminum	Glass	Plastic
Self-Haul	$578	$151	$467
Third-Party	$647	$139	$538
Processor Scrap Deduction	$549	$123	$437
Payment to Processor	$580	$128	$457

Exhibit 3-37
2018 vs 2020 – Aluminum, Glass, and Plastic Transportation Cost Per Ton

Year	Aluminum	Glass	Plastic
2018	$41.30	$10.62	$34.72
2020	$38.86	$10.42	$31.47

Exhibit 3-38
2018 vs 2020 – Aluminum, Glass, and PET #1 Transportation with Scrap Value Deduction

Year	Aluminum	Glass	PET #1
2018	69%	72%	72%
2020	62%	63%	60%

Exhibit 4-1
Summary of COVID-19 Impacts

Impact Factor	Percentage
Shut Down	41%
Shortened Hours	16%
Additional Supplies	22%
Fewer Employees	7%
PPP Loan	1%
Other	13%

Exhibit 4-2
Quarterly Scrap Value Per Ton – Aluminum, PET #1, Glass, and HDPE #2 (2020 through 2022)

Material	2020 Q1	2020 Q2	2020 Q3	2020 Q4	2021 Q1	2021 Q2	2021 Q3	2021 Q4	2022 Q1
Aluminum	$490	$400	$469	$550	$739	$958	$1,127	$1,177	$1,290
PET #1	$194	$188	$184	$160	$127	$116	$115	$162	$250
Glass	-$2	-$3	-$3	-$4	-$5	-$6	-$8	-$7	-$7
HDPE #2	$196	$185	$186	$180	$188	$212	$249	$311	$408

Exhibit 4-3
Average Processing Payment Per Ton – PET #1, Glass, and HDPE #2 (2020 through 2022)

Material	2020 Average	2021 Average	2022 1st Quarter
PET #1	$387	$462	$266
Glass	$153	$160	$165
HDPE #2	$763	$745	$615

Exhibit 4-4
Comparison of Cost Coverage by Material Type (2020 and 2021)

Material	2020	2021	2-Year Average
Aluminum	84%	167%	N/A
PET #1	87%	99%	N/A
Glass	112%	111%	N/A
HDPE #2	86%	80%	N/A
Combined	92%	124%	108%

Exhibit 5-11
Comparison of Glass Processing Payments and Processing Fees (2004-2022)

Year	Dollars per Ton	Percent Change
2004	$74.52	N/A
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%
2022	$165.32	8%

Year	Cents per Container	Percent Change
2004	$0.0018	N/A
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%
2022	$0.0043	14%

Exhibit 5-12
Comparison of PET #1 Processing Payments and Processing Fees (2004-2022)

Year	Dollars per Ton	Percent Change
2004	$330.41	n/a
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%
2022	$265.58	-30%

Year	Cents per Container	Percent Change
2004	$0.0017	n/a
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%
2022	$0.0005	-32%

Exhibit 5-13
Comparison of HDPE #2 Processing Payments and Processing Fees (2004-2022)

Year	Dollars per Ton	Percent Change
2004	$510.62	n/a
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%
2022	$615.27	-19%

Year	Cents per Container	Percent Change
2004	$0.0104	n/a
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%
2022	$0.0057	-5%