2023 Processing Fee Final Report

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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

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). The 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 for recyclers that do not receive handling fees, referred to as processing fee recyclers or PF recyclers.
- Summarizes tasks that Crowe and their subcontractors conducted to obtain the final, statewide, weighted-average processing fee recycler costs per ton.
- Provides analyses of the results of this processing fee cost survey.

A major component of the Beverage Container Recycling Program (program) is processing fees paid by beverage manufacturers to recyclers as processing payments to help cover recycling costs. Most recyclers in the program are required to redeem all beverage container material types. Scrap values of glass, plastics, and bi-metal are not sufficient to cover the cost of recycling so they are subsidized by paying recyclers a processing payment. The cost to recycle beverage containers is determined by the processing fee cost survey.

California Public Resource Code, Division 12.1, Chapter 6, 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 California Beverage Container Recycling and Litter Reduction Act program (AB 2020, Margolin, Chapter 1290, Statutes of 1986), including a reasonable financial return and cost of living adjustment, and the scrap value for the material. The processing fee is imposed on beverage manufacturers. That processing fee, along with supplemental funds from unredeemed containers, are the funds used to provide processing payments to recyclers.

CalRecycle has been conducting processing fee cost surveys every two years since 2002.

A. Processing Fee Cost Survey Results

The statewide recycler costs per ton for the 10 material types in the beverage container recycling program are presented in **Exhibit 1.**

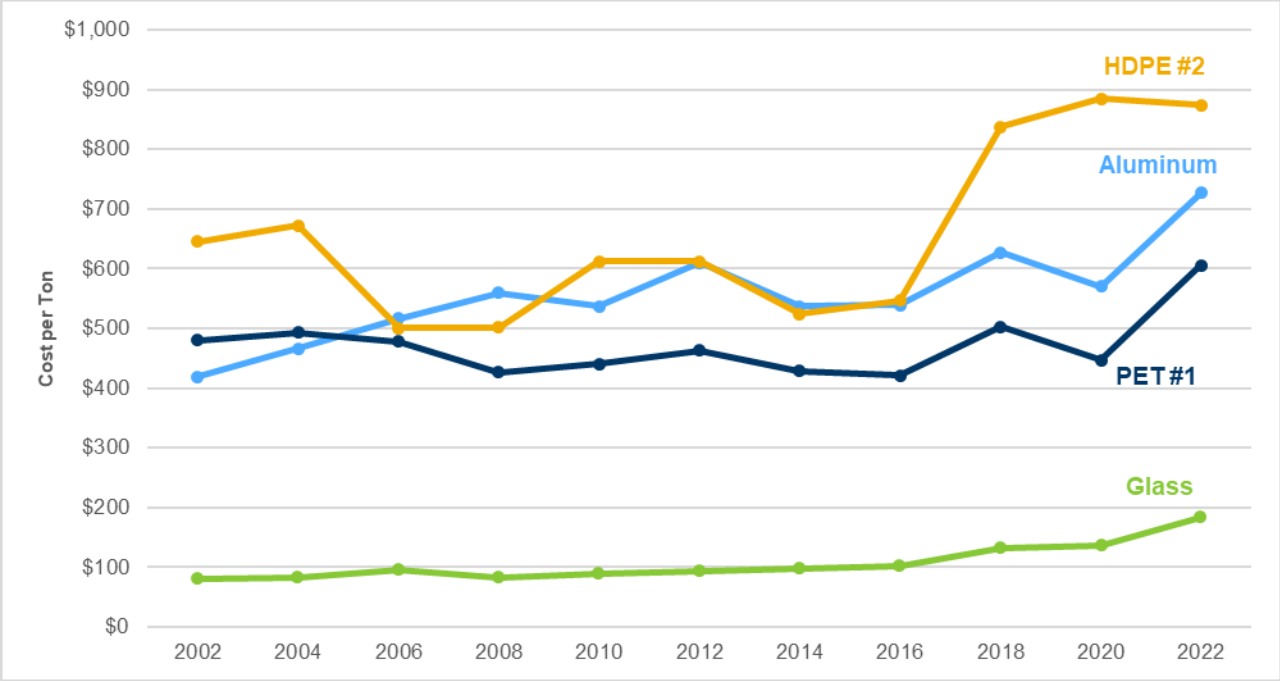
Exhibit 2 compares 2022 costs per ton to the 10 prior cost surveys in which CalRecycle measured recycler costs (even years 2002 through 2020). Note that costs per ton in Exhibit 2 are not adjusted for inflation, reasonable financial return, or cost of living (COLA). Compared to 2020, the 2022 cost-per-ton results for aluminum increased by 28%, glass increased by 34%, PET #1 increased by 36%, and HDPE #2 decreased by 1%.

Exhibit 1
Statewide Costs per Ton to Recycle for Processing Fee Recyclers (2022)

Material	Cost per Ton without Reasonable Financial Return	Cost per Ton with Reasonable Financial Return and COLA	N = Sample Number of Sites
1. Aluminum	$727.46	$837.02	137
2. Glass	183.45	211.08	138
3. PET #1	605.19	696.33	137
4. HDPE #2	874.10	1,005.74	135
5. Bi-Metal	1,101.76	1,267.68	NA
6. PVC #3	1,374.85	1,581.90	NA
7. LDPE #4	1,961.34	2,256.72	NA
8. PP #5	1,759.59	2,024.58	NA
9. PS #6	1,089.91	1,254.06	NA
10. Other #7	1,194.17	1,374.01	NA

Note: The reasonable financial return is 10% and the COLA is 4.6%. Overall, 140 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
Summary Comparison of Aluminum, Glass, PET, and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results (2002 to 2022)



B. Summary of Results

Overall, the increase in cost per ton between 2020 and 2022 was significant. The analyses identify a combination of factors that may be impacting recycling costs, summarized in **Exhibit 3.**

Exhibit 3
Summary of Key Factors for Changes in Costs between 2020 and 2022

Key Factor	Impact to Costs
1. High inflation and increases to cost of living	Consumer price index (CPI) increased by 12.9%.[1] CPI increased an average of 4.5% per survey between 2002 and 2022. CPI increased by 4.5% between 2020 and 2022. *Impact: Nearly 3 times higher rate of inflation contributes to higher costs.*
2. Less tons recycled, about the same number of sites	Total tons decreased by approximately 9%, while the number of sites decreased by 3%. This results in fewer tons per recycler on average. The decrease was driven by a 16% decrease in glass tons. Aluminum and PET #1 tons remained nearly flat. This resulted in a 12% decrease to the average number of tons recycled per recycler for glass. *Impact: Reduced tons per recycler contributes to higher costs.*
3. Increased proportion of small recyclers	For all materials, stratum 3 showed a 20% cost increase, paired with a 4% increase to tons. This resulted in the proportion of costs for small recyclers increasing two times more than the proportion of tons. Because the proportion of small recycler costs increased higher than the larger recyclers, this indicates that small recyclers are continuing to experience higher cost pressures. On average, stratum 3 recyclers represent roughly 40% to 50% of all costs. Therefore, the changes to stratum 3 costs and tons significantly impact overall costs. *Impact: Higher costs relative to tons contributes to higher costs.*
4. Significant increase in transportation costs	Driven by the 78% increase in diesel prices, transportation costs per ton increased by 69%. There was also an increased number of recyclers self-hauling, which is the highest cost transportation method. *Impact: The combination of fuel price increases, and utilization of a higher cost transportation method contributes to higher costs.*

[1] Source: U.S. Department of Labor, Bureau of Labor Statistics, West Urban Consumer Price Index (as of October 2023)

Key Factor	Impact to Costs
5. Higher California Redemption Value (CRV) hourly wages	Weighted-average CRV labor hourly wages increased by 3%, driven by a 10% increase in stratum 2 while stratum 1 slightly decreased and stratum 3 essentially did not change. *Impact: Higher average CRV hourly wages contributes to higher costs.*
6. Increased hours handling CRV materials	Labor hours per ton increased 9% for aluminum and PET #1, and 17% for glass. More hours spent per unit of volume indicates a loss of productivity. For glass, there was a decrease in the average tons handled per recycler, which contributed to the increase in glass. For aluminum and PET #1, there was a slight increase in the average tons handled per recycler, but it was not enough to offset other factors such as the increasing proportion of low volume stratum 3 recyclers. *Impact: Spending more time handling materials contributes to higher costs.*
7. Reduced low wage sites	The number of low wage sites or sites below the minimum wage decreased to 14%, from 18% in the prior year. *Impact: Fewer low wage sites contribute to higher costs.*
8. Less volume per operating hour	In 2020, sampled processing fee recyclers were closed on average for nearly 7 weeks and could shorten operational hours up to 4 months beyond the closures. In 2022, recyclers did not experience widespread shutdowns and maintained full operating hours. Due to this, recyclers handled slightly less volume spread across more operating hours. *Impact: Decreased productivity contributes to higher costs.*
9. Recycler staffing levels	In 2020, many recyclers laid off a portion of their workforce due to temporary site closures and COVID uncertainty. These temporarily reduced staffing levels resulted in increased efficiencies that may not be representative of nonpandemic conditions. In 2022, site staffing levels increased after the pandemic, although there was a 9% decrease in total volume. I*mpact: Decreased productivity contributes to higher costs.*

1. Processing Fee Cost Survey Methodology

This section describes the cost survey methodology, from establishing the survey sample frame, to quality control procedures, and all the supporting tasks in between. Subsection A summarizes major tasks accomplished over a nine-month period to complete this processing fee-cost survey, as well as additional detail for four key areas:

A. *Overview of Cost Survey Methodology*
B. *Survey Design*
C. *Conducting Site Visit Surveys*
D. *Quality Control and Confidentiality Procedures*
E. *Cost Survey Methodology Validation*

A. Overview of Cost Survey Methodology

- **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 the 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. For the 2022 cost survey, Crowe removed recycling centers subject to investigation by CalRecycle for significant infractions from the population and the survey sample. This included identifying and removing 18 sites for this 2022 processing fee cost survey, resulting in a processing fee recycler population of 559. Three additional processing fee sites in the original sample were replaced due to an investigation during the survey months.
- **Revised and updated the Cost Survey Training Manual and training materials.** For the 2023 cost survey, Crowe continued to update and revise the training manual and training materials. The manual consists of 10 chapters, each emphasizing actions for survey team members to take in the field and when completing site files. The 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 and developed videos and other training content.

- **Revised and conducted cost survey training** consisting of six half-days of interactive training sessions, training site visits, and a follow-up session. Activities during the first four days of training included conducting cost survey interview role playing activities, mentoring from experienced survey team members, and completing a site visit cost model and associated documentation. As part of training, each new survey team member conducted a cost survey site visit with a highly experienced team member to provide "real-world" experience. Following the field visits, new survey members spent one to two days completing the site files. The entire survey team reconvened in person after the training site visits to present and discuss the site visits and review the remainder of the training materials. For this 2022 cost survey, Crowe also conducted a one-hour training for quality control reviewers.
- **Updated and calibrated the Labor Allocation Cost Survey Model**, a 19-worksheet, Excel-based **computer model used to allocate recycling center costs to beverage container material types based on labor allocations.** Crowe updated the cost survey model to reflect 2022 container per pound, CRV payment information, and procedural changes to the cost survey. In addition, Crowe calibrated the Indirect Cost Allocation Sub-Models for Aluminum/Bi-Metal and All-Plastics with 2022 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. In 2023, the cost model has undergone significant improvements. These changes are part of Crowe's ongoing commitment to maintain and improve the model, ensuring it becomes a more valuable and effective tool for surveyors over time. Crowe introduced new features for easier identification of site owners, added new worksheets to provide more comprehensive insights, and automated several quality control processes. The model now incorporates local wage data tailored to specific cities or counties.
- Created the survey files, which 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 140 recycling center on-site visits** during 26 weeks between April 28, 2023, and October 24, 2023, 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 the 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 recycling analysts. It typically took between one to three hours to complete the on-site survey. In addition to the on-site time, over eight hours of additional time was typically 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 (5) 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 occurred before the site files were released for data processing and data analysis. These quality assurance steps ensured that each site file was complete and accurate, and that all results from the labor allocation model and the indirect cost allocation sub-models were accurate. In total, over 27 hours were generally spent for each completed recycler site, including the site team and quality control hours. Crowe created a secure SharePoint site, accessible only to the project team and developed a secure online file review system for team members to upload and review survey files.
- **Analyzed the primary database of results and determined final costs per ton by material type.** Using an automated process, Crowe extracted results from each of the 140 completed labor-hour allocation cost models. Crowe developed an Excel workbook to calculate total costs by material type and total tons by material type for each of the four major beverage container material types. Crowe also calculated the percent change in HDPE #2 cost per ton between 2020 and 2022. 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 2022 cost per ton on the percent change in HDPE #2 cost per ton between 2020 and 2022 (bi-metal and plastics #3 to #7). Using defined and documented statistical procedures, Crowe calculated error rates at a 90% confidence interval for the four relevant material types. Crowe conducted additional detailed analyses of the results presented in this draft report.

B. Survey Design

Crowe followed processing fee and handling fee cost survey procedures consistent with the 10 prior cost surveys. The population of processing fee, or PF, recycling centers eligible for the cost survey was defined as all recycling centers:

- Not receiving handling fees between January 2022 and December 2022,
- Certified and operational on or before March 1, 2022,
- Reported redemption volume between January 2022 and December 2022,
- Not subsidized by the Department of Rehabilitation, and
- Not subject to CalRecycle investigation for major infractions.

There were 18 sites removed from the population due to investigations, leaving 581 recycling centers in this total traditional recycling center population.

This overall processing fee cost survey using 2022 data had a similar sample size to the most recent processing fee cost surveys (2022: 140 unique sites, 2020: 146 unique sites, 2018: 154 unique sites). To obtain these cost survey results the Crowe team completed 140 recycler cost surveys from April 2023 through October 2023. These 140 processing fee recycling centers comprising the Processing Fee Cost Survey are also referred to as PF for PF recycling centers in this report as they are not included in the handling fee analysis of the cost survey.

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 4.**

Exhibit 4
Stratum Definitions for Processing Fee Recyclers (2022)

Stratum	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

Sample Selection

The sample design consisted of 234 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 initiated a new site investigation or subsequently decertified a site, (2) sites were closed or sold, and the owner was not available, and (3) sites were found to be subsidized by the Department of Rehabilitation.

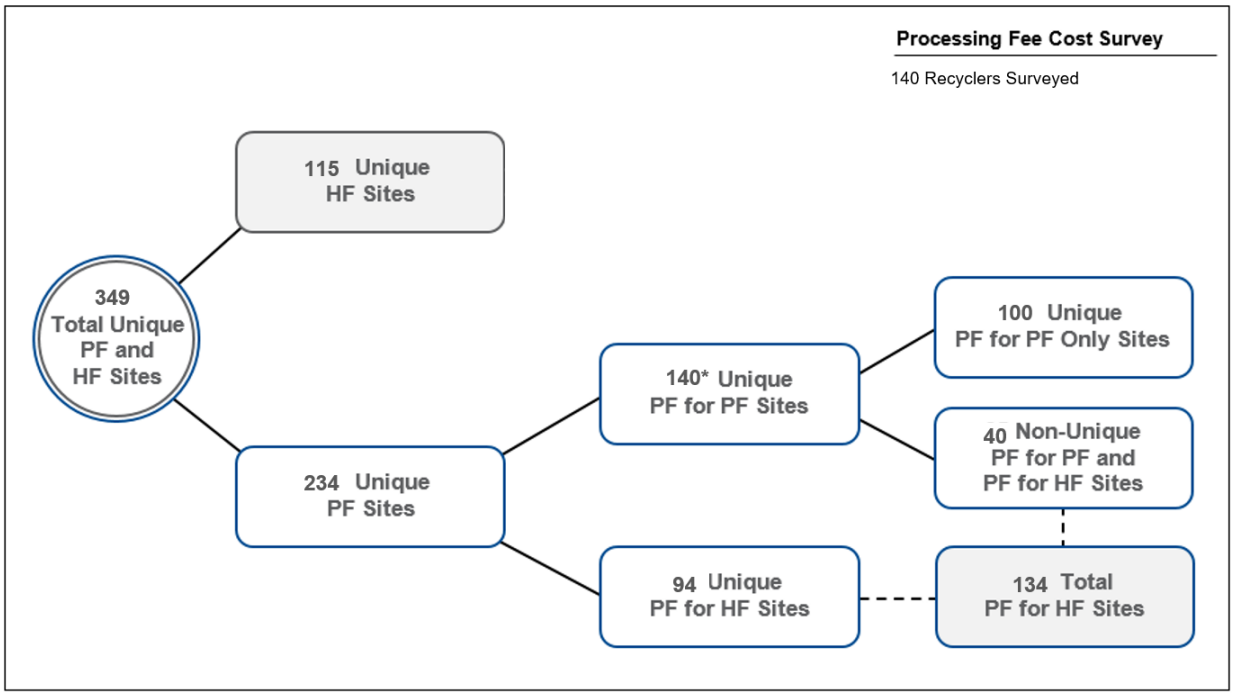
In any given year, there are any number of processing fee recycling centers that close during the survey year or prior to our survey site visit. When possible, Crowe surveyed sites that had closed, meeting with the site owner to obtain the required financial and labor information. However, there were many instances where the owner was unavailable or unwilling to cooperate.

Crowe selected alternative sites for these initially dropped sites. Crowe replaced each dropped site with the next site in a 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 234 processing fee, and 115 handling fee recyclers. The final 234 processing fee recyclers included 140 unique sites for the processing fee cost survey. **Exhibit 5** illustrates the total number of processing fee and handling fee recyclers surveyed, 349 unique sites, and the number of recyclers in the processing fee cost survey, 140 unique sites.

Exhibit 5
Processing Fee and Handling Fee Cost Survey Sample (2022)



Note: 40 PF sites within the 140 also were within the handling fee (HF) cost survey (PF for HF sites), for a total 134 (94 + 40) PF sites used for the cost per container calculation.

C. Conducting Site Visit Surveys

A significant component of the cost survey involved scheduling site visits and communicating with recyclers chosen from the sample frame. Because conducting a cost survey fundamentally entails the collection of proprietary financial information, sensitivity to stakeholder relations is essential. Without willing and active cooperation from the selected recycling center operators, determining the actual costs of beverage container recycling would be exceptionally difficult, and the results would be hard to support. The approach was to communicate with site operators and managers from the start of the process to help them understand what the cost survey entailed, what information we were seeking to obtain, and, perhaps most importantly, to correct misunderstandings about the purpose of the cost survey.

Starting in late April 2023, introduction letters on CalRecycle letterhead were sent to all selected recyclers to:

- Inform them that they were selected to participate in a processing fee cost survey,
- Outline what was expected of the recycler, and
- Introduce Crowe as CalRecycle's cost survey contractor.

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, and the survey team contacted recyclers the week prior to each site visit.

There were three phases of an individual cost survey, illustrated in **Exhibit 6:**

- **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 6
Three Phases of the Cost Survey (2022)

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

Pre-Site Visit

Before conducting the on-site cost survey, the survey team obtained all available information about that site. Crowe entered recycling volumes for 2022 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.

Another critical 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, beverage container indirect, and all materials indirect 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 four to 10 or more hours further compiling the site data, entering information into the cost model, completing the *Site Memorandum* and site file, and reviewing the site file. In many cases, site managers did not have all the necessary information available at the site visit, and the survey team had to telephone 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 work papers, 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.

D. Quality Control and Confidentiality Procedures

Data quality control was a primary focus of the cost survey project. Quality control procedures included five separate levels of review and totaled 11.5 hours per site on average. These data quality control procedures were essential to ensure the cost survey results were fair, equitable, accurate, reasonable, justifiable and defensible.

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

Confidentiality was important for the cost survey. The data collected from each recycling site were not to be disclosed, as the release of the data could potentially be compromising to a recycling business. As a result, Crowe developed formal policies regarding confidentiality. Every Crowe and subcontractor employee who 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); DVBABA LLC (Disabled Veteran Business Enterprise Subcontractor); and Vet Business Services, LLC (Disabled Veteran Business Enterprise Subcontractor) also signed company confidentiality agreements.

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. Financial printouts and worksheet drafts with site-specific information were securely shredded. The final site electronic site files will be delivered to CalRecycle for its secure record retention. Crowe laptop computers were protected against unauthorized access by encryption security software that requires a password to use the laptops.

E. Cost Survey Methodology Validation

Crowe conducted additional analysis to test the validity of the survey results. This subsection discusses distribution of cost-per-ton results. Based on the analyses described below and throughout this section, we conclude that our methodology is consistent with prior years. We are confident that the cost-per-ton results consistently reflect recycler operations and costs.

Distribution of Cost per Ton Results

Crowe evaluated the distribution of 2022 cost per ton results. Our assumption was that if the cost survey was conducted without bias, we would expect a generally right-skewed normal distribution of cost-per-ton results from our sample. That is, the 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 recycling centers by cost per ton is expected to be bunched up toward the left, with a tail stretching toward the right.

Exhibit 7 through **Exhibit 10** 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 recycling centers, and the horizontal axis is cost per ton. The horizontal axis of the cost per ton is in $100 increments for aluminum and PET #1, $200 increments in HDPE #2, and $25 increments for glass. Note that the range for each horizontal bar represents an up-to amount; for example, the $200 bar represents from $100.01 to $200.

Exhibit 7
2022 Sampled Processing Fee Recyclers, Distribution of Aluminum Cost per Ton

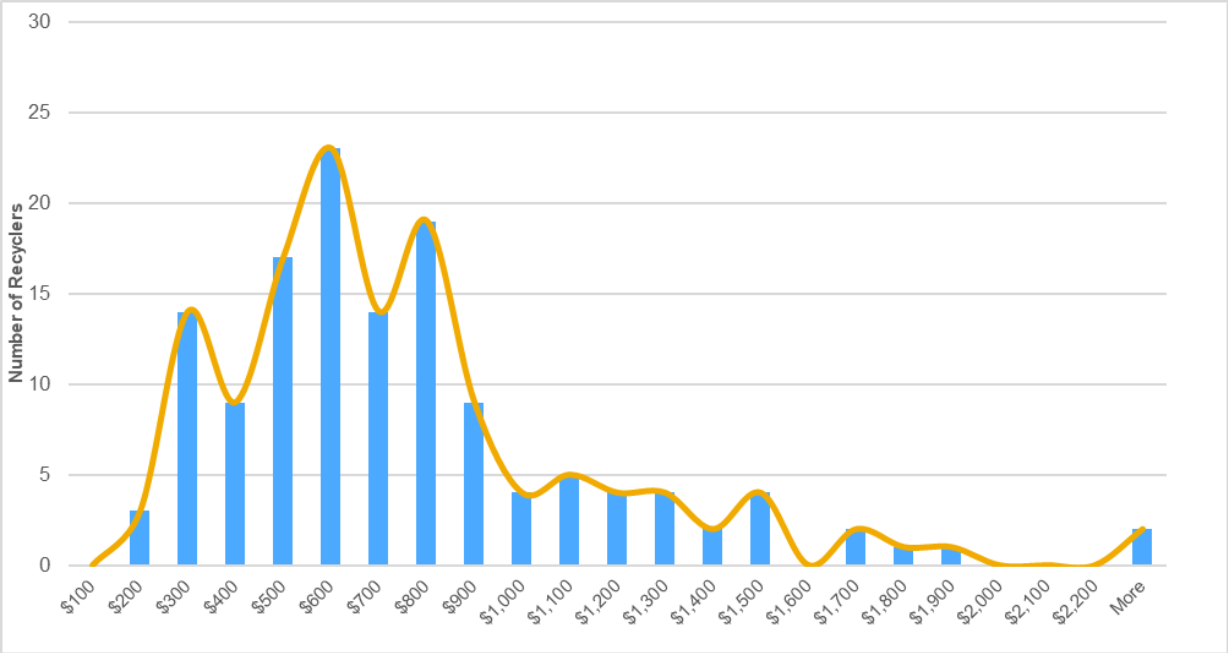


Exhibit 8
2022 Sampled Processing Fee Recyclers, Distribution of Glass Cost per Ton

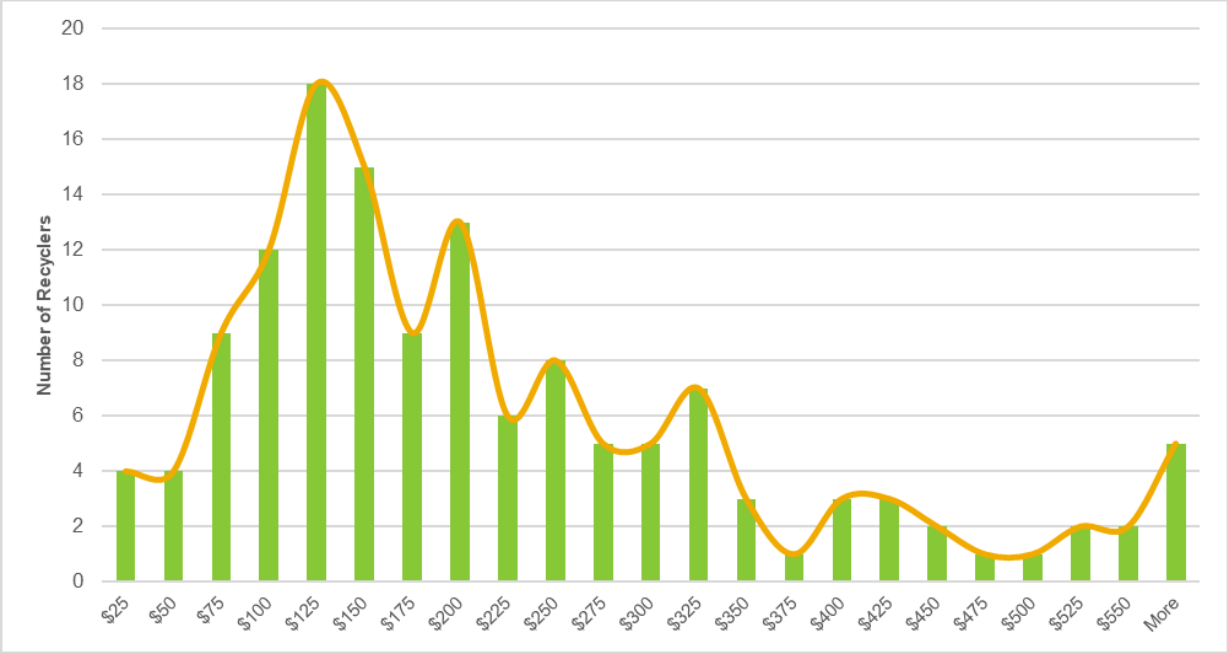


Exhibit 9
2022 Sampled Processing Fee Recyclers, Distribution of PET #1 Cost per Ton

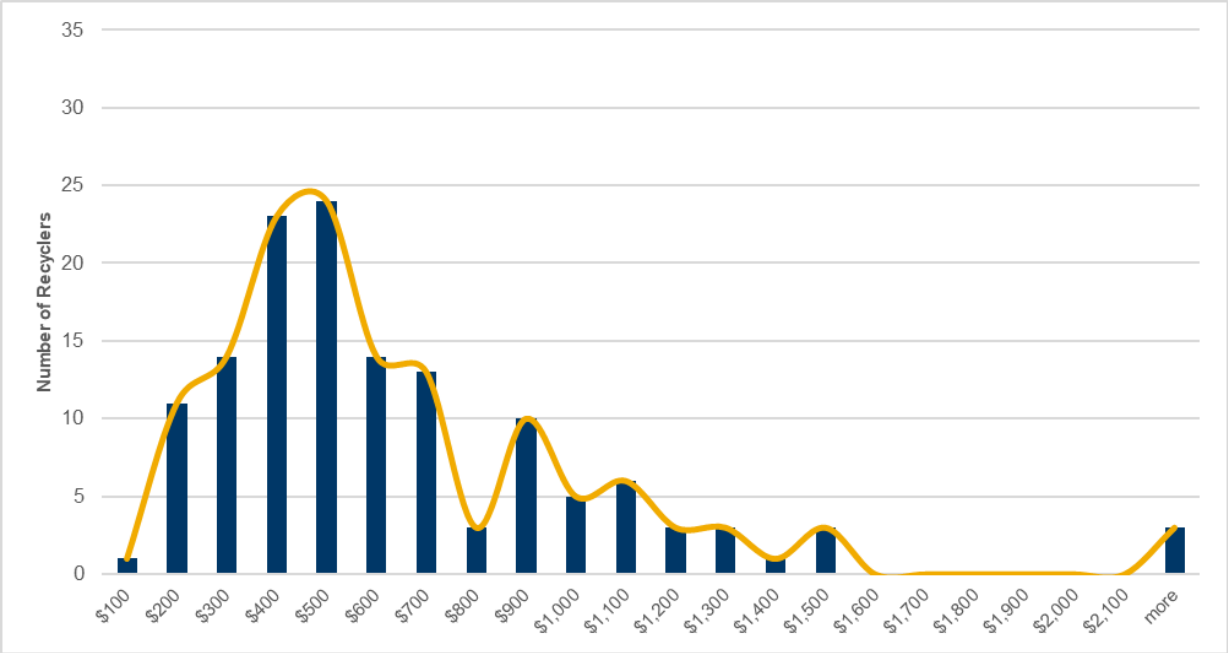
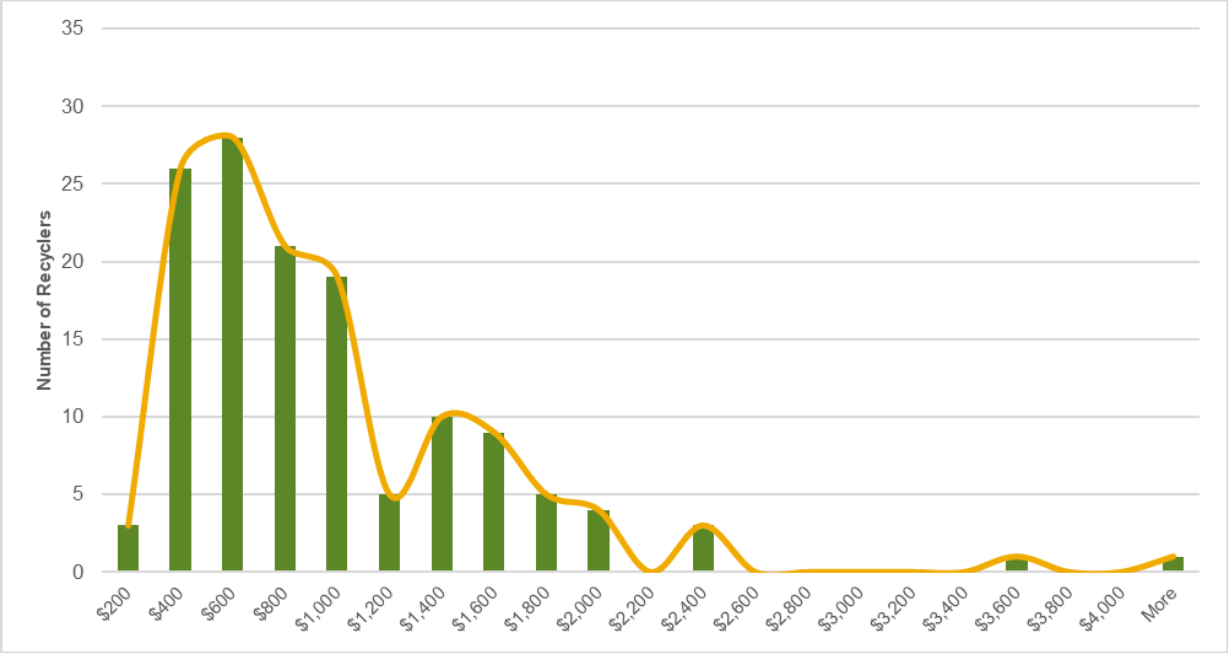


Exhibit 10
2022 Sampled Processing Fee Recyclers, Distribution of HDPE #2 Cost per Ton



The histograms demonstrate consistent distributions among all four material types. In addition, they are consistent with the prior cost-survey frequency histograms, which were similarly right-skewed. The distributions are right skewed with a tail to the right as the 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 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 end of costs, there are fewer constraints. For example, a recycler with low tonnage and high fixed costs could have a very high cost per ton.

Each of the four histograms also shows a slight “bump” to the right-hand side, with slightly more recycling centers having 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.

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 10 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 the sample design.[2] For this 2022 processing fee cost survey, 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 2020 and 2022 cost surveys. **Exhibit 11** illustrates the two calculation approaches that were used to determine processing fee recycler costs per ton for 10 beverage container material types.

[2] The California Beverage Container Recycling and Litter Reduction Act specifies that cost-per-ton calculations be based on a statewide weighted average and not a simple average (taking the average of each site and dividing by the total number of sites).

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

Most recyclers in the total population accept and recycle these four material types.[3] For that reason, Crowe used a weighted (by stratum) average statewide cost per ton for these materials. There were 140 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 2022 tons data for both the sample and population. The next step was to calculate the average cost per ton by stratum, which is equal to the sample stratum cost divided by the sample stratum tons. Next, we multiplied this figure by the stratum population tons to determine the total population costs for each stratum, for each material type. Finally, Crowe determined the statewide, weighted-average cost per ton by summing the three strata total population costs, then dividing by the total population tons. **Exhibit 12** 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 2022 cost survey was the seventh since 2002 (the first was the 2010 cost survey) for which the state did not calculate material-specific costs per ton for bi-metal and plastics #3 to #7. Senate Bill 1357 (SB 1357, Statutes of 2008) states the Department shall adjust the costs of recycling for material types that make up less than 5% of the total number of containers recycled by the percentage change in the most recently measured cost of recycling HDPE #2 beverage containers (even if HDPE #2 makes up less than 5% of total containers recycled). Thus, the cost per ton to recycle bi-metal and plastics #3 to #7 was based on the calculated -1.26% change in HDPE #2 costs per ton between 2020 and 2022. For the 2022 cost per ton for each of these six minority materials (bi-metal, PVC #3, LDPE #4, PP #5, PS #6, and Other #7), the cost per ton decreased by calculating -1.0126 times the respective minority material cost per ton measured in 2020.

[3] 4% fewer recyclers accepted HDPE #2 during 2022, but the number of HDPE #2 recyclers is still quite large, although the total tons are significantly less than for the other three materials, aluminum, glass, and PET #1.

Exhibit 11
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 2020 ($885.21) and 2022 ($874.10):

$$\text{Percent change} = \frac{\$874.10 - \$885.21}{\$885.21} = \frac{-\$11.11}{\$885.21} = -1.26\%$$

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

$$\text{2020 cost per ton} + (\text{2020 cost per ton} \times -1.26\%)$$

Exhibit 12
Weighted-Average by Strata Calculation Example for Processing Fee Recycler Glass Cost per Ton (2022)

Strata	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton[4]
1	17,019.21	$2,752,618.74	$161.74
2	20,967.19	$3,177,742.95	$151.56
3	11,728.26	$2,607,567.54	$222.33
Sample Total	49,714.66	$8,537,929.23	$171.74

Strata[5]	Population Glass Tons	Population Glass Cost	Population Cost per Ton
1	40,930.31	$6,620,068.19	N/A
2	55,942.59	$8,478,658.41	N/A
3	68,726.16	$15,279,886.83	N/A
Sample Total	165,599.05	$30,378,613.43	$183.45[6]

Financial Return

The California Beverage Container Recycling and Litter Reduction Act, California Public Resources Code, Division 12.1, Chapter 6, Section 14575(b)(2) specifies that "a reasonable financial return for recyclers" should be included in the processing payment calculation. The reasonable financial return is multiplied by the cost of recycling to determine a cost of recycling with financial return. Based on amendments to California Code of Regulations, Title 14, Division 2, Chapter 5, Section 2975, the reasonable financial return applied to the cost of recycling for the January 1, 2024, processing payment and processing fee calculations was 10%.

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

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

[6] A statewide, weighted-average result of $183.45 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, 2024, included a cost-of-living adjustment (COLA) of 4.6%. This was the sixth time that CalRecycle has utilized a COLA in its cost of recycling calculation. The COLA adjustment was a mechanism to account for the fact that the 2022 cost data would already be over a year old when the processing fees and processing payments were to take effect on January 1, 2024.

B. Cost Results

The costs per ton to recycle for each of the 10 material types with and without the reasonable financial return and COLA are summarized in **Exhibit 13.** This exhibit also shows the 2022 survey sample size for the four relevant material types.

Exhibit 14 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 13
Statewide Costs per Ton to Recycle for Processing Fee Recyclers (2022)

Material	Cost per Ton without Reasonable Financial Return	Cost per Ton with Reasonable Financial Return and COLA[a]	N = Sample Number of Sites[b]
1. Aluminum	$727.46	$837.02	137
2. Glass	183.45	211.08	138
3. PET #1	605.19	696.33	137
4. HDPE #2	874.10	1,005.74	135
5. Bi-Metal	1,101.76	1,267.68	NA
6. PVC #3	1,374.85	1,581.90	NA
7. LDPE #4	1,961.34	2,256.72	NA
8. PP #5	1,759.59	2,024.58	NA
9. PS #6	1,089.91	1,254.06	NA
10. Other #7	1,194.17	1,374.01	NA

[a] The reasonable financial return is 10% and the COLA is 4.6%.

[b] Overall, 140 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 14
Strata and Population Costs and Tons for Processing Fee Recyclers (2022)

Stratum 1 – High PET #1 Tons

Material Type	Sample Costs	Sample Tons	Stratum 1 Population Costs	Population Tons
Aluminum	$4,801,127.98	9,132.79	$10,743,591.48	20,436.73
Glass	2,752,618.74	17,019.21	6,620,068.19	40,930.31
PET #1	6,596,368.97	15,014.80	14,769,193.51	33,618.30
HDPE #2	152,197.41	224.03	362,568.89	533.70

Stratum 2 – Medium PET #1 Tons

Material Type	Sample Costs	Sample Tons	Stratum 2 Population Costs	Population Tons
Aluminum	$4,791,422.08	7,157.08	$12,431,326.44	18,568.91
Glass	3,177,742.95	20,967.19	8,478,658.41	55,942.59
PET #1	6,785,512.86	12,421.93	17,749,707.66	32,493.74
HDPE #2	336,137.65	485.49	756,875.20	1,093.17

Stratum 3 – Low PET #1 Tons

Material Type	Sample Costs	Sample Tons	Stratum 3 Population Costs	Population Tons
Aluminum	$4,070,792.06	4,333.90	$23,057,830.26	24,548.15
Glass	2,607,567.54	11,728.26	15,279,886.83	68,726.16
PET #1	5,231,195.65	6,446.55	29,470,520.71	36,317.45
HDPE #2	161,680.85	132.62	1,069,141.74	876.94

Combined Population Strata

Material Type	Population Costs	Population Tons	Statewide Cost per Ton
Aluminum	$46,232,748.18	63,553.79	**$727.46**
Glass	30,378,613.43	165,599.05	**183.45**
PET #1	61,989,421.88	102,429.50	**605.19**
HDPE #2	2,188,585.83	2,503.81	**874.10**

Minority Materials

Material Type	2020 Cost/Ton	1.26% Decrease	2022 Cost per Ton
PVC #3	$1,115.82	-14.06	**$1,101.76**
LDPE #4	1,392.39	-17.54	**1,374.85**
PP #5	1,986.37	-25.03	**1,961.34**
PS #6	1,782.04	-22.45	**1,759.59**
Other #7	1,103.82	-13.91	**1,089.91**
Bi-Metal	1,209.41	-15.24	**1,194.17**

Error Rates and Confidence Intervals for Costs per Ton

The California Beverage Container Recycling and Litter Reduction Act (AB 2020, Margolin, Chapter 1290, Statutes of 1986), California Public Resources Code, Division 12.1, Chapter 6, 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% confidence level (California Code of Regulations (CCR), Title 14, Division 2, Chapter 5, section 2000 (a)(47)). Internal CalRecycle policy further establishes a 10% error rate.

In developing the sample design, Crowe determined that rather than set the sample to achieve an 85% confidence interval and then add oversample, it would be more statistically accurate to set the confidence interval higher, at 90%. The sample size was developed based on 2020 cost survey results to achieve a 90% confidence interval with a 10% error rate. Only after the survey was complete could we determine whether the actual specifications of a 90% confidence interval and the target 10% error rate were met.

The final data analysis shows that the processing fee cost survey met and exceeded all prior statistical requirements (the 2002 to 2020 surveys of recyclers also met and exceeded these requirements). In all cases the error rate at a 90% confidence level was below 10%. The error rate at the 90% confidence interval for each of the four relevant materials is provided in **Exhibit 15.** For comparison, this exhibit also provides error rates at the 90% confidence interval for each of the four (or five or six) relevant material types from the 2002-2020 processing fee cost surveys.[7]

The 2022 cost survey generally achieved a similar high degree of statistical confidence as the 10 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 review levels for each site; some site files were sent back to the original survey team for additional investigation and revisions before they were approved.

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[7] The bi-metal error rate at the 90% confidence interval is slightly higher in 2004 as compared to 2002. However, for the first time, the 2004 bi-metal sample was a statistically valid random sample drawn specifically for bi-metal, as opposed to the "hybrid" sample of available sites that was used in 2002 to determine bi-metal costs per ton. In 2004, 2006, and 2008, the bi-metal sample consisted of a statistically valid random sample drawn specifically for bi-metal. The 2006 cost survey was the first time we utilized a random sample (rather than a census) for Other #7, and thus the first time we calculated error rates for this plastic resin. We again utilized a random sample for Other #7 in the 2008 cost survey. For the 2010 to 2022 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 15
Sample Error Rates for Processing Fee Recyclers, by Material Type (2002 to 2022)

Material Type	2022	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**4.97%**	5.80%	7.52%	6.71%	5.86%	5.71%	6.27%	5.66%	6.61%	5.55%	7.82%
2. Glass	**7.29%**	7.91%	6.88%	7.80%	6.49%	5.24%	7.52%	6.19%	8.17%	7.35%	9.21%
3. PET #1	**4.92%**	5.29%	7.40%	6.11%	6.23%	5.18%	7.56%	6.39%	8.05%	7.33%	9.77%
4. HDPE #2	**6.41%**	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	F	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	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	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	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	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	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. In 2022, HPDE #2 cost per ton decreased by 1.26% as compared to 2020.

Exhibit 16 provides a summary comparison of the number of surveyed sites for each material type for the cost surveys from 2002 to 2022. The stratified random sample for this 2022 processing fee cost survey was slightly lower than the prior cost survey. The 2022 survey marked the first such cost survey where the number of recyclers reporting aluminum was less than the total sample, or 137 of 140.

Exhibit 16
Summary Comparison of Number of Surveyed Sites for Processing Fee Recyclers (2002 to 2022)

Material Type	2022	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**137**	146	154	143	151	151	129	116	123	117	136
2. Glass	**138**	142	152	137	151	147	128	112	121	115	131
3. PET #1	**137**	146	153	140	151	148	129	115	122	115	132
4. HDPE #2	**135**	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	N/A	40	40	52	65
6. PVC #3	N/A	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	N/A	20	13	10	11
8. PP #5	N/A	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	N/A	32	15	11	12
10. Other #7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	40	40	67	49

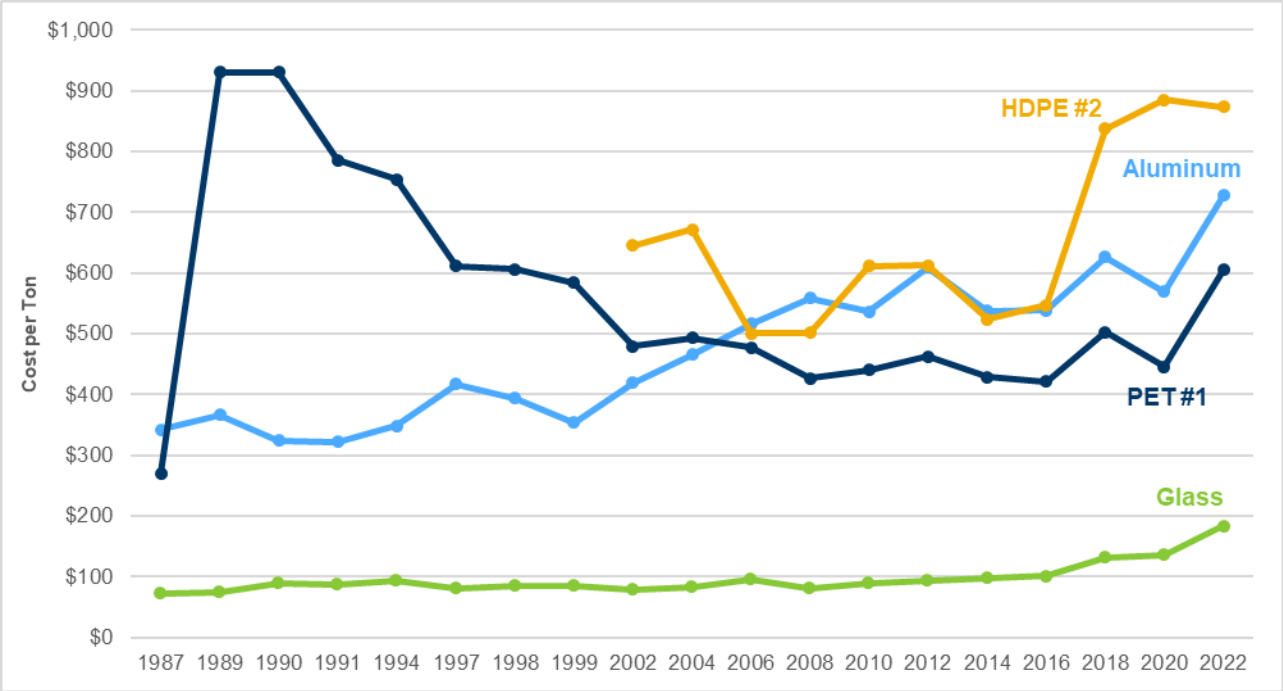
C. Historical Trends in Cost per Ton Results

Recycler costs per ton for processing fees were first determined in 1987. The initial cost of recycling survey for 50 recyclers represented the first time such costs were measured and calculated.

Over the past 36 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 of experience and evolution of the cost survey process. Cost per ton results from the program's earliest years 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 17 provides the historical cost per ton results for all years in which recycler cost surveys were conducted. **Exhibit 18** provides the cost per ton results from 2002 to 2022. 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 2020, the 2022 cost per ton results for aluminum increased by 28%, glass increased by 34%, PET #1 increased by 36%, and HDPE #2 decreased by 1%. As compared to 2020 recycling volumes, the 2022 recycling volumes for aluminum decreased by 2%, glass decreased by 16%, PET #1 decreased by 1%, and HDPE decreased by 17%. **Exhibit 19** compares CPI-adjusted costs per ton from 2002 to 2022 for aluminum, glass, PET #1, and HDPE #2 using the U.S. Department of Labor, Bureau of Labor Statistics, and West Urban Consumer Price Index (CPI).[8]

Exhibit 17
Aluminum, Glass, PET, and HDPE Plastic Processing Fee Recycler Cost per Ton (1987 to 2022)

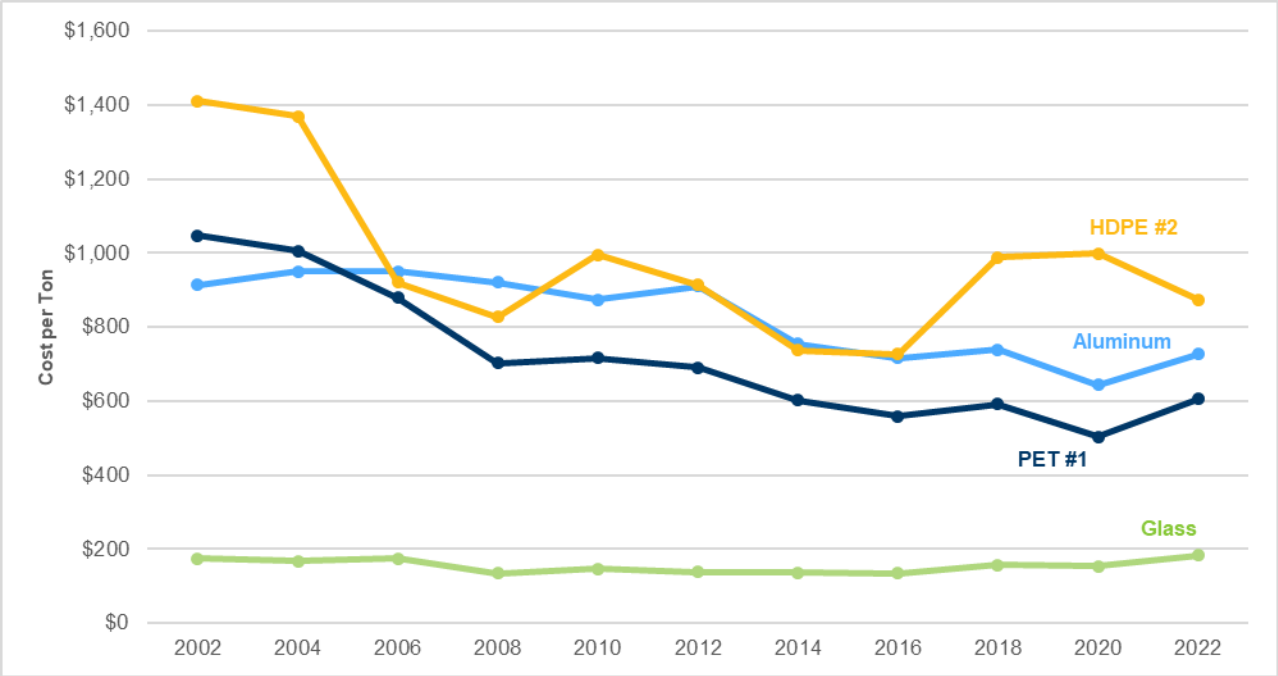


[8] U.S. Department of Labor, Bureau of Labor Statistics, West Urban Consumer Price Index (as of Oct 2023)

Exhibit 18
Historical Statewide Costs per Ton (Without Reasonable Financial Return) (2002 through 2022)

Material Type	2022	2020	2018	2016	2014	2012	2010	2008	2006	2004	2002
1. Aluminum	**$727.46**	$569.76	$626.61	$539.11	$537.29	$609.81	$537.06	$559.23	$516.13	$465.90	$418.95
2. Glass	**183.45**	136.73	132.68	101.04	97.50	92.88	89.76	81.60	94.98	82.45	79.81
3. PET #1	**605.19**	446.34	502.44	421.30	428.55	462.79	440.61	426.76	477.73	493.31	479.63
4. HDPE #2	**874.10**	885.21	838.00	547.11	524.23	612.50	611.62	501.67	500.64	671.73	645.91
5. Bi-Metal	**1,101.76**	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	**1,374.85**	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	**1,961.34**	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	**1,759.59**	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	**1,089.91**	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	**1,194.17**	1,209.41	1,144.95	747.50	716.27	836.86	835.69	685.44	741.93	1,264.47	759.32

Exhibit 19
Summary Comparison of Aluminum, Glass, PET, and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002 to 2022)



Aluminum

The aluminum cost per ton results increased 28% from $569.76 cost per ton in 2020 to $727.46 cost per ton in 2022. This $727.46 cost per ton is the highest in the past 10 surveys. In 2022, the processing fee recycler population recycled 63,554 tons of aluminum, down from 65,104 tons recycled in 2020, a 2% decrease. 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, the average tons of aluminum recycled per year increased in 2022 to the highest level in the past 10 cost surveys. The increase resulted from 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 compared to previous survey years. However, the increase in the cost per ton to recycle aluminum coupled with volatile scrap market conditions in 2022 indicate a decline in potential profits from aluminum for recyclers. In 2022, aluminum made up 19% of tons of CRV material recycled by the population, roughly a 1.3% increase from 2020.

Glass

The glass cost per ton results increased 34% from $136.73 cost per ton in 2020 to $183.45 cost per ton in 2022. This $183.45 cost per ton is the highest in the past 10 surveys. The results reflect a continued trend of increased glass costs since 2008, resulting in a cost per ton over $100 for the fourth time. In 2022, total glass volumes, at 165,599 tons, were lower compared to all other survey years. Glass volumes continued to decline between 2020 and 2022, compared to the stabilized levels between 2014 and 2016, following a large decrease between 2012 and 2014. The average number of tons of recycled glass per recycler slightly decreased from 342 tons in 2018 to 337 tons in 2020, then decreased more significantly to 296 in 2022. In 2022, glass made up its lowest historical percent share of CRV material recycled at 50%. In 2020, glass made up 53% of tons of CRV material recycled, compared to a high of 68% in 2002.

PET #1

The PET #1 cost per ton results increased 36% from $446.34 cost per ton in 2020 to $604.19 cost per ton in 2022. This $604.19 cost per ton is the highest in the past 10 surveys. For PET #1, the costs have historically fluctuated year to year within a relatively narrow band between $400 to $500 cost per ton, but 2022 has bucked the trend at over $600 cost per ton. Tons of PET #1 recycled decreased by 1% from 2020 to 2022. 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, 177 tons in 2020, to 183 tons in 2022. In 2022, PET #1 made up its greatest share of CRV materials recycled, at 31%, an increase of 2.6% from 2020.

Between 1990 and 2002, the cost per ton for PET #1 dropped each year, from over $900 to under $500. This large cost per ton reduction over time was likely related to improved recycling practices as PET #1 recycling has become a mainstream, established business. The historical decline of PET #1 cost per ton is likely due to significant increases in tons recycled. The 2022 PET #1 cost per ton results are higher than the average of all cost per ton results from combined surveys (2002 to 2020 average is $458 cost per ton).

HDPE #2

The HDPE #2 cost per ton results decreased by 1.26% from $885 cost per ton in 2020 to $874 cost per ton in 2022. HDPE #2 costs per ton are based on the sub-model and relative costs compared to PET #1 and, to a lesser extent, other plastics. The requirement to redeem separated CRV-only material continued to impact on HDPE #2 recycling in 2022. HDPE #2 is the only beverage container material to have a commingled rate significantly lower than 100% 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%) 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%. These changes increase relative costs for HDPE #2, reflecting the additional cost of sorting non-CRV HDPE #2 from HDPE #2 beverage containers. Despite overall volumes decreasing by 17%, costs only decreased by 1%. In 2022, HDPE #2 made up its lowest share of CRV materials recycled, at 0.7%, a decrease of 0.1% from 2020.

Bi-Metal and Plastics #3 to #7

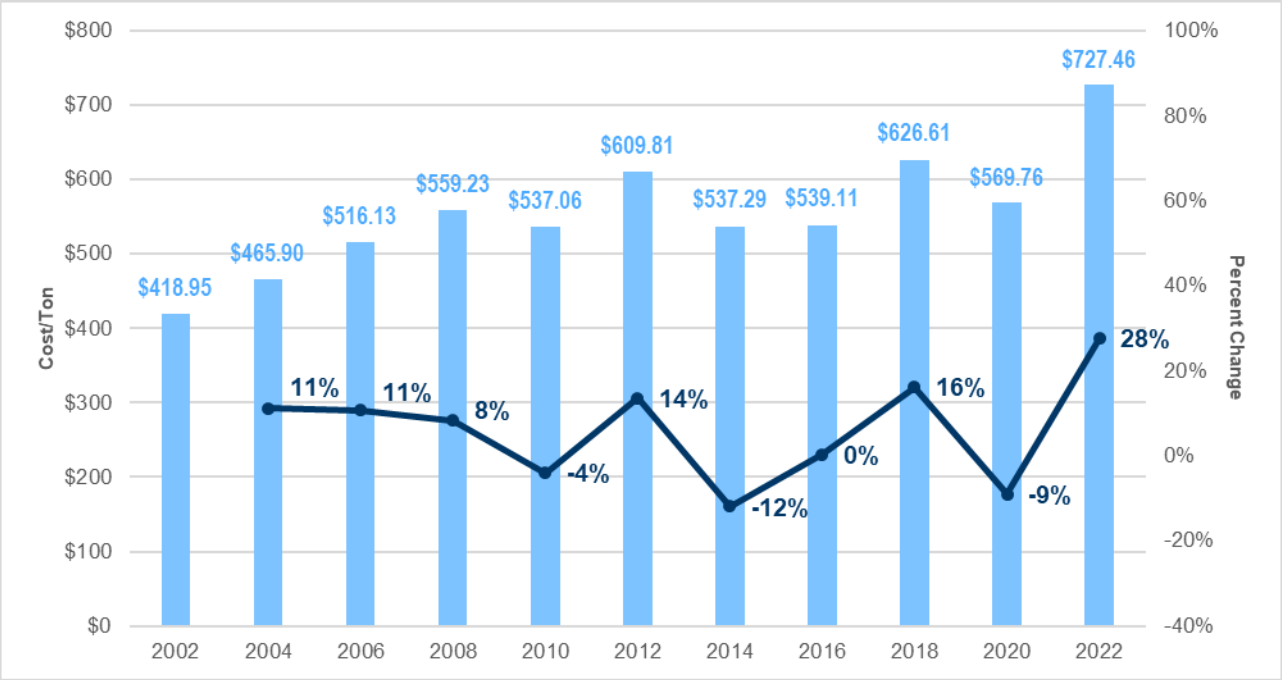
This is the seventh cost survey that the cost per ton for bi-metal and plastics #3 to #7 was indexed to the percentage change in HDPE #2 cost per ton, as specified in Senate Bill (SB) 1357 (Statutes of 2008). Per statute, CalRecycle adjusts the costs of recycling for material types that make up less than 5% of the total number of containers recycled by the percentage change in the most recently measured cost of recycling HDPE #2 beverage containers (even if HDPE #2 makes up less than 5% of total containers recycled).

In calendar year 2022, HDPE #2 made up only 0.75% of all beverage containers recycled. In total bi-metal and plastics #3 through #7 made up 0.15% of containers recycled. Thus, while HDPE #2 recycling is minimal compared to aluminum, glass, and PET #1, it is still substantial 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 1.26% decrease in HDPE #2 between 2020 and 2022. Thus, for the 2022 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 1.26%.

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

Exhibit 20 through **Exhibit 23** provide comparisons of the processing fee recycler costs per ton and recycling tons over the last 11 cost surveys, for the four majority material types. The percent figures, secondary axis next to each column show the percentage change from the previous two years.

Exhibit 20
Aluminum Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)[a]



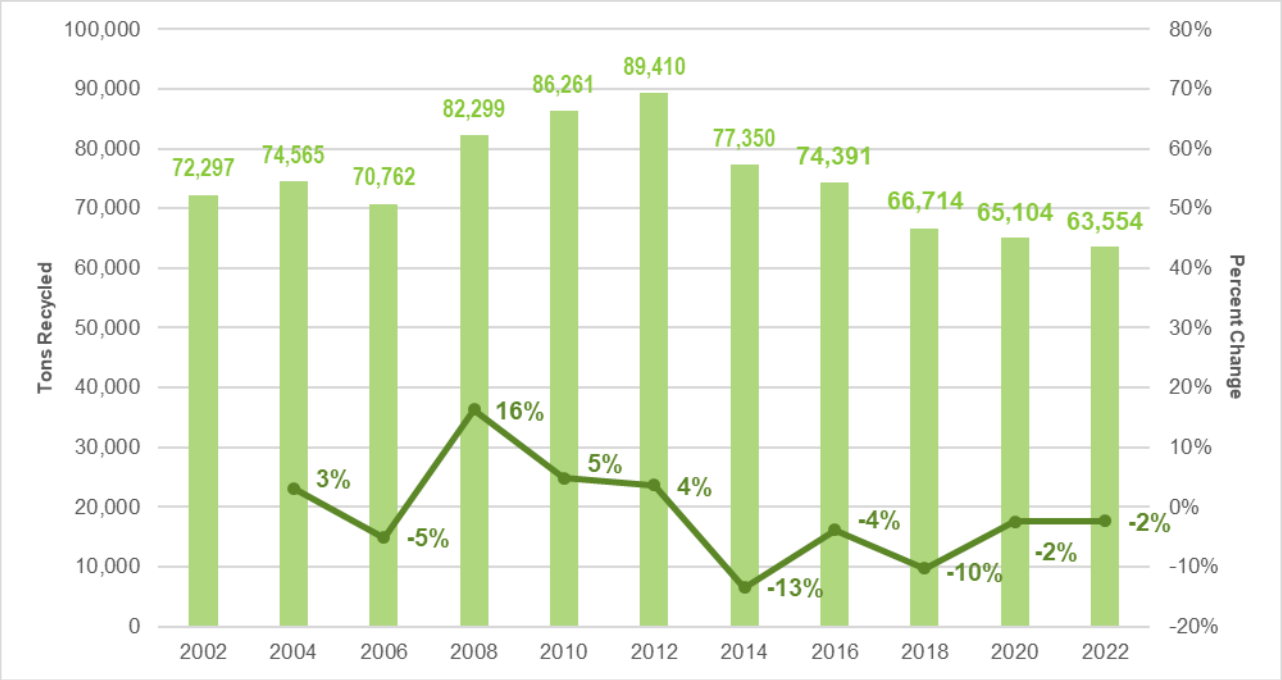
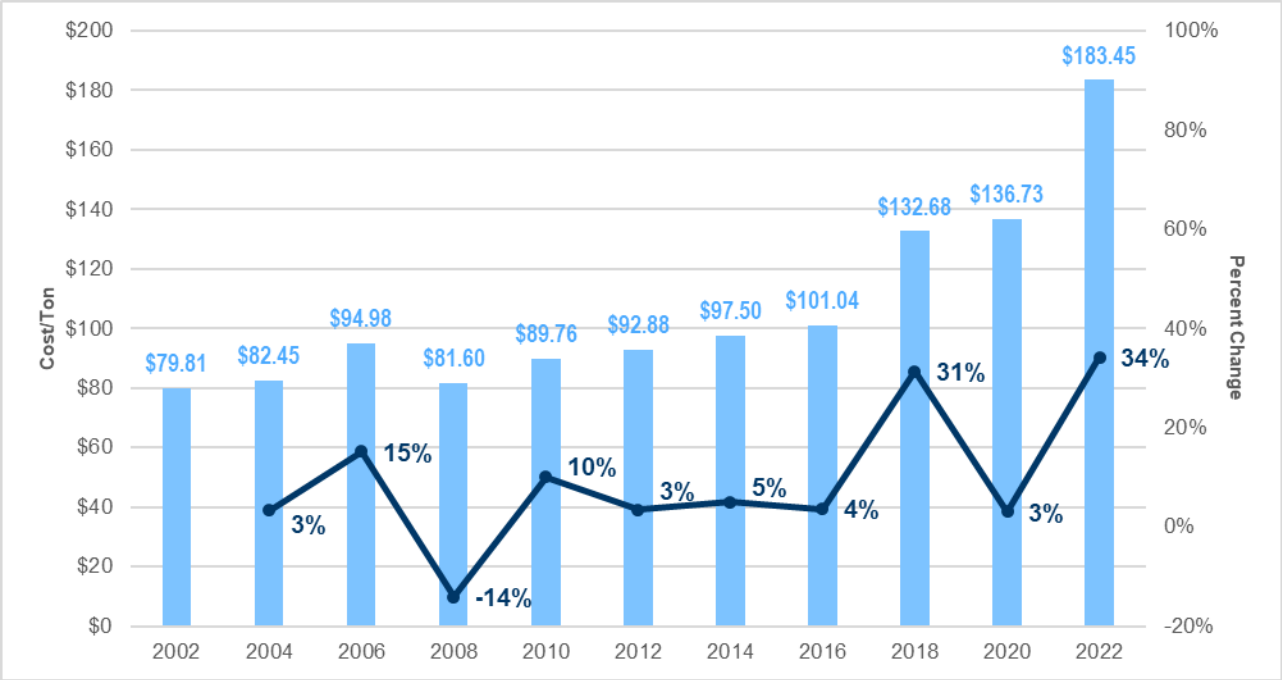


Exhibit 21
Glass Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)[b]



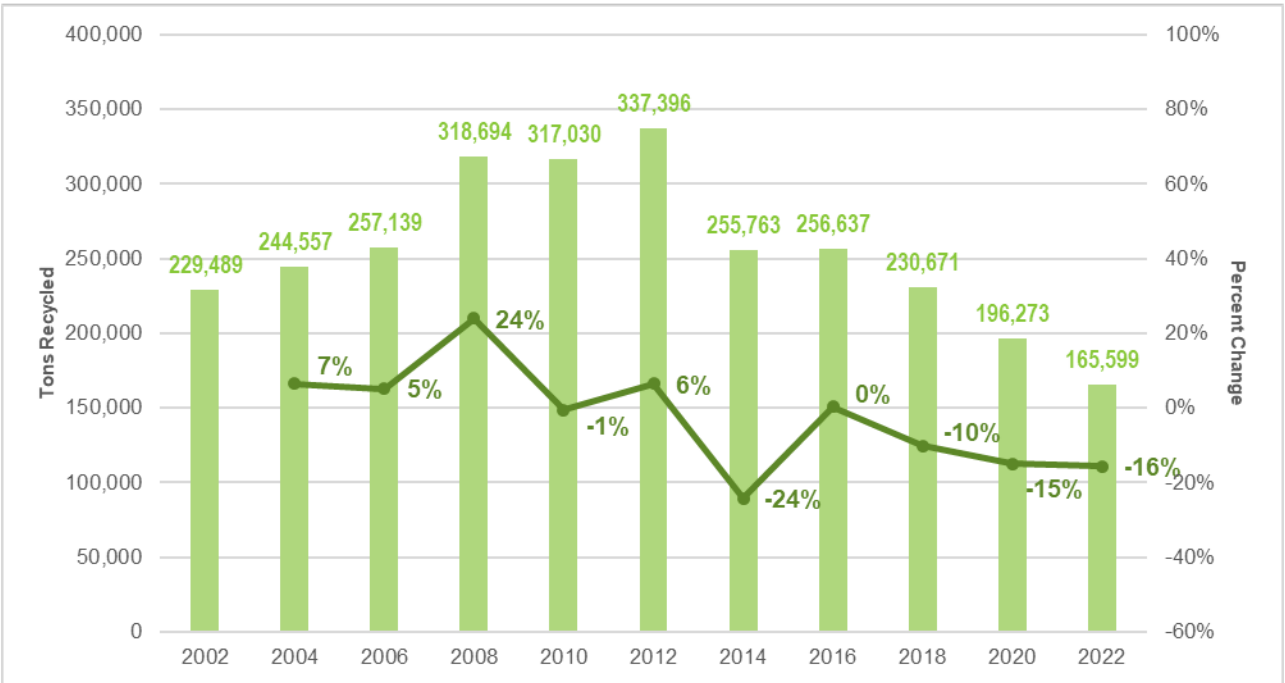
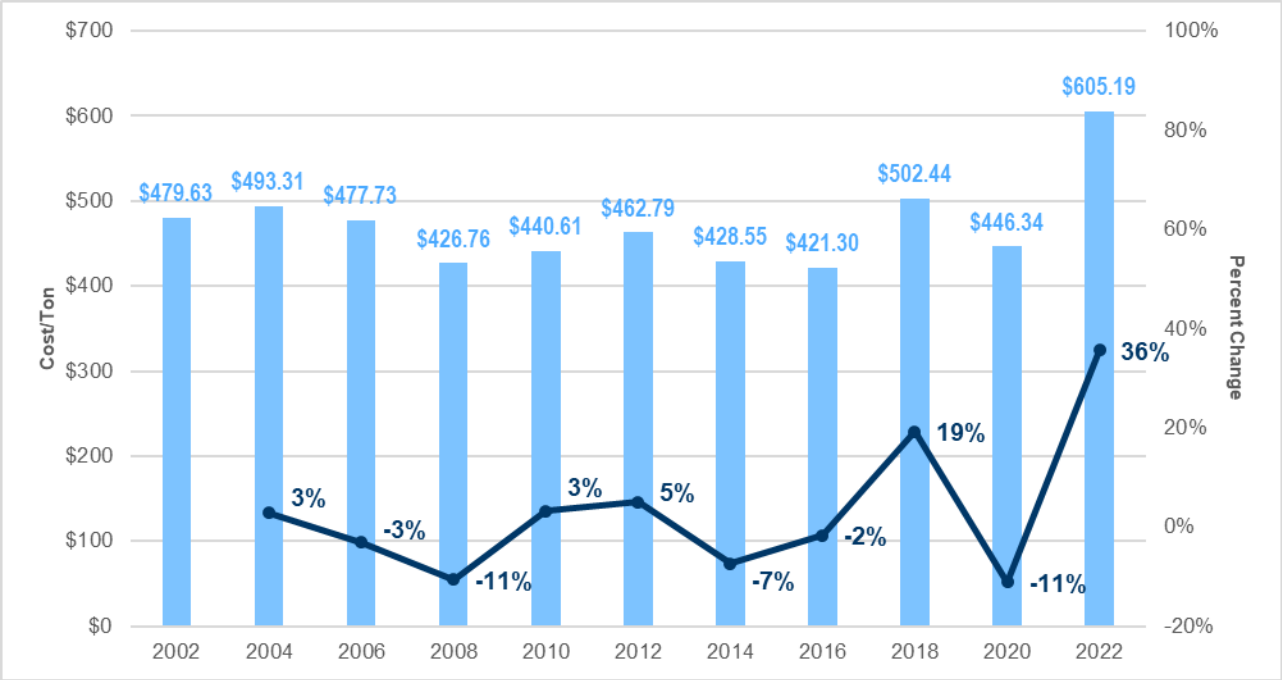


Exhibit 22
PET #1 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)[c]



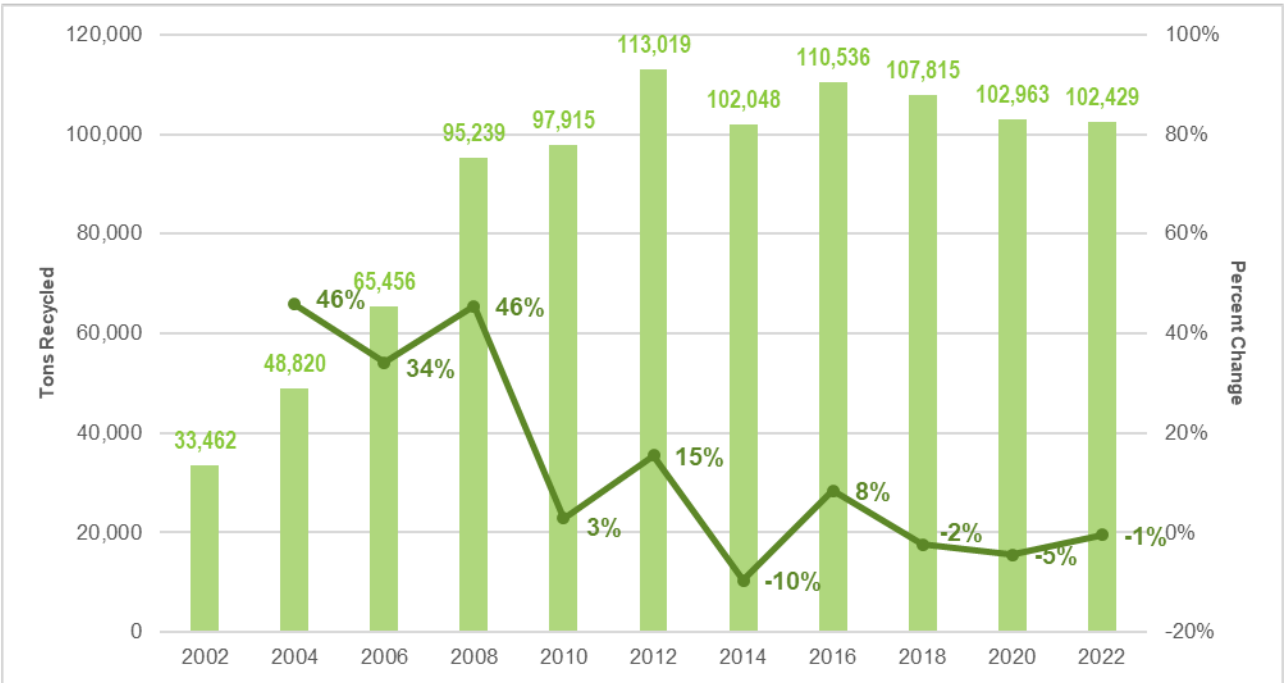
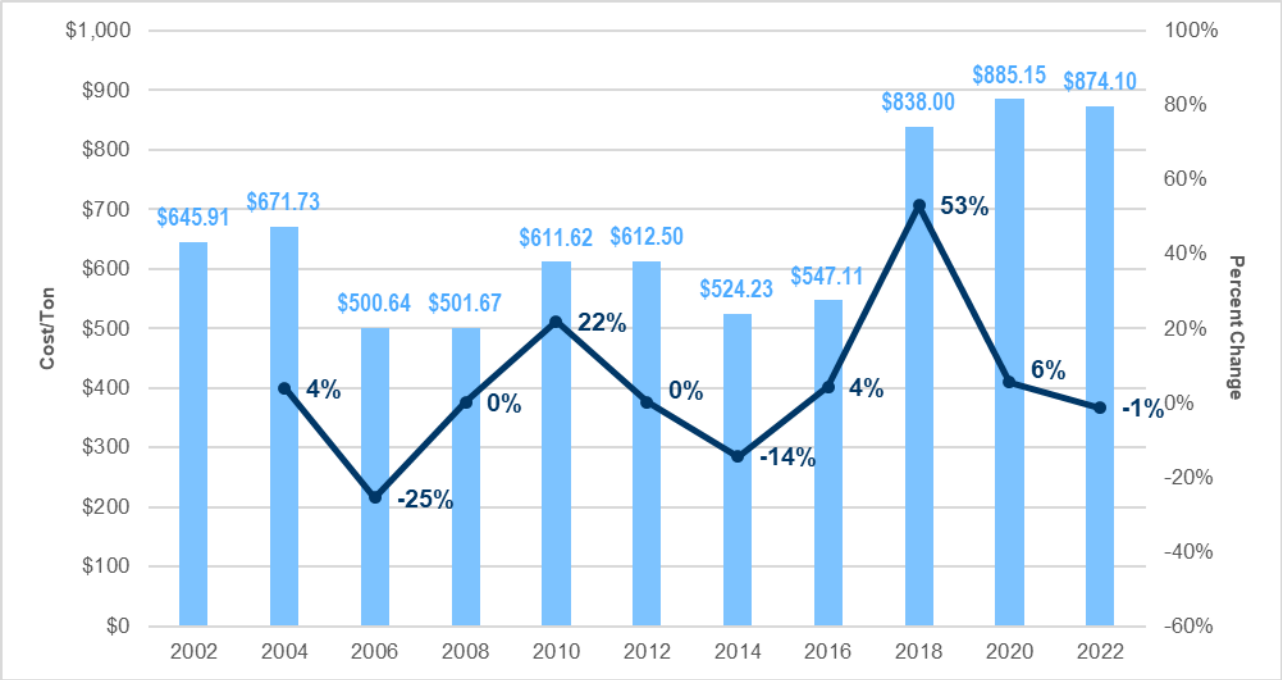
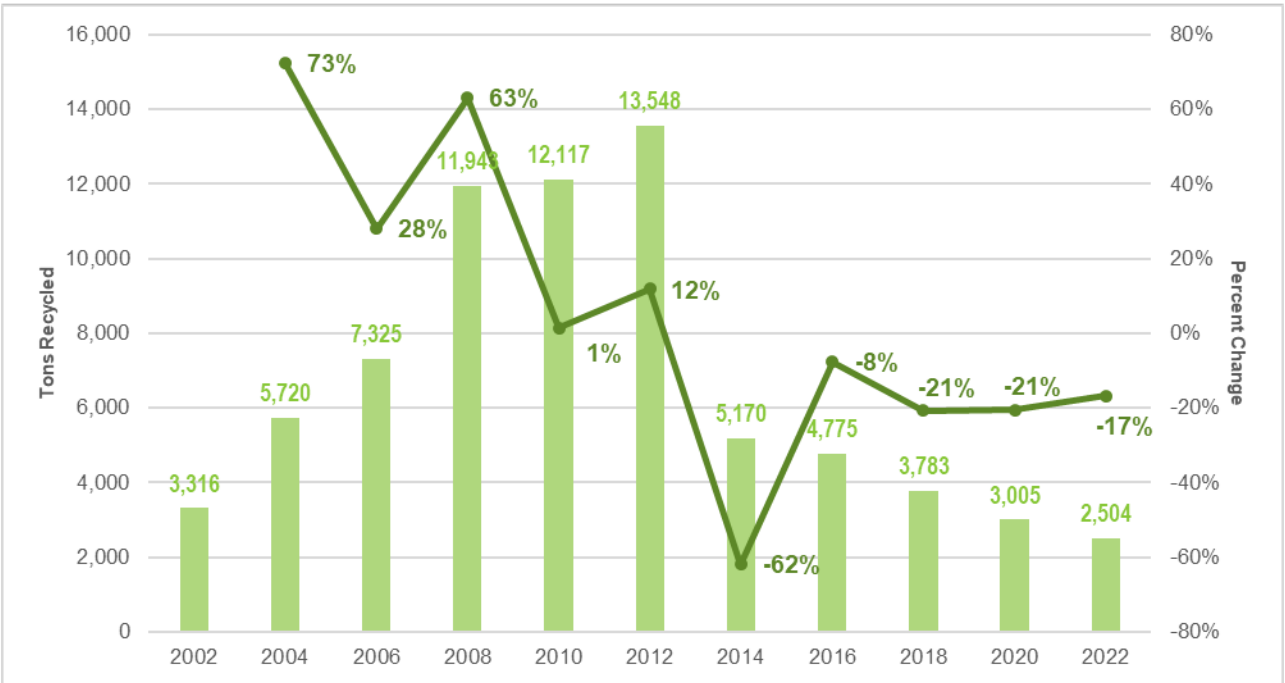


Exhibit 23
HDPE #2 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)[d]

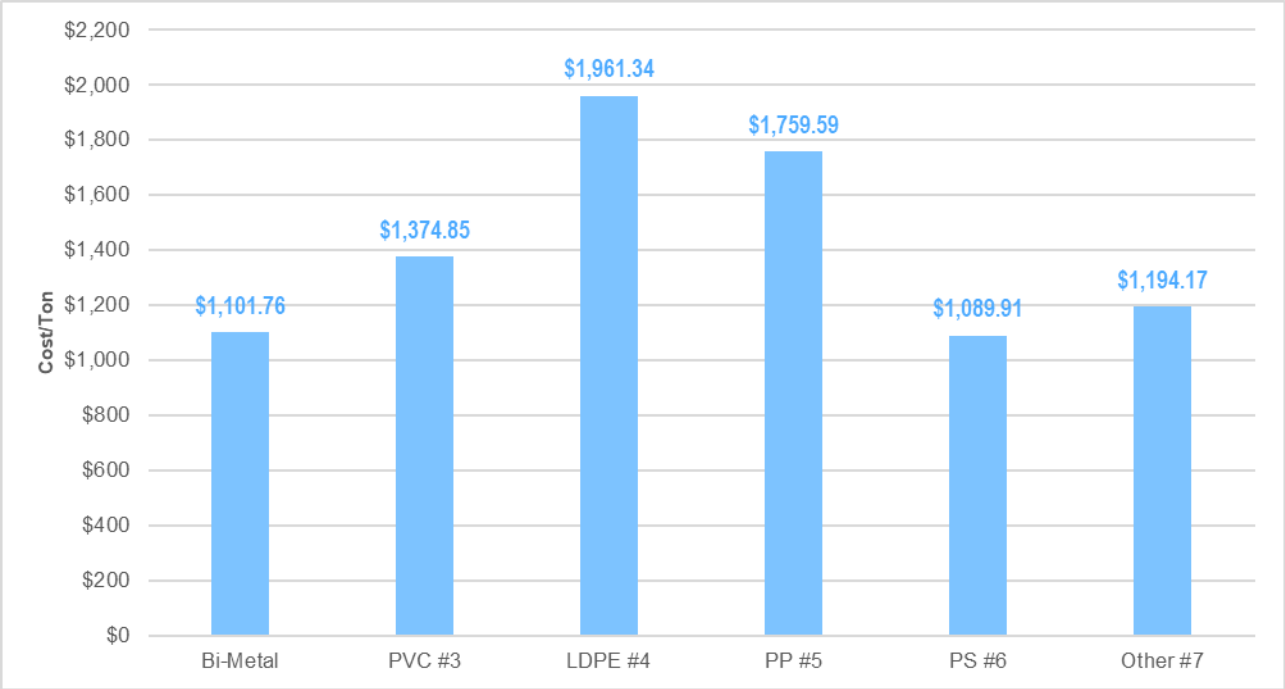




E. Cost per Ton Results for Six Minority Material Types

Exhibit 24 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 2022 survey results, costs per ton for each of these materials decreased by 1.26% compared to their 2018 cost per ton.

Exhibit 24
Bi-Metal and Plastics #3 to #7 Processing Fee Recycler Costs per Ton (2022)



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 25** 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 26 provides the weighted-average cost per ton by stratum for glass, aluminum, PET #1, and HDPE #2 for 2020 and 2022 and the percent change between 2020 and 2022. For glass, aluminum, and PET #1, the cost per ton for stratum 1 generally increased the least (14 to 30%), while the cost per ton for stratum 3 increased the most (38 to 49%). For HDPE #2, the trend for stratum 1 and 2 have decreased costs, while stratum 3 has an increase on par with the other materials.

Exhibit 25
Example Calculation of 2022 Statewide, Weighted-Average Cost per Ton for Glass

Strata	Sample Glass Tons	Sample Glass Cost	Sample Cost per Ton[9]
1	17,019.21	$2,752,618.74	$161.74
2	20,967.19	$3,177,742.95	$151.56
3	11,728.26	$2,607,567.54	$222.33
Sample Total	49,714.66	$8,537,929.23	$171.74

Strata[10]	Population Glass Tons	Population Glass Cost	Population Cost per Ton
1	40,930.31	$6,620,068.19	N/A
2	55,942.59	$8,478,658.41	N/A
3	68,726.16	$15,279,886.83	N/A
Sample Total	165,599.05	$30,378,613.43	$183.45[11]

[9] Simple weighted-average cost per ton for each stratum, and simple weighted-average for the sample.
[10] Total costs for each stratum, calculated by multiplying sample cost per ton from above, by total glass tons, summed for entire population.
[11] A statewide, weighted-average result of $183.45 per ton, calculated by dividing total population glass costs by total population glass tons.

Exhibit 26
Comparison of Cost per Ton by Material Type and Stratum (2020 and 2022)

Glass

Stratum	2022	2020	% Change
1	**$161.74**	$124.15	30%
2	**$151.56**	$129.91	17%
3	**$222.33**	$152.31	46%

PET #1

Stratum	2022	2020	% Change
1	**$439.32**	$383.34	15%
2	**$546.25**	$412.55	32%
3	**$811.47**	$545.36	49%

Aluminum

Stratum	2022	2020	% Change
1	**$525.70**	$461.64	14%
2	**$669.47**	$557.49	20%
3	**$939.29**	$678.88	38%

HDPE #2

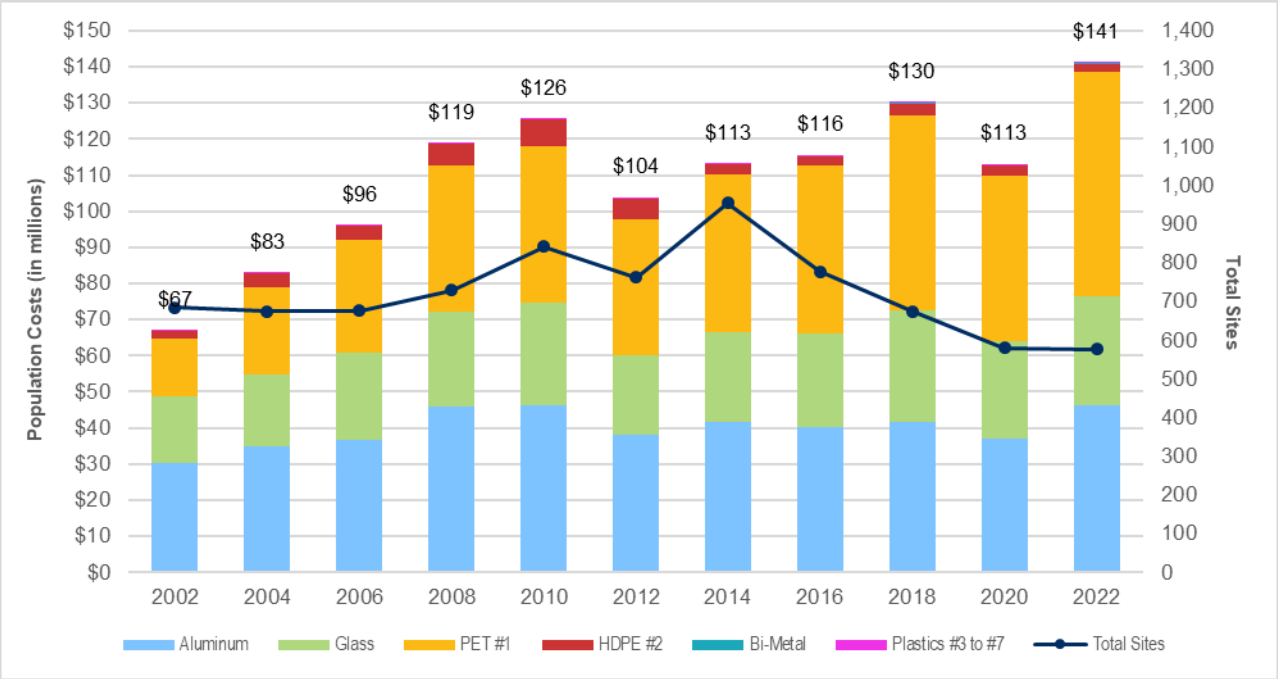
Stratum	2022	2020	% Change
1	**$679.35**	$920.90	-26%
2	**$692.37**	$809.02	-14%
3	**$1,219.17**	$958.05	27%

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

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

Exhibit 27 illustrates population costs[12] from 2002 to 2022. 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 until 2020. This analysis illustrates that the results of 2020 may have been an anomaly due to COVID; comparisons between 2018 and 2022 may be more reflective of longer-term trends. Between 2020 and 2022, total costs increased approximately 25%.

Exhibit 27
Total Population Costs for Processing Fee Recyclers (2002 to 2022)

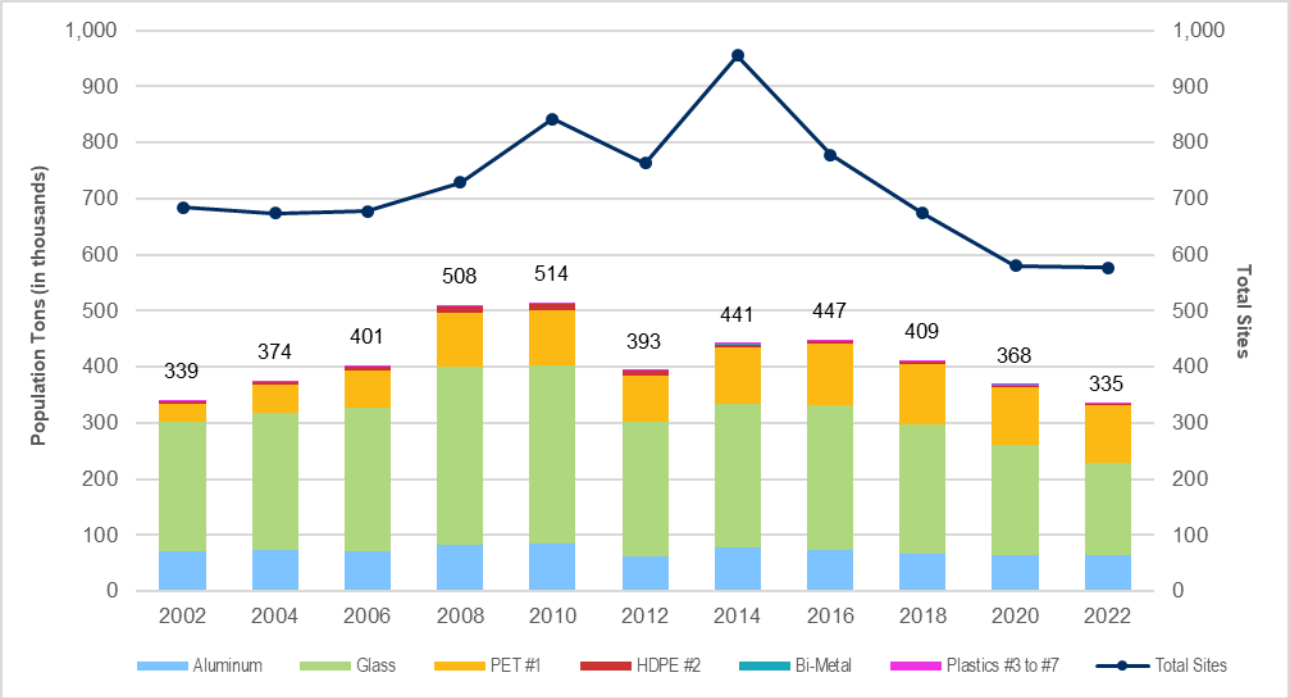


[12] The 2012, 2014, and 2018 population costs represent reduced populations for both years (269 investigated recyclers were removed for 2012, 42 investigated recyclers were removed for 2014, 31 investigated recyclers were removed from 2018, 30 investigated recyclers were removed in 2020, and 18 investigated recyclers were removed in 2022).

Exhibit 28 illustrates the changes in population tons[13] from 2002 to 2022. Like total costs, total tons increased between 2002 and 2010, reset in 2012 (with a reduced population), and then generally decreased through 2022. Between 2018 and 2020, total tons decreased by approximately 10%. Finally, between 2020 and 2022, total tons decreased by approximately 9%.

In 2022, the percentage of glass decreased by 4% (50% for glass), the percent for aluminum increased by 1% (19%), and PET #1 increased by 2% (31%). Across all years, HDPE #2 and minority materials combined made up approximately 1% of total tons recycled.

Exhibit 28
Total Population Tons for Processing Fee Recyclers (2002 to 2022)



[13] The 2012, 2014, and 2018 population tons represent reduced populations for both years (269 investigated recyclers were removed for 2012, 42 investigated recyclers were removed for 2014, 30 investigated recyclers were removed in 2020, and 18 investigated recyclers were removed in 2022).

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

Exhibit 29 through **Exhibit 33** provide the number of sites and tons per strata for the four major material types from 2002 to 2022. 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; for 2020, it excludes 30 investigated recycler sites; and then for 2022, it excludes 18 investigated recycler sites. The tables illustrate substantial shifts over time in the number of recyclers, size of recyclers, and tons of material recycled. Crowe continued to utilize a PET-based strata definition reflective of the current recycling marketplace.

Examining results by each material type:

- Aluminum tons recycled continued to drop to below levels of the early 2000s. Aluminum tons dipped to the lowest levels of the decade between 2018 and 2022, dropping to the lowest level in 2022.
- Glass tons recycled has continued to decline over the past few surveys, with even lower levels in 2022 than seen in 2002. Glass tonnage continues to be more evenly distributed across strata then previously when stratum 1 sites handled most of the material starting in 2018. Since 2018, stratum 3 sites handle most 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. Volumes have stabilized between 2020 and 2022.
- HDPE #2 tonnage increased until 2012, but declined between 2012 and 2014, and continued to decline from 2016 to 2018[14], in 2020, and in 2022, dropped to the lowest level since 2002.

[14] 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 29
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
2022	58	118	383	559

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
2022	95,712	108,266	130,622	334,600

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 7 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. 2022 is the survey population of processing fee recyclers, which excludes 18 investigated recyclers.

Exhibit 30
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
2022	58	118	380	556

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
2022	20,437	18,569	24,548	63,554

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 7 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. 2022 is the survey population of processing fee recyclers, which excludes 18 investigated recyclers.

Exhibit 31
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
2022	58	118	366	542

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
2022	40,930	55,943	68,726	165,599

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 7 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. 2022 is the survey population of processing fee recyclers, which excludes 18 investigated recyclers.

Exhibit 32
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
2022	58	118	374	550

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
2022	33,618	32,494	36,317	102,429

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 7 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. 2022 is the survey population of processing fee recyclers, which excludes 18 investigated recyclers.

Exhibit 33
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
2022	58	116	334	508

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
2022	534	1,093	877	2,504

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 7 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. 2022 is the survey population of processing fee recyclers, which excludes 18 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. **Exhibit 34** through **Exhibit 37** illustrate the 2022 costs per ton and survey population size by strata for aluminum, glass, PET #1, and HDPE #2.

These figures illustrate the following key findings:

- Apart from glass, costs per ton were lowest for large stratum 1 sites. Stratum 2 costs per ton were consistently 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.
- Stratum 1 and 2 sites for all materials were below the statewide weighted-average cost per ton.

Comparing recycling volumes and cost contributions by stratum to the statewide weighted-average cost per ton between 2012, 2014, 2016, 2018, 2020, and 2022 provides insight into the changes in cost per ton between survey years. As the strata definitions have changed over time, including the new strata definition in 2018, the cost per ton results cannot be directly compared between strata. However, this does not impact the overall cost per ton results.

Exhibit 34
Aluminum Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

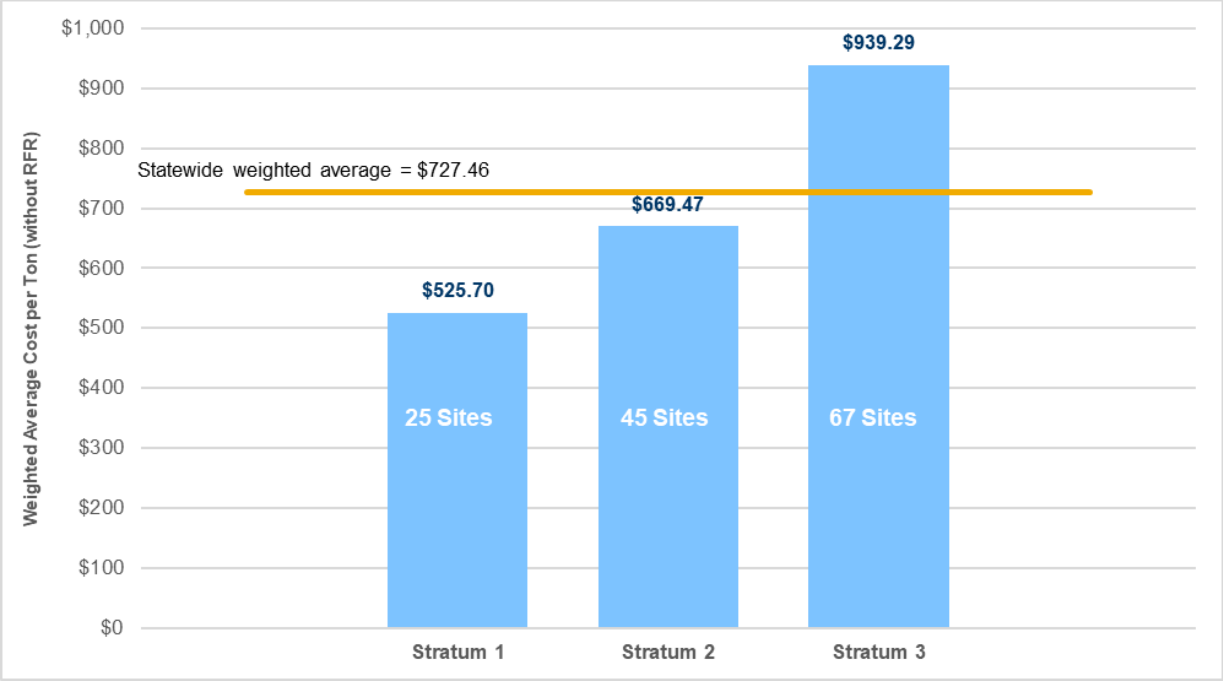


Exhibit 35
Glass Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

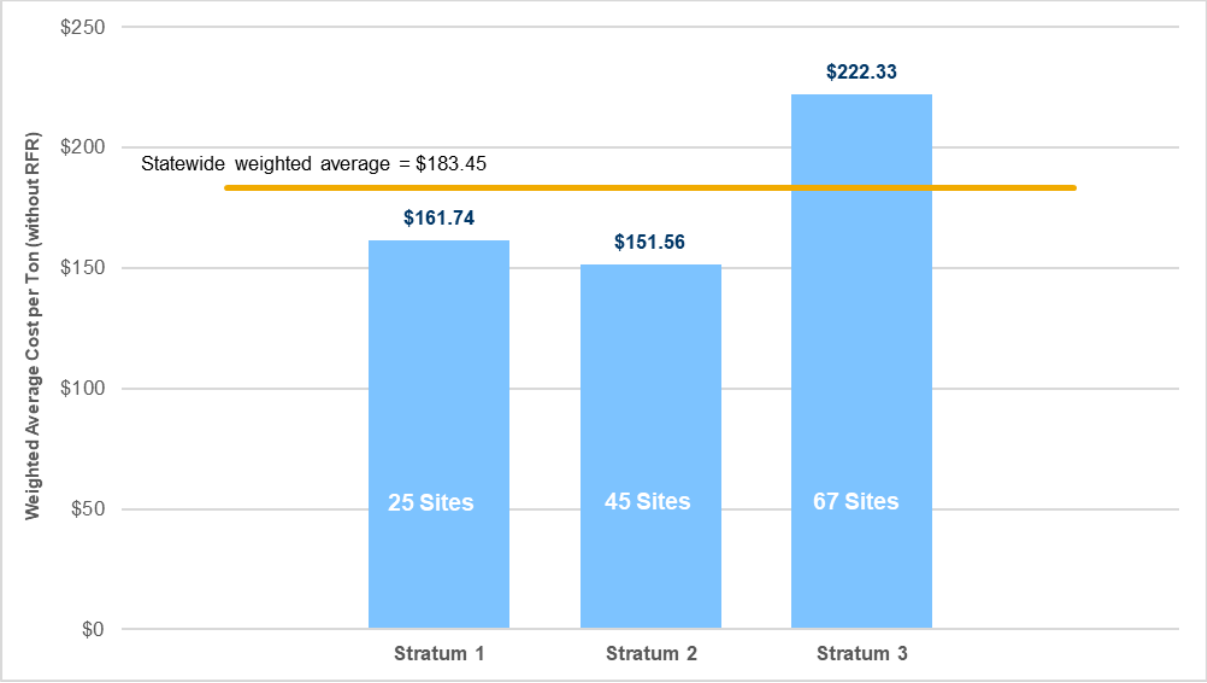


Exhibit 36
PET #1 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

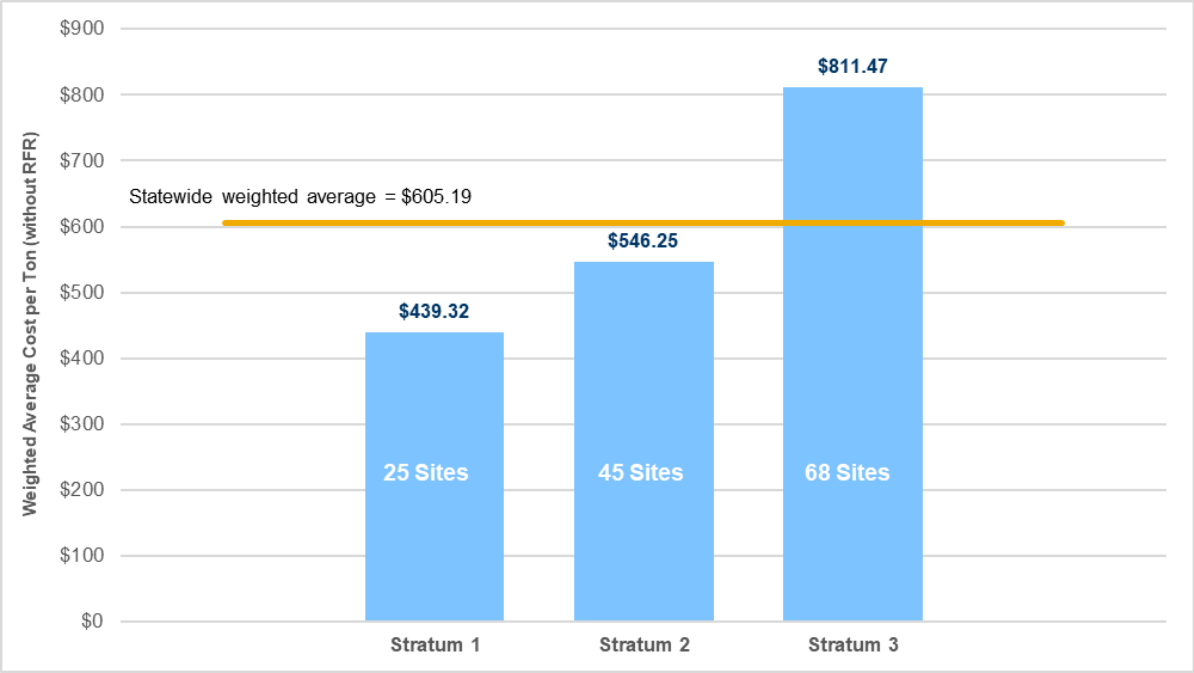


Exhibit 37
HDPE #2 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

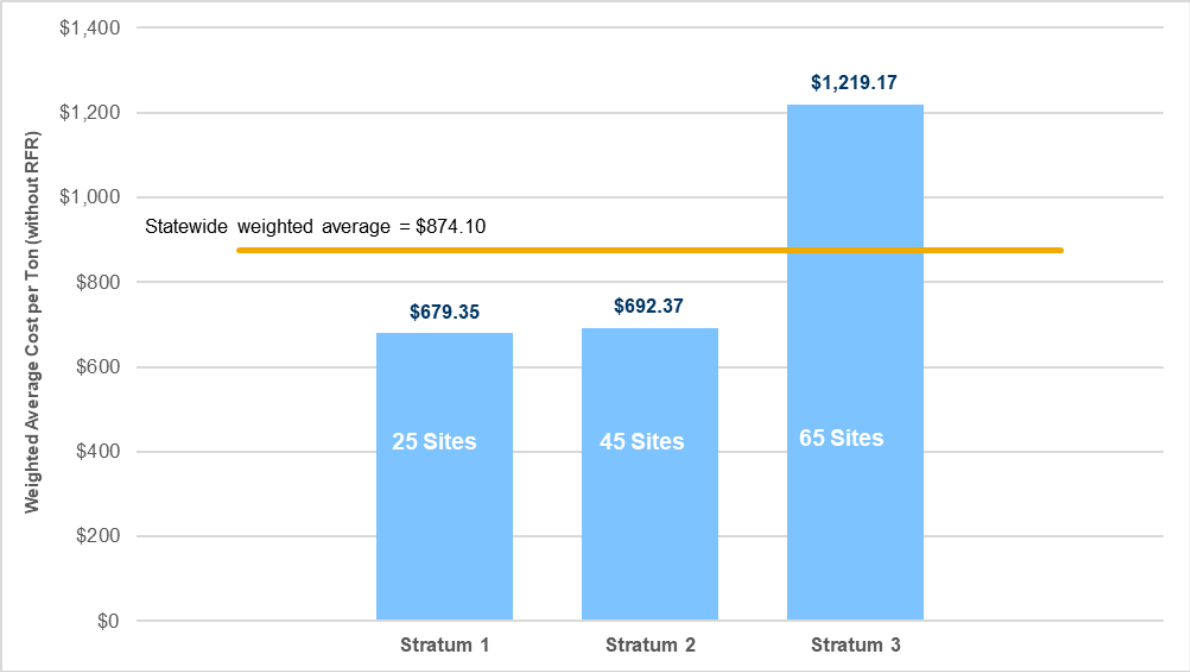


Exhibit 38 through **Exhibit 40** illustrate the percent of population tons recycled by each stratum and the percent of total population costs by each stratum for 2012, 2014, 2016, 2018, 2020, and 2022. The light blue shade at the top of each bar represents stratum 1, the middle green shade represents stratum 2, and the bottom dark blue shade represents stratum 3. Note that the new strata definition for the 2016 and 2018 surveys resulted in a change in the 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 in 2014. The 2018 change in the distribution of sites resulted in an increased number of stratum 3 recyclers, with fewer stratum 1 and stratum 2 recyclers. In 2018, 2020, and 2022 the proportion of costs and tons by stratum were relatively even and reasonably consistent as compared to prior survey years.

Exhibit 38 provides the tons and cost comparison for glass. When comparing tons, this exhibit shows increases in percent of tons for stratum 2 and 3, and a resulting decline for stratum 1 between 2012 and 2014, with 2016 shifting back to 2012 proportions. In 2018, percentage tons increased significantly for stratum 3 and declined for stratum 1 and 2. Between 2018 and 2020, stratum 3's percentage of tons and percentage of total costs decreased. In 2022, proportions generally revert to the proportions seen in 2018. Between 2020 and 2022, stratum 3 recyclers make up 8% more in costs for glass, which is an increase of 20%. Compared to this, stratum 3 recyclers make up 4% more tons for glass, which is an increase of 9%. As the proportion of costs increased 2.1 times as much as the proportion of tons, this contributes to higher costs for glass across all categories.

Exhibit 39 illustrates the same data for aluminum. For aluminum, the shifts in tons and costs between stratum 1 to stratum 2 and 3 also occurred, to a similar extent. In 2022, like glass, proportions generally revert to the proportions seen in 2018. Between 2020 and 2022, stratum 3 recyclers make up 8% more in costs for aluminum, which is an increase of 19%. Compared to this, stratum 3 recyclers make up 4% more tons for aluminum, an increase of 10%. As the proportion of costs increased 1.8 times as much as the proportion of tons, this contributes to higher costs for aluminum across all categories.

Exhibit 40 illustrates the same data PET #1. For PET #1, the shifts in tons and costs between stratum 1 and 2 to stratum 3 also occurred to a similar extent. In 2022, like glass, proportions generally revert to the proportions seen in 2018. Between 2020 and 2022, stratum 3 recyclers make up 8% more in costs for PET #1, an increase of 19%. Compared to this, stratum 3 recyclers make up 2% more tons for glass, which is an increase of 7%. As the proportion of costs increased 2.5 times as much as the proportion of tons, this contributes to higher costs for glass across all categories.

Exhibit 38
Glass, Percent of Population Tons Recycled and Percent of Total Costs (2012 to 2022)

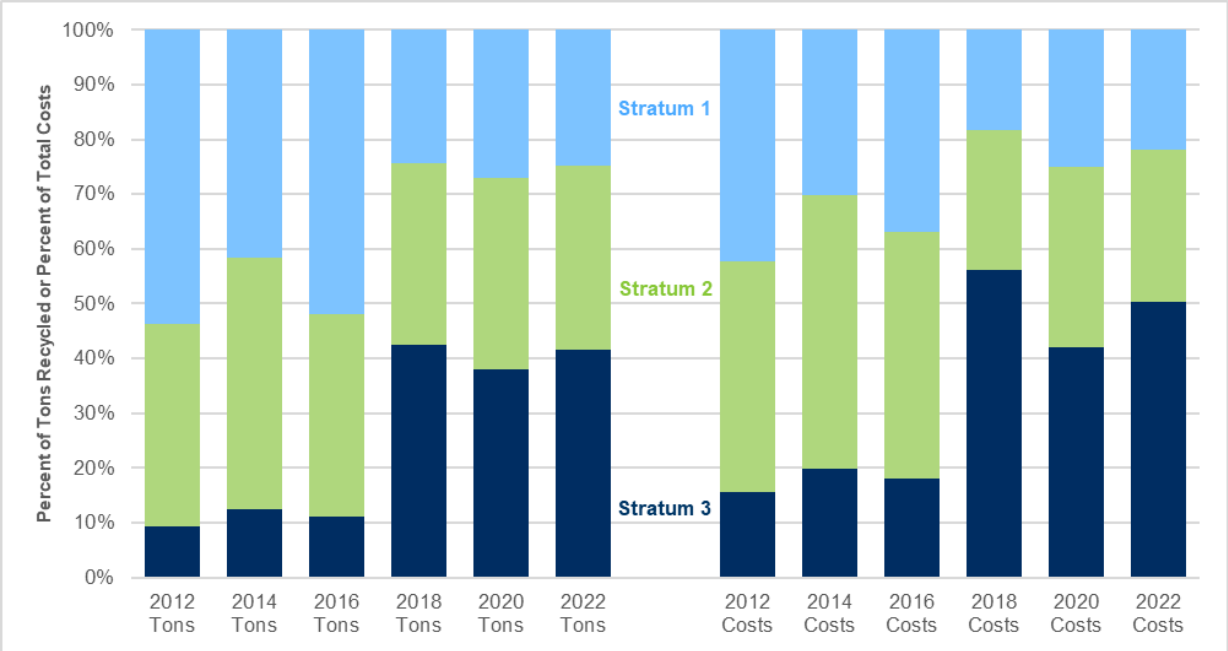


Exhibit 39
Aluminum, Percent of Population Tons Recycled and Percent of Total Costs (2012 to 2022)

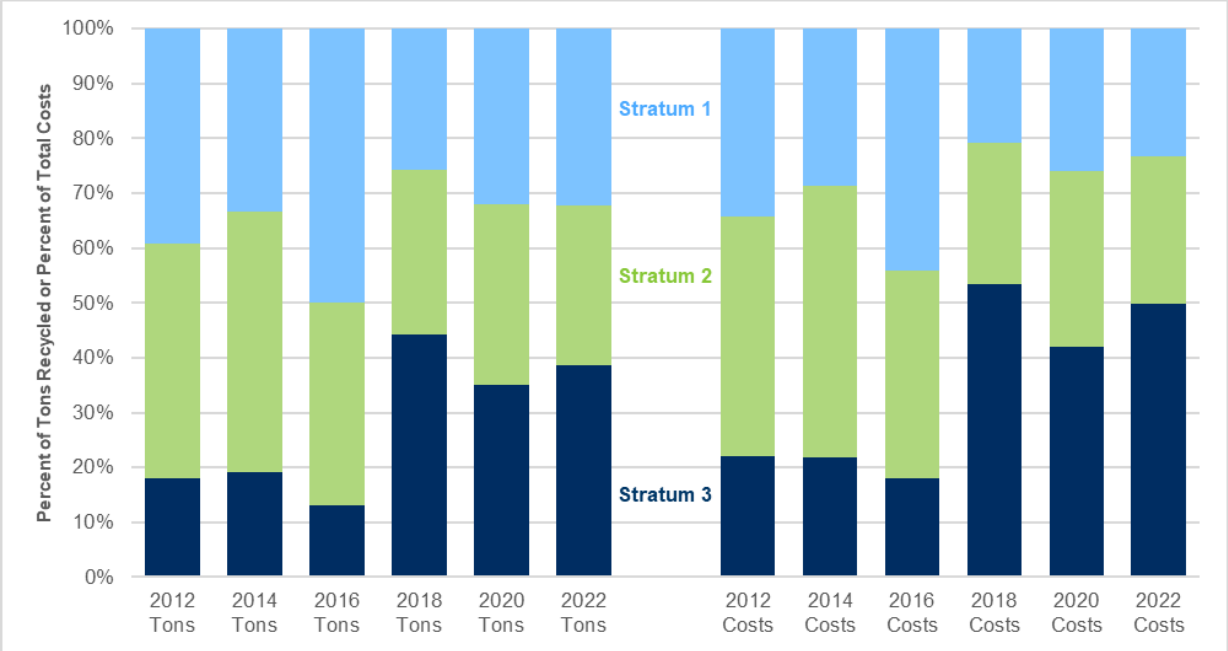
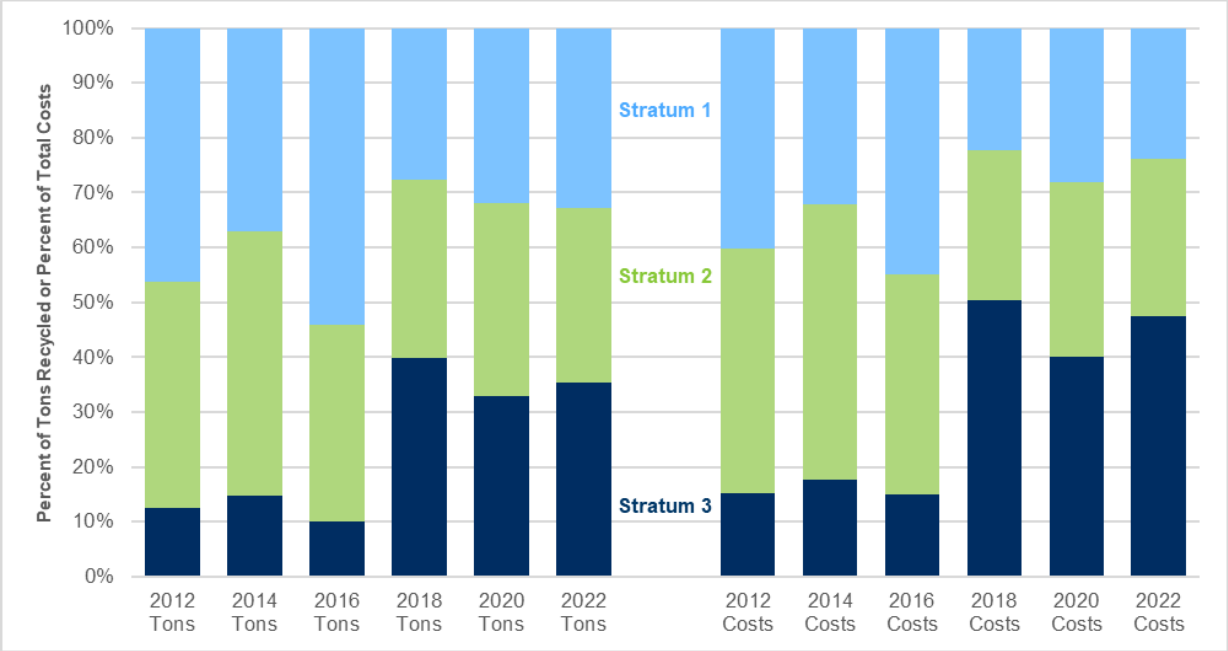


Exhibit 40
PET #1, Percent of Population Tons Recycled and Percent of Total Costs (2012 to 2022)



D. Changes in the 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 no direct linear relationship between the cost of recycling and tons recycled. In addition, the relative increase or decrease in costs and tons between any two given cost surveys are not necessarily the same. Below, we present a series of graphs that explore the relationship between population CRV costs and tons recycled and how changes in these two variables impact changes in the cost per ton over time. In this subsection, we examine the impact of these changes on cost per ton results.

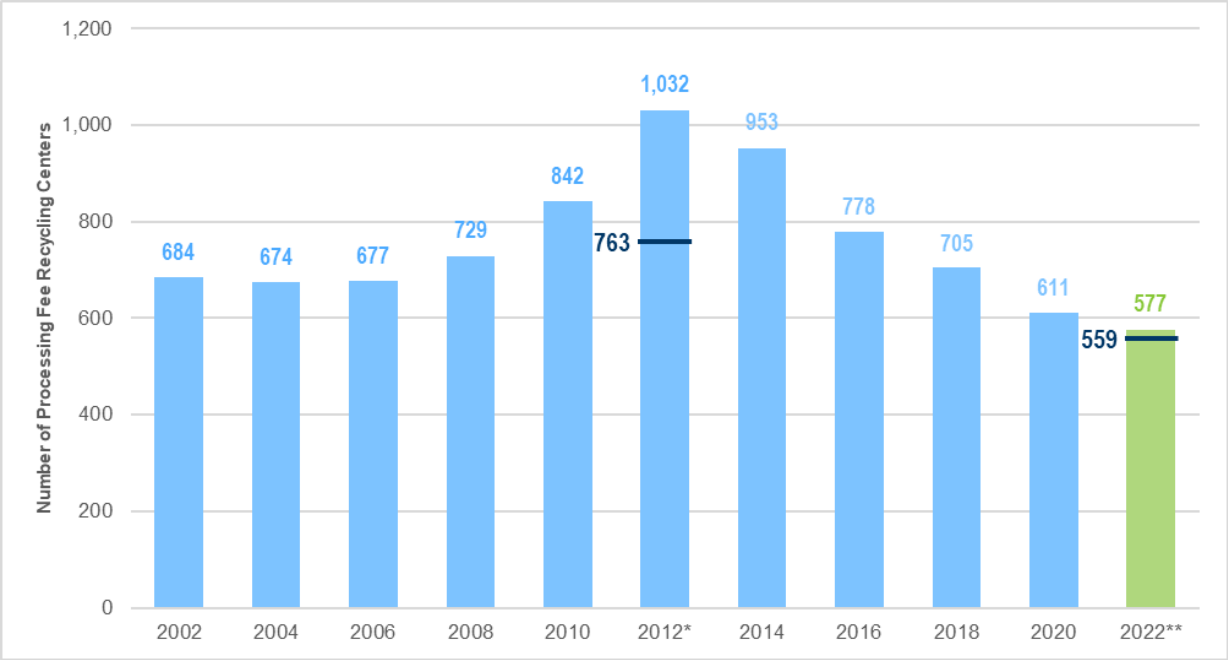
Historical Trends in Population Number of Recyclers

To some extent, the population costs and recycled tons are related 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 41 provides the number of PF recyclers in the population for each of the 10 prior and current processing fee cost surveys. The number of PF recyclers increased between 2004 and 2012. Starting in 2012, the number of recycling centers declined for every survey,

ranging between 6% and 18%. Between 2020 and 2022, the number of recycling centers declined by another 6%.

Exhibit 41
Number of Processing Fee Recycling Centers (2002 to 2022)



Note: In 2012, Crowe reduced the population from 1,032 recycling centers to 763 recycling centers by removing all 269 recycling centers that were under investigation by CalRecycle, including those only under probation investigation. In 2014, Crowe removed only 42 recycling centers that were under investigation by CalRecycle for major violations. In 2018, Crowe removed 31 recycling centers that were under investigation by CalRecycle for major violations, reducing the total population from 705 to the survey population of 674 recycling centers. 2022 includes 18 PF Recyclers being investigated. These were removed from the survey population (559 recyclers).

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 low 559 PF population recyclers in 2022 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.

Average Tons Recycled per Recycling Center

Between 2020 and 2022, recycler productivity (i.e., average tons recycled by recycling center) increased for the fourth time since 2008 for aluminum and PET #1. Increases in recycler productivity generally result in lower costs per ton, as recyclers gain efficiency. The 2022 statewide processing fee recycler cost per ton results indicate that recyclers continue to gain efficiencies due to a continued decline in the recycler population. In total, between 2020 and 2022, the average tons per recycler for aluminum increased by 1%, and PET #1 increased by 3%, however, glass decreased by 12%.

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 recycling centers in the population since 2008. Starting with the economic downturn in 2008 and continuing at least into 2012, recycling centers were opening to capture the increase in CRV recycling. Between 2010 and 2012, the number of recycling centers grew faster than the tons of material recycled. As a result, the average tons handled per recycling center declined. Between 2014 and 2016, the total tons of material recycled increased slightly, and the number of recycling centers declined. Between 2016 and 2018, the total tons of material recycled decreased, as did the number of recycling centers. Between 2016 and 2018, total tons of material recycled increased relative to the number of recycling centers. Between 2020 and 2022, the total tons of material recycled decreased to a greater extent than the decrease in the number of recycling centers.

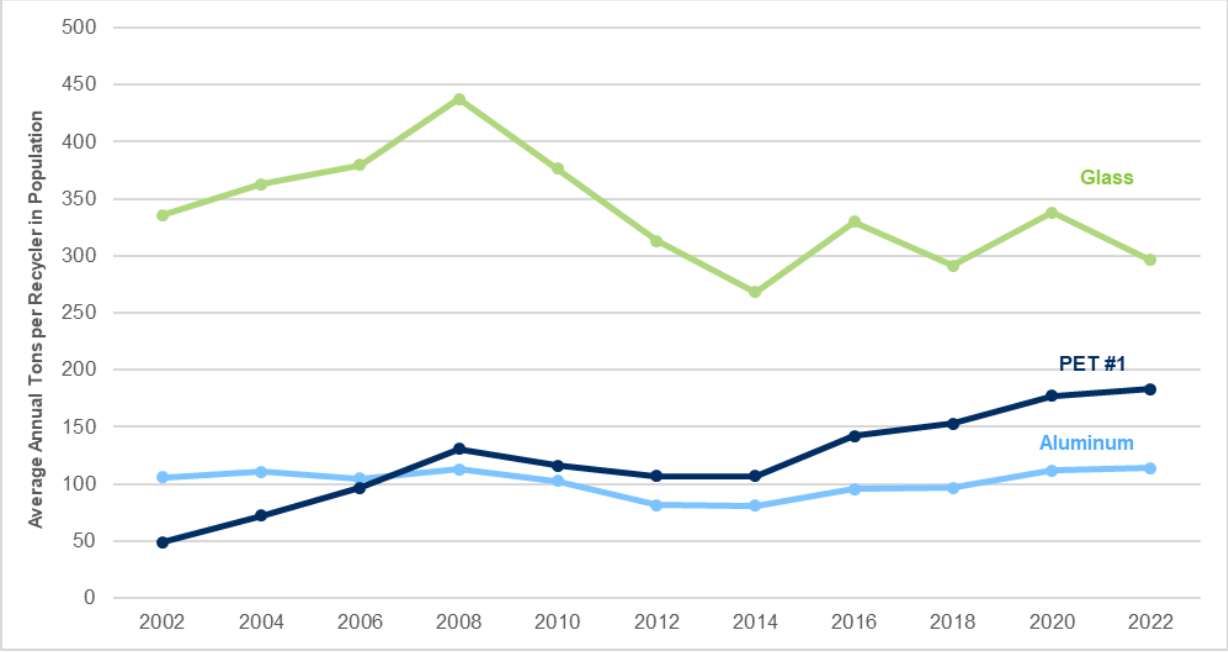
Exhibit 42 provides the average tons of aluminum, glass, and PET #1 recycled per recycling center for each cost survey year, 2002 through 2022. Each cost survey year's data point is the quotient determined by dividing population tons recycled by the number of recycling centers in the population. For 2012, we use the average tons recycled by the survey sample (reduced) population; however, 2012 average tons recycled were very similar between the reduced and full population.

Overall, average tons per recycler show the following trends beginning from 2008:

- Glass has been trending down from a decade high of 437 tons per recycler in 2008 to 296 tons per recycler in 2022, a 32% decline in 8 years.
- PET #1 has been trending up and now sits at a decade high at 183 tons per recycler in 2022, up 40% from 2008.
- Aluminum has declined as low as 81 and is now at a decade high at 114 tons per recycler. Between 2008 and 2022, the average tons per recycler remained nearly unchanged.

With SB 1013 (Atkins, Chapter 610, Statues of 2022) implementation in January 2024, these metrics will be impacted at varying degrees. Glass per recycler is likely to increase, but how it impacts aluminum and PET #1 is uncertain.

Exhibit 42
Average Tons of Aluminum, Glass, and PET #1 Recycled per Processing Fee Recycler (2002 to 2022)

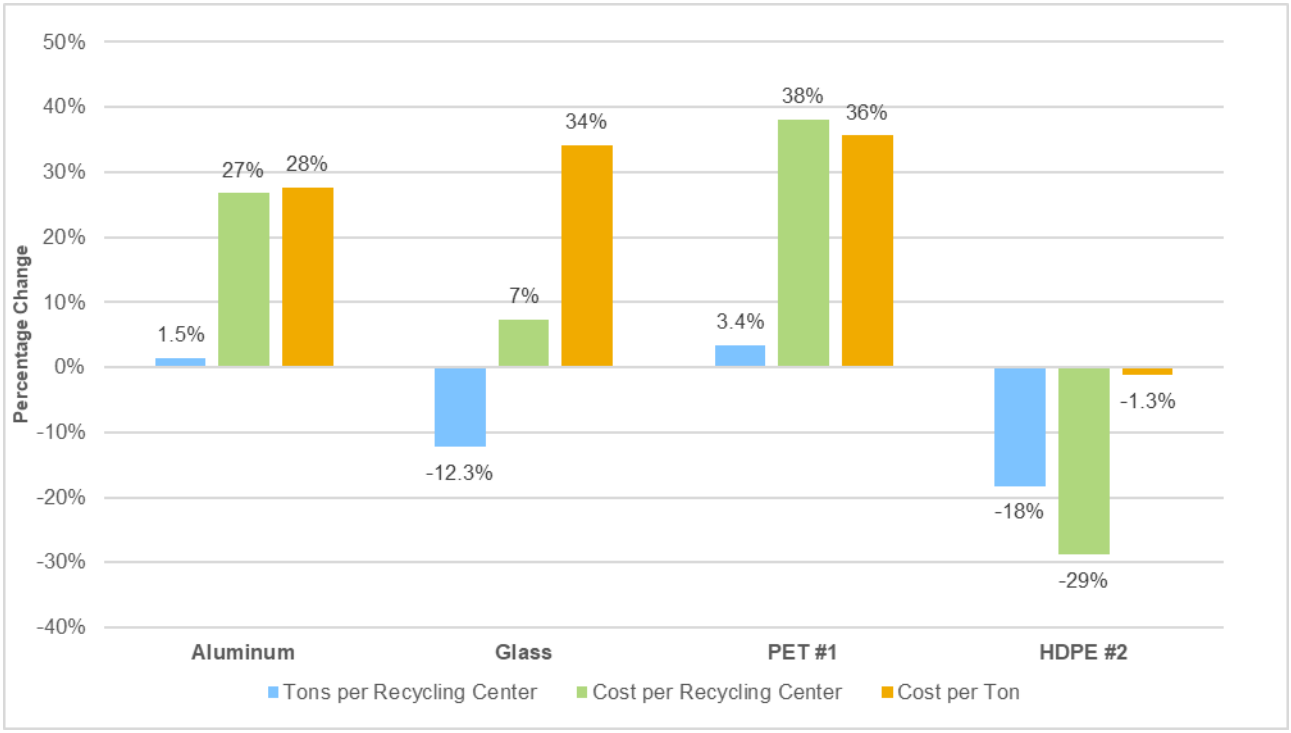


Change in Tons per Recycling Center, Costs per Recycling Center, and Cost per Ton

Exhibit 43 summarizes the relationship between recycling center productivity, costs, and cost per ton. The figure shows the percent change in average tons per recycling center, average costs per recycling center, and statewide weighted-average cost per ton, between 2020 and 2022, 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 recycling center) increased slightly, with the average cost per recycling center and cost per ton increasing significantly. For glass, tons recycled per recycling center decreased while cost per recycler increased and cost per ton increased significantly. For HDPE #2, tons recycled per recycling center decreased and cost per recycling center to a greater extent. The significantly lower cost per recycling center supports the cost per ton result for HDPE #2.

If all else held equal, the higher tons recycled per recycling center would result in lower costs. However, other factors are contributing to higher cost per ton. A similar effect, but in the opposite direction, occurred with HDPE #2 where there was a decrease in tons recycled per recycling center as well as cost per ton. Glass observed the most typical pattern when overall costs are similar between the two years with a decrease in tons recycled per recycling center and an increase in cost per ton.

Exhibit 43
Percentage Change in Tons per Recycler, Costs per Recycler, and Statewide, Weighted-Average Processing Fee Recycler Cost per Ton (2020 to 2022)



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 increases between 2020 and 2022, we compared the average CRV category costs for the two survey samples. These data reflect the total costs in a particular category divided by the number of sampled recycling centers. They do not consider costs by stratum or recycling tons per site; they simply reflect an average category cost per recycling center for the 146 recycling centers surveyed as part of the 2020 cost survey and the 140 recycling centers surveyed as part of the 2022 cost survey. **Exhibit 44** provides the cost category comparison between 2020 and 2022, which includes a CPI adjustment for 2022. The CPI adjustment between 2020 and 2022 was 12.9%.[15]

Exhibit 44
Comparison of Average Processing Fee Recycler Category Costs (2020 and 2022)

Cost Category	2022 (n=140)	% of CRV Costs	2020 (n=146)	% of CRV Costs	CPI Adjusted 2020	% Change 2020 (adj.) to 2022
Direct Labor	$149,514	48.8%	$131,957	51.9%	$148,979	0.4%
Indirect Labor	$20,360	6.6%	$18,439	8.0%	$20,818	-2.2%
General Business Overhead	$23,507	7.7%	$14,905	7.0%	$16,828	39.7%
Transportation	$25,702	8.4%	$16,014	6.6%	$18,080	42.2%
Rent	$37,361	12.2%	$31,717	10.6%	$35,808	4.3%
Depreciation	$9,401	3.1%	$4,701	1.9%	$5,307	77.1%
Property Tax	$811	0.3%	$1,132	0.5%	$1,278	-36.5%
Utilities	$10,060	3.3%	$7,459	3.0%	$8,422	19.5%
Supplies	$10,317	3.4%	$7,555	2.4%	$8,530	21.0%
Fuel	$2,009	0.7%	$1,402	0.8%	$1,583	26.9%
Insurance	$7,237	2.4%	$4,990	2.1%	$5,634	28.5%
Interest	$848	0.3%	$598	0.5%	$675	25.5%
Maintenance	$9,383	3.1%	$8,232	4.6%	$9,294	1.0%
Total CRV Costs per Site	**$306,509**	**100.0%**	**$249,102**	**100.0%**	**$281,237**	**9.0%**

[15] U.S. Department of Labor, Bureau of Labor Statistics, West Urban Consumer Price Index (as of Oct 2023)

This comparison illustrates several key points:

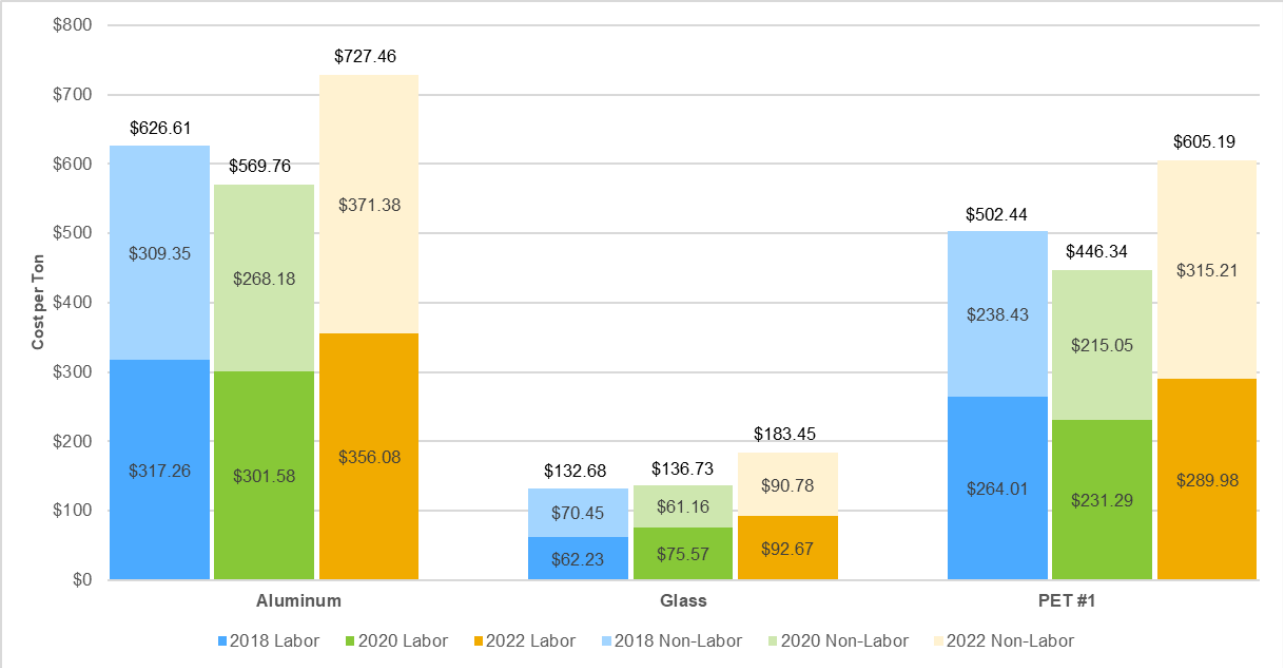
- Average CRV costs per recycling center increased by 9%, which directly contributes to the increase in cost per ton if volumes were held equal.
- The percent of CRV costs, by category, were similar between the two years. For example, direct labor represented 49% of CRV costs in 2022 and 52% in 2020.
- Consistent with prior cost surveys, the cost categories that make up the largest share of recycling center costs are:
    - Direct labor (~50%)
    - Rent (~10% to 12%)
    - Indirect labor (~6% to 8%)
    - Transportation (~6% to 8%)
    - General business overhead (GBO) (administrative costs, fees, etc.) (~7% to 8%)
- All cost categories increased besides indirect labor and property tax
- The cost categories with the greatest dollar decrease between 2020 and 2022, accounting for 72% of the decrease, were (ordered from greatest to least):
    - Direct labor
    - Transportation
    - GBO
    - Rent
- The increase in direct labor was the largest single factor, accounting for 31% of the increase.
- Transportation and GBO had the next greatest dollar decrease, each accounting for 17% and 15%, respectively.

Labor and Non-Labor Costs

We 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 45** 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 three survey years and across the three material types, further validating our survey methodology.

The two analyses presented above provide considerable confidence in our sample design and cost survey labor allocation methodologies that were the basis of the 2022 cost per ton results. The results also demonstrate a consistency in the cost survey labor allocation methodology between the 2018, 2020, and 2022 cost surveys.

Exhibit 45
Labor and Non-Labor Costs per Ton (2018, 2020, and 2022)



F. Changes in Labor Costs

Crowe analyzed CRV labor costs and labor hours to better understand how labor influenced the increase in cost per ton between 2020 and 2022. In the analyses below, 2022 labor costs are not adjusted by CPI, rather they are a straight dollar comparison across the two survey years. A CPI adjustment would increase 2020 costs by 12.9%, due to high inflationary factors that are two to three times higher than average.

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

- Factors that did lead to higher labor costs:
    - **Higher CRV hourly wages** – Weighted-average CRV hourly wages increased by 3%, driven by a 10% increase in stratum 2, while stratum 1 slightly decreased and stratum 3 essentially did not change.
    - **Increased hours handling all CRV materials** – Labor hours per ton increased 9% for aluminum and PET #1 and 17% for glass. This indicates a loss of labor productivity, by resulting in more hours spent per unit of volume.
    - **Reduced low wage sites** – the number of low wage sites or sites below the minimum wage decreased to 14% from 18% in the prior year. Less low wage sites contribute to higher costs.
- Factors that did not lead to higher labor costs:
    - **Labor allocations** – the allocation of CRV hours between material types or hours per ton by material type stayed generally the same.
    - **High wage sites** – in 2022, there were no sites with average AOL wages per hour higher than $100 per hour. This would generally indicate that the most profitable sites are less profitable than in prior years.

The average recycler wage per hour from 2020 to 2022 decreased by 9% when CPI-adjusted. This indicates that the increase in recycler wages is not keeping up with inflation. This implies that recyclers are not able to pay workers proportionally higher with the increased minimum wage, causing a wage compression between recycling center workers and other similar jobs. This would make it more difficult for recyclers to compete and hire workers. This puts additional pressure on recycling centers where staffing issues have been a recurring challenge.

Average CRV Wages per Hour

Crowe calculated CRV hourly wages by summing CRV labor costs across all recycling centers in each survey sample and dividing by the sum of CRV labor hours. It does not consider tons of CRV material. As seen above, labor reflects over 50% of the cost of CRV recycling.

Exhibit 46 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. 2022 average labor wages per hour increased since the last 2020 cost survey. The average recycler wage per hour (including owners, supervisors, and laborers) increased by only 3% between 2020 and 2022, from $19.48 per hour to $20.00 per hour. This 3% increase is much lower than the 15% increase in minimum wage between 2020 and 2022.

The average recycler wage per hour from 2020 to 2022 decreased by 9% when CPI-adjusted. This indicates that the increase in recycler wages is not keeping up with inflation. This implies that recyclers are not able to pay workers proportionally higher with the increased minimum wage, creating a level of wage compression between recycling center workers and other similar jobs. This would make it more difficult for recyclers to compete for and hire workers.

Exhibit 47 provides a summary of CRV hourly wages between 2020 and 2022 by stratum. Only Stratum 2 increased compared to the prior year. Stratum 2 increased by 10%, while Stratum 3 slightly decreased, and Stratum 1 decreased by 3%.

To provide context, at 2,080 hours annually, $20.00 per hour is equivalent to a gross annual income of $41,598. In 2021, the median household income in California was $84,097.[16] The California Poverty Measure for a family of four, slightly higher than the federal poverty level, was about $39,900 in early 2023.[17]

[16] California Quick Facts. U.S. Census Bureau (accessed 11/13/2023). https://www.census.gov/quickfacts/fact/table/CA#

[17] Poverty in California, October 2023 Fact Sheet. Public Policy Institute of California (accessed 11/13/2023): https://www.ppic.org/publication/poverty-in-california/

Exhibit 46
Average CRV Wages per Hour (2010 to 2022)

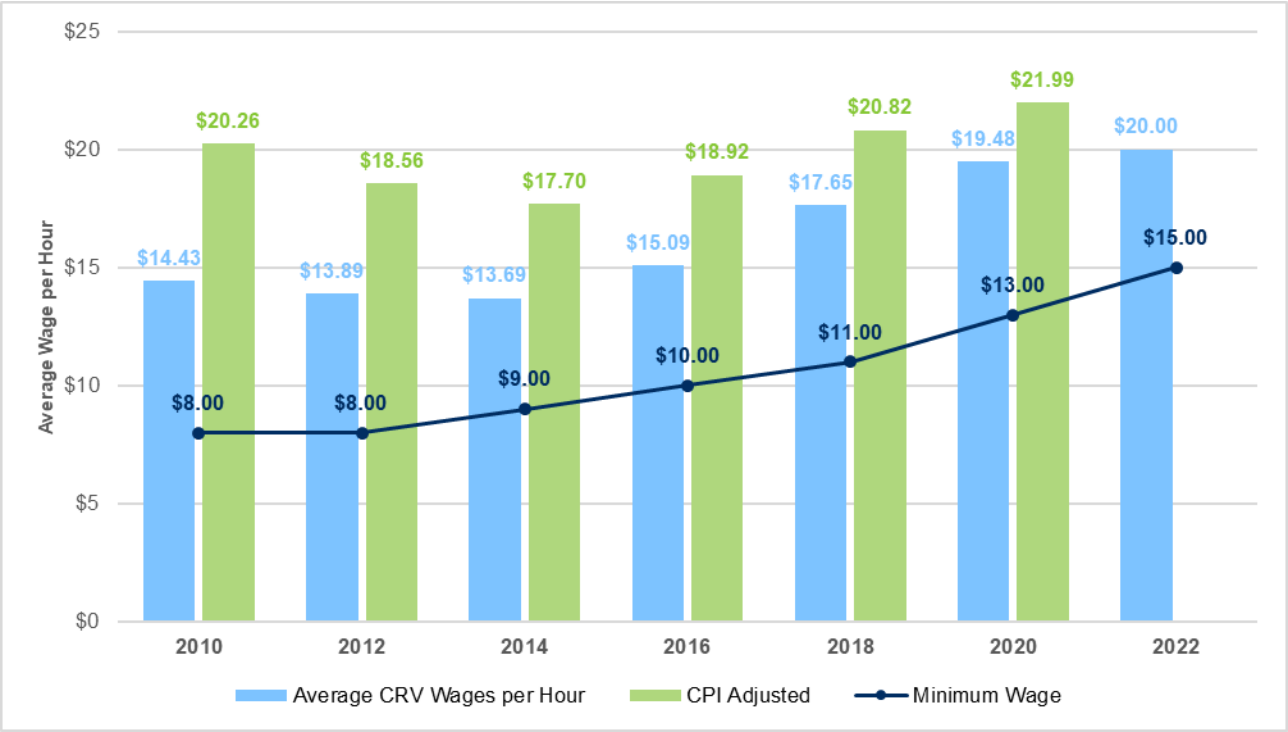
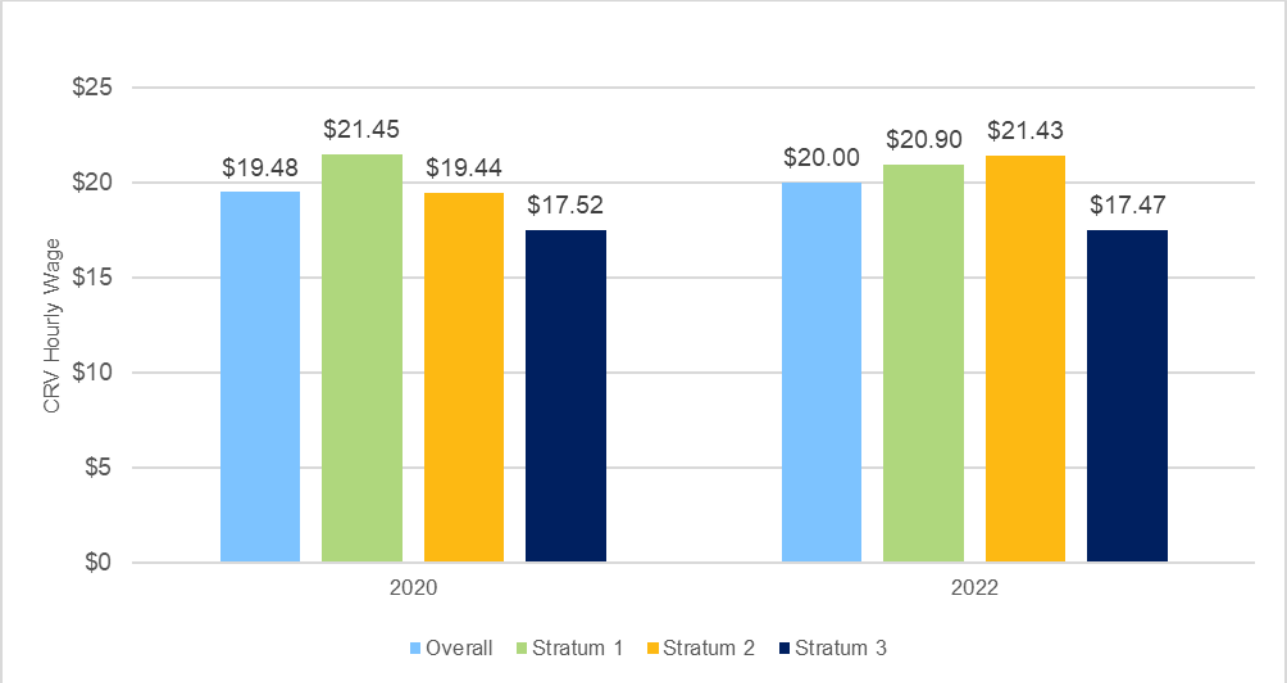


Exhibit 47
Comparison of CRV Hourly Wages Overall and by Strata (2020 and 2022)



Increases in DYL, AOL, and Overall Wage per Hour

Contrary to the weighted-average increase in CRV hourly wage, the simple average of overall hourly wages decreased slightly. Stratum 2 increased 12%, stratum 1 decreased by 2%, and stratum 3 decreased by 4%. These wages include all labor: other business, recycling center, 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 48** provides a comparison of average hourly wages by stratum and overall.

On average, CRV and non-CRV direct yard labor (DYL) hours make up over 80% of recycling center hours. The remaining less than 20% of recycling center hours are all other labor (AOL). DYL wages per hour increased by 8% while AOL wages per hour significantly decreased by 24%. The increase to DYL wages per hour was driven by increases in stratum 1 and 2, while all strata increased similarly for AOL wages per hour. The increase to DYL wages per hour and a decrease to AOL wages per hour indicate that recycling cents must continue to align with minimum wage, which may be at a sacrifice to the profitability of owners.

Exhibit 48
Comparison of DYL, AOL, and Overall Wage per Hour (2020 and 2022)

Average DYL per Hour

Strata	2020	2022	% Change
1	$17.05	**$19.06**	12%
2	16.72	**19.74**	18%
3	16.41	**16.55**	1%
Average	**$16.72**	**$18.02**	**8%**

Average AOL per Hour

Strata	2020	2022	% Change
1	$45.77	**$36.34**	-21%
2	39.67	**33.75**	-15%
3	28.42	**23.32**	-18%
Average	**$37.96**	**$29.00**	**-24%**

Average Overall Wage per Hour

Strata	2020	2022	% Change
1	$23.69	**$23.29**	-2%
2	20.13	**22.48**	12%
3	18.38	**17.73**	-4%

Average	**$20.73**	**$20.25**	**-2%**

Minimum Wage Increases

Changes in DYL are most likely to be impacted by changes in minimum wage. Because DYL accounts for over 80% of CRV labor, increases in DYL have a greater impact on CRV recycling costs than increases in AOL. California minimum wage increased 15%, from $13 per hour in 2020 to $15 per hour in 2022. Los Angeles (LA) County's minimum wage increased 12% during the same period. Approximately one-third of surveyed processing fee recyclers across both years were in LA County. As a result, changes in hourly wages in LA County sites have a significant impact on overall labor costs. However, because the average wages per hour in LA County decreased, LA County recyclers did not contribute higher labor costs.

As **Exhibit 49** illustrates, LA County DYL increased 2% between 2020 and 2022, while non-LA County DYL increased 12%. Average DYL in non-LA County sites was over $0.51 per hour higher than LA County sites in 2020 and $2.17 per hour higher than LA County in 2022. The outcome is different for LA County AOL wages per hour, which significantly decreased by 43% in 2022 while it increased by 3% for non-LA County sites. Overall, LA County wages continue to be less than the rest of the state.

Exhibit 49
Los Angeles County and non-Los Angeles County DYL, AOL, and Overall Wage per Hour (2020 and 2022)

Wage Category	LA County 2020 (n=46)	LA County 2022 (n=50)	LA County % Change	Non-LA County 2020 (n=100)	Non-LA County 2022 (n=90)	Non-LA County % Change
Minimum Wage	$15.00	**$16.04**	7%	$13.00	**$15.00**	15%
Direct Yard Labor (DYL)	$16.25	**$16.63**	2%	$16.76	**$18.80**	12%
All Other Labor (AOL)	$42.87	**$24.55**	-43%	$30.62	**$31.46**	3%
Overall Wage per Hour	$18.89	**$18.01**	-5%	$20.17	**$21.50**	7%

Changes 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, the owner's income or profits are equivalent to owner wages. These two business categories represent a large share of the survey population – 77% in 2022. Over the last several years, we have seen a growing number of recycling centers where the owner(s) work a significant number of hours but have low-to-no profits. This results in hourly wages that are below minimum wage, driving cost per ton down. This is one of the reasons for the "death spiral" that has been discussed as it relates to the cost of recycling.

Crowe evaluated the number and percent of surveyed recyclers with overall hourly wages below minimum wage in 2018 and 2020. **Exhibit 50** illustrates a decrease in the number of surveyed recycling centers with overall average hourly wages that were less than minimum wage between the two years. Although it is difficult to determine the extent of the impact, this is one factor that would lead to an increase in CRV costs per ton. Despite the increase to minimum wage, recycling centers can pay workers proportionally higher.

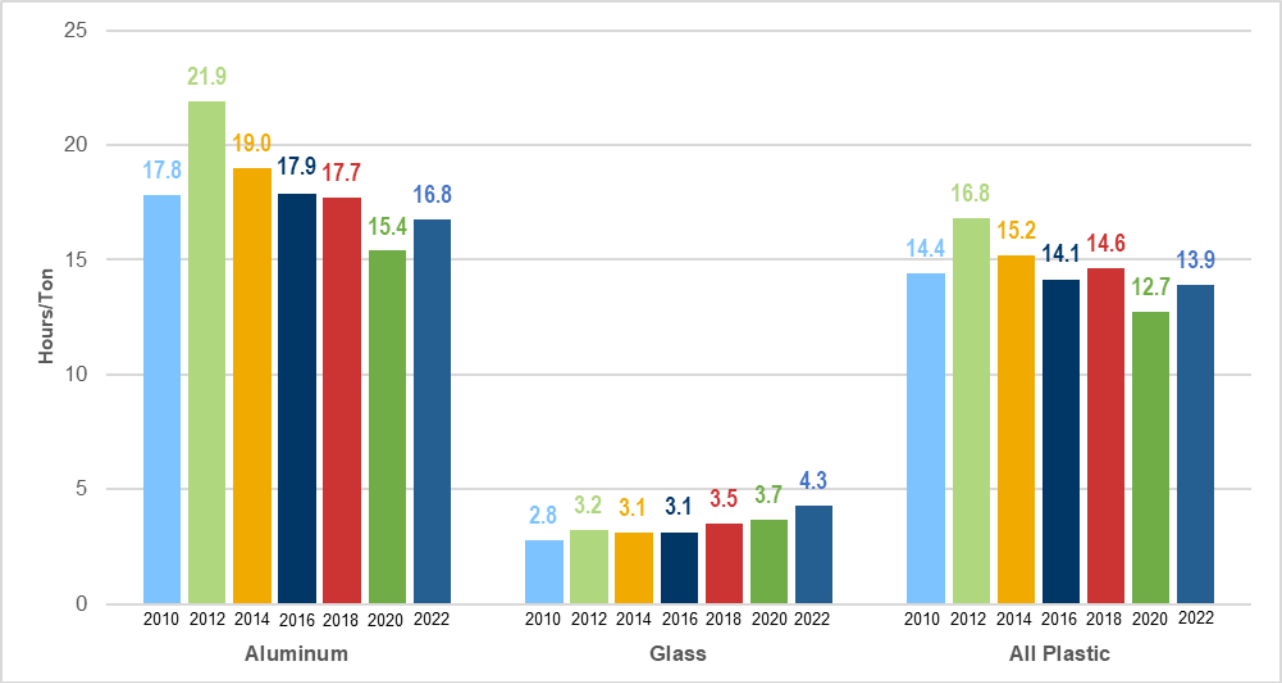
Exhibit 50
Comparison of Low Wage Recycling Centers (2020 and 2022)

Category	2020 (n=146)	2022 (n=140)
California Minimum Wage	$13.00	**$15.00**
Number of Surveyed PF Recyclers < Minimum Wage	26	**20**
Percent of Surveyed Sites < Minimum Wage	18%	**14%**
Range of Hourly Wages < Minimum Wage	$2.25 to $12.95	**$0.49 to $14.99**

Labor Hours per Ton Recycled

The labor hours required to handle one ton of CRV material is another measure of recycling center productivity and is a factor that directly impact on cost per ton. We calculated and compared the average processing fee for PF recycler labor hours allocated per ton of aluminum, glass, and plastic[18] recycled for the 2010 to 2022 surveys. **Exhibit 51** shows the labor hours allocated per ton of material recycled. Labor hours per ton increased across all material types, with aluminum and plastics both increasing by 9% and glass increasing by 17%.

Exhibit 51
Average Labor Hours per Ton of Aluminum, Glass, and All Plastic Recycled (2010 to 2022)



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

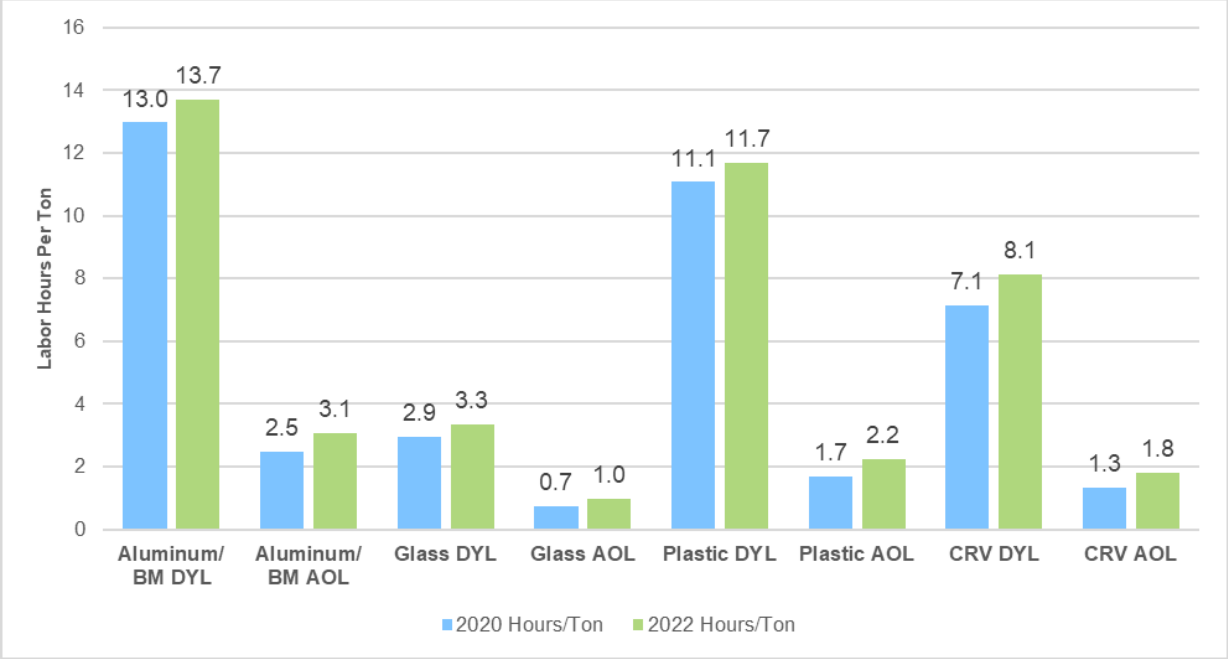
Despite the slightly higher tons recycled per recycling center for aluminum and plastic, there was an even higher increase in labor hours per ton. This indicates that recyclers are spending more time on fewer tons than before, reducing the average economies of scale among recyclers for these materials. The relationship for glass seems to be consistent with the higher labor hours per ton with lower tons per recycling center.

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

Increased Hours Handling CRV Materials

Building on the labor hour analysis, we calculated average labor hours per ton by material type based on survey sample hours by category and survey sample tons for each material type. **Exhibit 52** illustrates that labor hours per ton increased between 2020 and 2022 across all materials and labor categories. Overall, CRV DYL labor hours per ton increased by 14%, while the CRV AOL labor hours per ton increased by 34%. These increases in labor hours per ton contribute to higher costs per ton, which are likely linked to the increase in the proportions of stratum 3 recyclers.

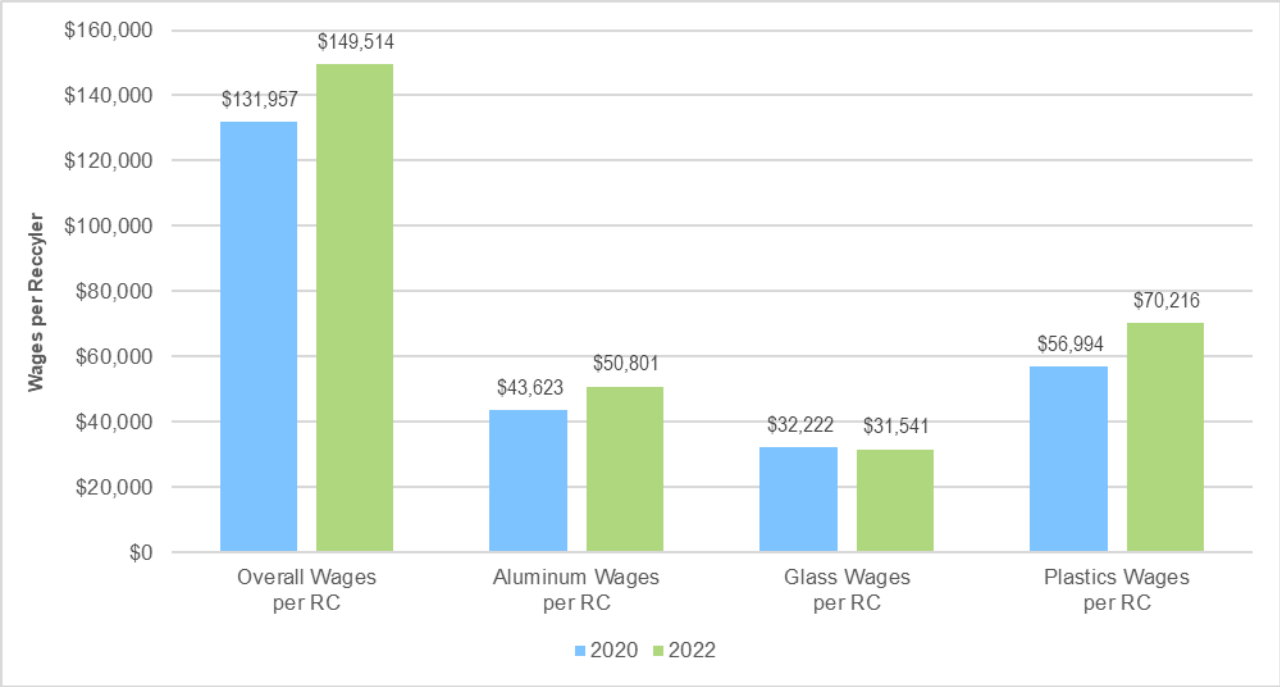
Exhibit 52
Labor Hours per Ton CRV Material by Activity (2020 and 2022)



Average Labor Costs per Recycler

Crowe calculated average labor costs per recycler by summing CRV labor costs across all recycling centers in the survey sample and dividing by the number of sampled recyclers. **Exhibit 53** provides a summary of average labor costs per recycler for aluminum, glass, and plastics. Average labor costs increased by 16% for aluminum, a slight decrease of 2% for glass, and an increase of 23% for plastics. The increases for aluminum and plastic wages resulted in an overall increase of 13% between 2020 and 2022. While the increases for aluminum and plastic are consistent with the increase in cost per ton, the slight decrease for glass is not consistent with the increase in cost per ton for glass. This indicates that something else is at play for glass that caused an overall increase.

Exhibit 53
Comparison of Average CRV Wages per Recycler (2020 and 2022)

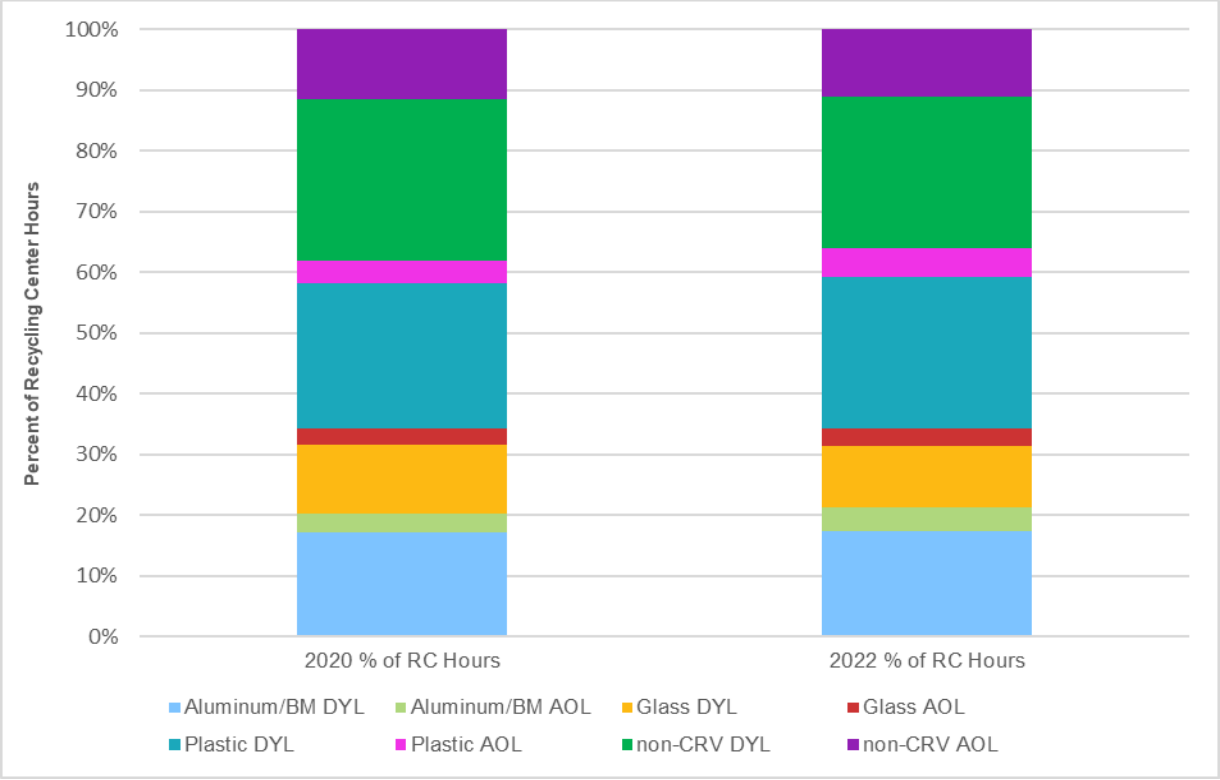


Labor Allocations

Determining the cost per ton by material type depends on labor allocations at the recycler level. We recognize that it is difficult for recyclers to allocate labor hours across non-CRV, CRV, and CRV material types. Crowe has developed extensive experience conducting thousands of recycling center cost surveys and labor allocations to help recyclers through this process. Because this process is not straightforward, we evaluated whether the increase in costs per ton resulted from allocating more labor hours to CRV materials. We analyzed total labor hours by category between 2020 and 2022 surveyed recyclers, comparing the percent of recycling center hours by various categories, illustrated in **Exhibit 54.**

As the exhibit illustrates, there were no significant changes in the allocation of CRV hours between material types or hours per ton by material type between surveyed processing fee recyclers over the two years. The percent of hours allocated to DYL and AOL non-CRV activity decreased slightly, indicating that recyclers are spending slightly more on CRV than non-CRV activities.

Exhibit 54
Percent of Recycling Center Labor Hours by Activity (2020 and 2022)



G. Changes in Transportation Costs

Crowe analyzed CRV transportation costs to better understand how transportation costs impacted the increase in cost per ton between 2020 and 2022. As mentioned above, transportation is among the larger contributors to overall CRV costs and the second highest contributor to the increase in average recycler 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. Although fuel includes general transportation costs and forklift fuel, they are subject to the same economic forces. In 2022, transportation (and fuel) costs represent 9% of total CRV costs for PF recyclers, which increased from 7.4% in 2020.

As gasoline and diesel underlie all transportation costs, changes in market price will cause a direct impact. In 2020, all grades of gasoline in California averaged $3.13 per gallon, while diesel averaged $3.38 per gallon. In 2022, the average price of gasoline increased to $5.41 per gallon, or an increase of 73%, while diesel increased to $6.03 per gallon, or an increase of 79%.13F19 The increase in the proportion of transportation as a share of total costs, as well as the increase in transportation cost per ton for each material type in 2022, are directly linked to higher fuel prices. The higher transportation costs per ton contributes to a higher overall cost per ton. The percentage of recyclers utilizing scrap value deduction decreased by about 8 to 16 total percentage points among each material type, which further contributes to higher transportation costs.

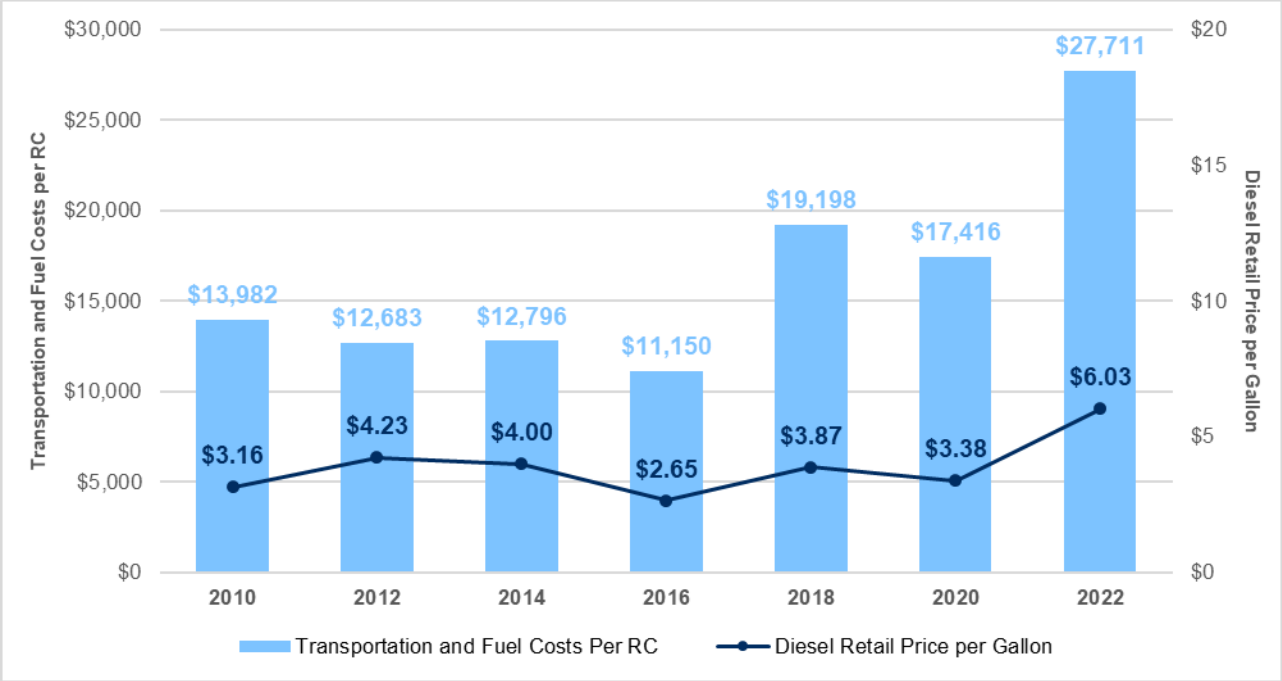
[19] Annual Retail Gasoline and Diesel Prices. U.S. Energy Information Administration. Accessed 11/9/2023.

Exhibit 55 compares diesel retail price per gallon[20] and average transportation costs per recycling center from 2010 to 2022. From 2020 to 2022, average transportation costs per recycling center increased by 59%, driven by the 78% increase in diesel prices.

Exhibit 56 compares 2020 and 2022 for transportation cost per ton for PF recyclers. Overall, the transportation cost per ton increased by 69% between 2020 and 2022. There were varied increases among stratum, with stratum 1 increasing by 112%, followed by stratum 3 increasing by 70%, then stratum 2 increasing by 46%.

Exhibit 57 compares 2020 and 2022 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. The results show that transportation cost per ton for all materials increased significantly; glass increased by 49%, aluminum increased by 56%, and plastic increased by 69%. These large increases are consistent with the increase in fuel prices.

Exhibit 55
Comparison of Average Transportation Cost per Surveyed Recycling Center and Diesel Prices (2010 to 2022)



[20] Source: U.S. Energy Information Administration, Annual Retail Gasoline and Diesel Prices (as of Oct 2023): Gasoline and Diesel Fuel Update - U.S. Energy Information Administration (EIA)

Exhibit 56
Transportation Cost per Ton (2020 and 2022)

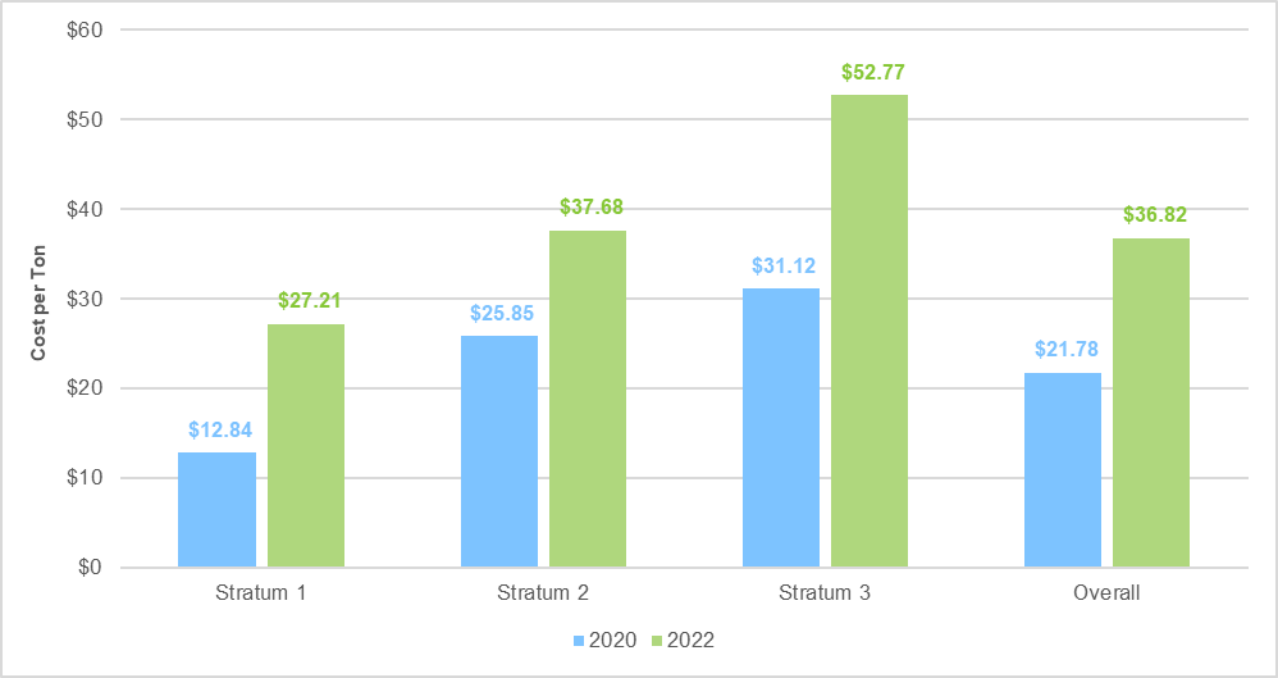
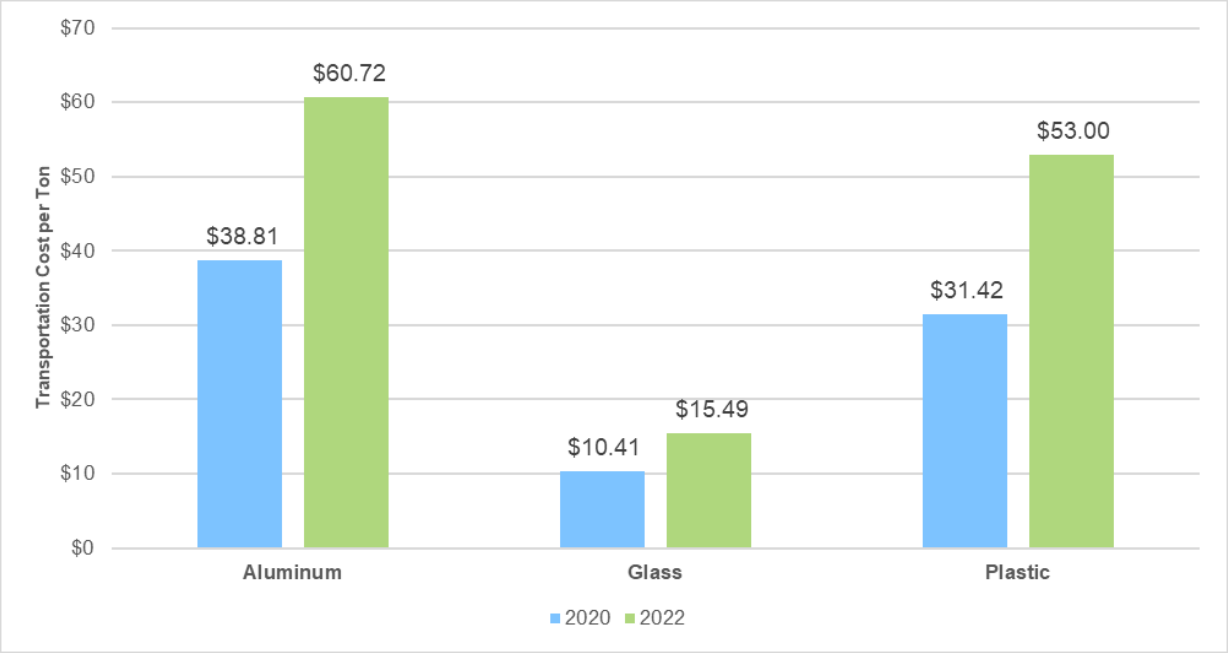


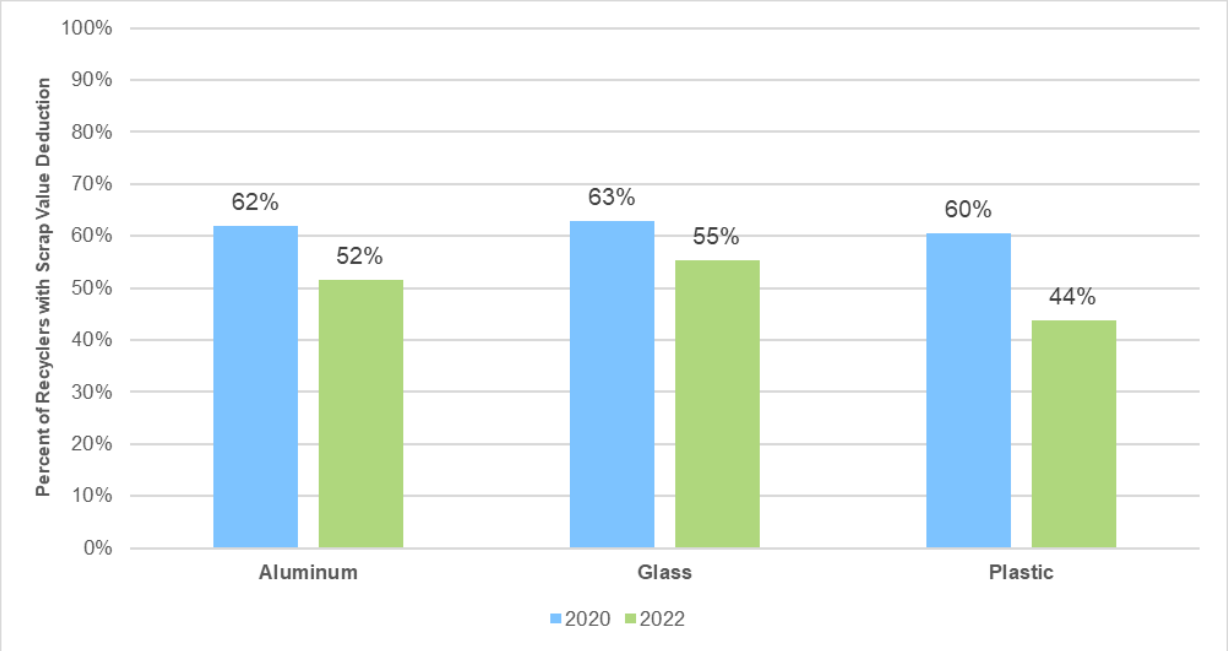
Exhibit 57
Aluminum, Glass, and Plastic Transportation Cost Per Ton (2020 and 2022)



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

Exhibit 58 shows a comparison between 2020 and 2022 for the percent of recyclers that utilized scrap value deduction. The percentages are out of the recyclers with a processor pick-up material, which is roughly a quarter to a third of the total PF recyclers for both years. The rate of scrap value deduction decreased 8% for glass, 10% for aluminum, and 16% for plastic. For recyclers "paying" for transportation with a scrap value deduction, transportation costs are reflected as decreased income, so there is no transportation line item when a material has a scrap value deduction.

Exhibit 58
Aluminum, Glass, and PET #1 Transportation with Scrap Value Deduction (2020 and 2022)



H. Summary of Processing Fee Cost Analyses

Overall, the change in cost per ton between 2020 and 2022 was significant. Our analyses identify a combination of factors that may be impacting recycling costs. The cost per ton for glass, aluminum, and PET #1 increased significantly compared to 2020. The cost per ton for HDPE #2 slightly increased compared to 2020. Many factors combine to influence recycling center costs, tons, and cost per ton, both upward and downward.

Between 2020 and 2022, there was a slight reduction in the overall survey population of PF recycling centers and to a greater extent, a decrease in the total tons of CRV material recycled. This combination alone could suggest a possible increase in cost per ton between 2020 and 2022. Our analysis of 2020 and 2022 cost survey data identifies

seven factors contributed to the increase in costs per ton. The seven factors are summarized in **Exhibit 59.**

Additionally, there are key operating conditions that existed in 2020 that are no longer factors in 2022. These changes likely contributed to higher costs across most recyclers. Two of these conditions are summarized below:

- **Less volume per operating hour.** In 2020, sampled processing fee recyclers were closed on average for nearly 7 weeks and were able to shorten operational hours up to 4 months beyond the closures. In 2022, recyclers did not experience widespread shutdowns and maintained full operating hours. Due to this, recyclers handled slightly less volume spread across more operating hours. This decreases productivity for the year and, therefore, contributes to higher costs.
- **Recycler staffing levels.** In 2020, recyclers laid off a portion of their workforce due to temporary site closures and COVID uncertainty. These temporarily reduced staffing levels resulted in increased efficiencies that may not be representative of non-pandemic conditions. In 2022, site staffing levels increased after the pandemic, although there was a 9% decrease in total volume, which contributed to the higher costs per ton results.

Exhibit 59
Summary of Key Factors for Changes in Costs between 2020 and 2022

Key Factor	Impact to Costs
1. High inflation and increases to cost of living	Consumer price index increased by 12.9%.[21] CPI increased an average of 4.5% per survey between 2002 and 2022. CPI increased by 4.5% between 2020 and 2022. *Impact: Nearly 3 times higher rate of inflation contributes to higher costs.*
2. Less tons recycled, about the same number of sites	Total tons decreased by approximately 9%, while the number of sites decreased by 3%. This results in fewer tons per recycler on average. The decrease was driven by a 16% decrease in glass tons. Aluminum and PET #1 tons remained nearly flat. This resulted in a 12% decrease to the average number of tons recycled per recycler for glass. *Impact: Reduced tons per recycler contributes to higher costs.*

[21] Source: U.S. Department of Labor, Bureau of Labor Statistics, West Urban Consumer Price Index (as of Oct 2023)

Key Factor	Impact to Costs
3. Increased proportion of small recyclers	For all materials, stratum 3 showed a 20% increase in costs, paired with a 4% increase to tons. This resulted in the proportion of costs for small recyclers increasing two times more than the proportion of tons. Because the proportion of small recycler costs increased higher than the larger recyclers, this indicates that small recyclers are continuing to experience higher cost pressures. On average, stratum 3 recyclers represent roughly 40% to 50% of all costs. Therefore, the changes to stratum 3 costs and tons have a significant impact on overall costs. *Impact: Higher costs relative to tons contributes to higher costs.*
4. Significant increase in transportation costs	Driven by the 78% increase in diesel prices, transportation costs per ton increased by 69%. There was also an increased number of recyclers self-hauling, which is the highest cost transportation method. *Impact: The combination of fuel price increases, and utilization of a higher cost transportation method contributes to higher costs.*
5. Higher CRV hourly wages	Weighted-average CRV hourly wages increased by 3%, driven by a 10% increase in stratum 2 while stratum 1 slightly decreased and stratum 3 essentially did not change. *Impact: Higher average CRV hourly wages contributes to higher costs.*
6. Increased hours handling CRV materials	Labor hours per ton increased by 9% for aluminum and PET #1, and 17% for glass. More hours spent per unit of volume indicates a loss of productivity. For glass, there was a decrease in the average tons handled per recycler, which contributed to the increase in glass. For aluminum and PET #1, there was a slight increase in the average tons handled per recycler but was not enough to offset other factors such as the increasing proportion of low volume, stratum 3 recyclers. *Impact: Spending more time handling materials contributes to higher costs.*
7. Reduced low wage sites	The number of low-wage sites or sites below the minimum wage decreased to 14%, from 18% in the prior year. *Impact: Fewer low wage sites contribute to higher costs.*

Key Factor	Impact to Costs
8. Less volume per operating hour	In 2020, sampled processing fee recyclers were closed on average for nearly 7 weeks and were able to shorten operational hours up to 4 months beyond the closures. In 2022, recyclers did not experience widespread shutdowns and maintained full operating hours. Due to this, recyclers handled slightly less volume spread across more operating hours. *Impact: Decreased productivity contributes to higher costs.*
9. Recycler staffing levels	In 2020, many recyclers laid off a portion of their workforce due to temporary site closures and COVID uncertainty. These temporarily reduced staffing levels resulted in increased efficiencies that may not represent non-pandemic conditions. In 2022, site staffing levels increased after the pandemic, although there was a 9% decrease in total volume. I*mpact: Decreased productivity contributes to the higher costs.*

4. Processing Payments and Processing Fees

In this section, we describe how processing payments and processing fees are calculated. We then compare current and historical processing payments and processing fees based on survey results from 2004 to 2022 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 Beverage Container Recycling and Litter Reduction Act, Section 14575(b)(2) specifies "a reasonable financial return for recyclers" should be included in the processing payment calculation. The RFR is multiplied by the cost of recycling to determine a cost of recycling with financial return. As described below, the cost of recycling is also multiplied by a Cost-of-Living Adjustment (COLA). This cost is used in the processing payment and processing fee calculations. **Exhibit 60** 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, 2022, processing payment and processing fee calculations was 10%. The California Code of Regulations, Section 2975, specifies how the RFR is to be calculated, as follows:

> *For calendar year 2023, the Department is proposing using a reasonable financial return of 10% 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%. 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, 2024, processing payment calculation also includes a COLA of 4.6%. 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, 2024, processing payments and fees is from 2022 and the scrap value is based on average scrap values from October 1, 2022, through September 30, 2023. 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 time period.

Exhibit 60
Historical Reasonable Financial Return Values (1991 to 2023)

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
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%
2023	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. Thus, the processing fee would, in theory, create an incentive for beverage manufacturers to use material types that were less costly to recycle, and/or that did not have a processing fee. At the same time, the recycler, who was required to accept these materials because of the beverage container program, would not suffer a loss.

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

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

CalRecycle pays the processing payment to processors, who then pass the payment on to recyclers, based on the weight of material redeemed.

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

In 2003, 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%, up to 90%, 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 61.** 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 62** 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 63 provides the per ton processing payments for recyclers, effective January 1, 2024.

Exhibit 64 is a copy of the 2024 Processing Fees notice published by CalRecycle on December 15, 2023. 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. The exhibit also documents Section 14575(j) reduction in the processing fee for glass and PET #1.

Exhibit 61
Processing Fee Reduction Factors with Adequate Funds

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

Exhibit 62
Processing Fee Reduction Factors for January 1, 2024, Processing Fees

Material	Percent of Processing Payment
Glass	12%
PET #1	11%
HDPE #2	14%
PVC #3	65%
LDPE #4	65%
PP #5	65%
PS #6	65%
Other #7	65%
Bi-Metal	65%

Exhibit 63
January 1, 2024, Processing Payments

Material	Processing Payment
Glass	$212.47
PET #1	$552.02
HDPE #2	$757.00
PVC #3	$1,581.90
LDPE #4	$2,252.49
PP #5	$1,996.12
PS #6	$1,251.16
Other #7	$1,370.52
Bi-Metal	$1,252.35

Exhibit 64
Processing Fees Public Notice
(December 15, 2023)

(Effective January 1, 2024)

	Glass	PET	HDPE*	Vinyl	LDPE	PP	PS	Other	Bimetal
Cost of Recycling per Ton with Reasonable Financial Return & COLA	$ 211.08	$ 696.33	$ 1,005.74	$ 1,581.90	$ 2,256.72	$ 2,024.58	$ 1,254.06	$ 1,374.01	$ 1,267.68
Scrap Value per Ton	-$1.39	$ 144.31	$ 248.74	$ -	$ 4.23	$ 28.46	$ 2.90	$ 3.49	$ 15.33
Processing Payment per Ton	$ 212.47	$ 552.02	$ 757.00	$ 1,581.90	$ 2,252.49	$ 1,996.12	$ 1,251.16	$ 1,370.52	$ 1,252.35
Processing Payment per Pound	**$ 0.10623**	**$ 0.27601**	**$ 0.37850**	**$ 0.79095**	**$ 1.12624**	**$ 0.99806**	**$ 0.62558**	**$ 0.68526**	**$ 0.62618**
Containers per Pound	1.96	24.30	7.60	9.70	40.80	10.90	100.20	3.10	8.00
Manufacturers' Percentage of Processing Payment	12%	11%	14%	65%	65%	65%	65%	65%	65%
Processing Fee Pursuant to Section 14575(f)	$ 0.00650	$ 0.00125	$ 0.00697	$ 0.05300	$ 0.01794	$ 0.05952	$ 0.00406	$ 0.14368	$ 0.05088
Section 14575(j) Processing Fee Reduction	$ 0.00074	$ 0.00015	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Processing Fee per Container	**$ 0.00576**	**$ 0.00110**	**$ 0.00697**	**$ 0.05300**	**$ 0.01794**	**$ 0.05952**	**$ 0.00406**	**$ 0.14368**	**$ 0.05088**

*The processing fee for wine or distilled spirits contained in a beverage container that is a box, bladder, or pouch, or similar container is equivalent to the HDPE processing fee.

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, 2024, processing payments and fees, the average scrap value used for the calculation covers the period from October 1, 2022, to September 30, 2023.

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 10th 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 10 beverage container material types from October 1, 2022, through September 30, 2023, are shown in **Exhibit 65.** These were the values used for the January 1, 2024, processing payment and processing fee calculations.

Exhibit 65
Statewide Average Scrap Values for the January 1, 2024, Processing Payment, and Processing Fee Calculations

Material	Scrap Value (per Ton)
1. Aluminum	$1,257.31
2. Glass	-1.39
3. PET #1	144.31
4. HDPE #2	248.74
5. Bi-Metal	15.33
6. PVC #3	0.00
7. LDPE #4	4.23
8. PP #5	28.46
9. PS #6	2.90
10. Other #7	3.49

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 66** compares the processing payments for the nine relevant material types for the years following the 10 most recent cost surveys (i.e., for the January 1, 2004, 2006 to 2024 processing payments to recyclers). **Exhibit 67** compares the percentage change in the processing payment per ton between each succeeding cost survey.

Exhibit 66
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	2024
1. Glass	$74.52	$83.68	$94.52	$66.87	$88.26	$94.72	$101.07	$119.96	$125.26	$153.00	$165.32	**$212.47**
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	**552.02**
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	**757.00**
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	**1,252.35**
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	**1,581.90**
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	**2,252.49**
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	**1,996.12**
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	**1,251.16**
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	**1,370.52**

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

Exhibit 67
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	2022 to 2024
1. Glass	12%	13%	-29%	32%	7%	7%	19%	24%	27%	8%	**29%**
2. PET #1	-31%	-13%	26%	-100%	N/A	42%	51%	64%	50%	-30%	**108%**
3. HDPE #2	-21%	-46%	-4%	40%	10%	-42%	130%	145%	79%	-19%	**23%**
4. Bi-Metal	21%	46%	-29%	22%	1%	-22%	24%	30%	54%	8%	**-2%**
5. PVC #3	54%	-54%	10%	18%	9%	-21%	-9%	-4%	93%	8%	**-2%**
6. LDPE #4	-55%	27%	-38%	5%	1%	-7%	19%	25%	51%	8%	**-3%**
7. PP #5	-55%	21%	28%	21%	-6%	-13%	16%	21%	52%	9%	**-1%**
8. PS #6	-51%	-72%	-25%	21%	-2%	-27%	26%	33%	65%	8%	**-2%**
9. Other #7	65%	-46%	5%	16%	2%	-17%	21%	27%	51%	8%	**-3%**

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. Glass, PET#1, and HDPE #2 processing payments to recyclers increased significantly between 2020 and 2022 due to a decrease in scrap values for each material coupled with the increase in cost per ton results detailed in *Section 2* of this report. Processing payments for all minority materials increased roughly -5% to +5%.

Beverage manufacturers pay processing fees on each beverage container sold. **Exhibit 68** compares the per container processing fees from 2004 to 2024. **Exhibit 69** compares the percent change in the per container processing fees between each succeeding cost survey.

Exhibit 68
Comparison of Processing Fees (per Container) (2004-2024)

Material Type	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022	2024
1. Glass	$0.00181	$0.00229	$0.00240	$0.01373	$0.00237	$0.00182	$0.00232	$0.00283	$0.00375	$0.00426	**$0.00576**
2. PET #1	0.00167	0.00159	0.00072	0.00569	0.00000	0.00016	0.00024	0.00045	0.00066	0.00045	**0.00110**
3. HDPE #2	0.01042	0.00503	0.00216	0.01821	0.00213	0.00215	0.00140	0.00384	0.00602	0.00574	**0.00697**
4. Bi-Metal	0.02194	0.02557	0.04825	0.04526	0.04470	0.03671	0.03027	0.03457	0.04799	0.05371	**0.05088**
5. PVC #3	0.03578	0.05501	0.02525	0.02768	0.01194	0.03895	0.00755	0.02248	0.05014	0.05393	**0.05300**
6. LDPE #4	0.03153	0.01181	0.01691	0.00982	0.01082	0.01017	0.00924	0.01124	0.01696	0.01794	**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	**0.05952**
8. PS #6	0.0293	0.01437	0.00507	0.00176	0.00227	0.00223	0.00166	0.00206	0.00348	0.00385	**0.00406**
9. Other #7	0.0216	0.03664	0.04217	0.05009	0.07353	0.08660	0.07173	0.08716	0.13610	0.14628	**0.14368**

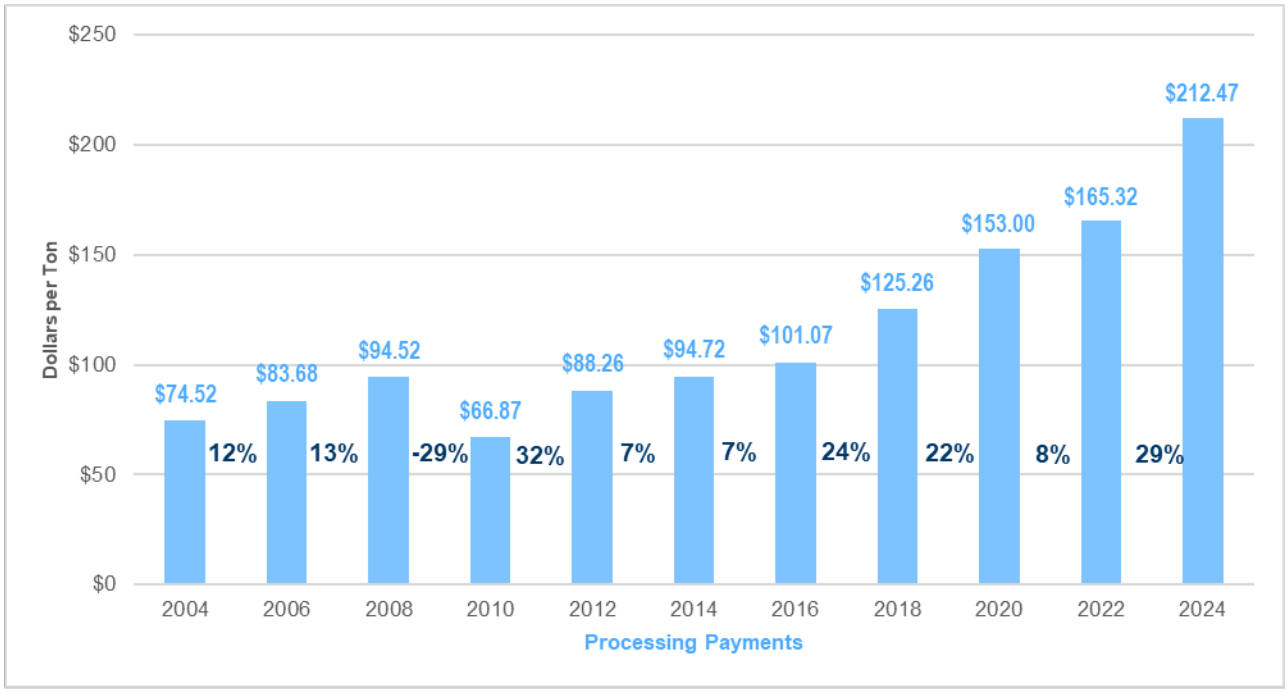
Note: Includes an increased manufacturer's percentage share as a result of the proportional reduction required due to insufficient funds.

Exhibit 69
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	2022 to 2024
1. Glass	27%	5%	472%	-83%	-23%	27%	22%	33%	14%	**35%**
2. PET #1	-5%	-55%	690%	-100%	N/A	50%	88%	47%	-32%	**144%**
3. HDPE #2	-52%	-57%	743%	-88%	1%	-35%	174%	57%	-5%	**21%**
4. Bi-Metal	17%	89%	-6%	-1%	-18%	-18%	14%	39%	12%	**-5%**
5. PVC #3	54%	-54%	10%	-57%	226%	-81%	198%	123%	8%	**-2%**
6. LDPE #4	-63%	43%	-42%	10%	-6%	-9%	22%	51%	6%	**0%**
7. PP #5	-67%	263%	20%	-56%	-5%	28%	-15%	13%	10%	**-3%**
8. PS #6	-51%	-65%	-65%	29%	-2%	-26%	24%	69%	11%	**5%**
9. Other #7	70%	15%	19%	47%	18%	-17%	22%	56%	7%	**-2%**

Exhibit 70 through **Exhibit 72** compare the processing payments and processing fees for 2004 to 2024 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 70
Comparison of Glass Processing Payments and Processing Fees (2004 to 2024)



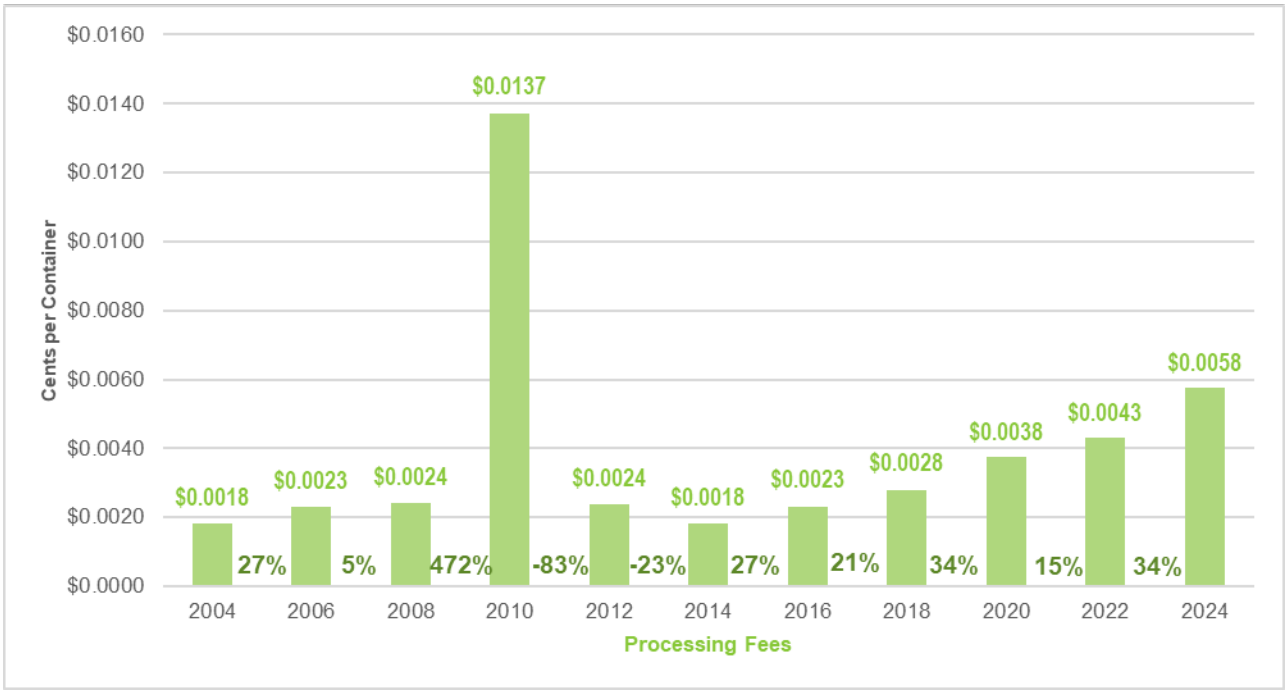
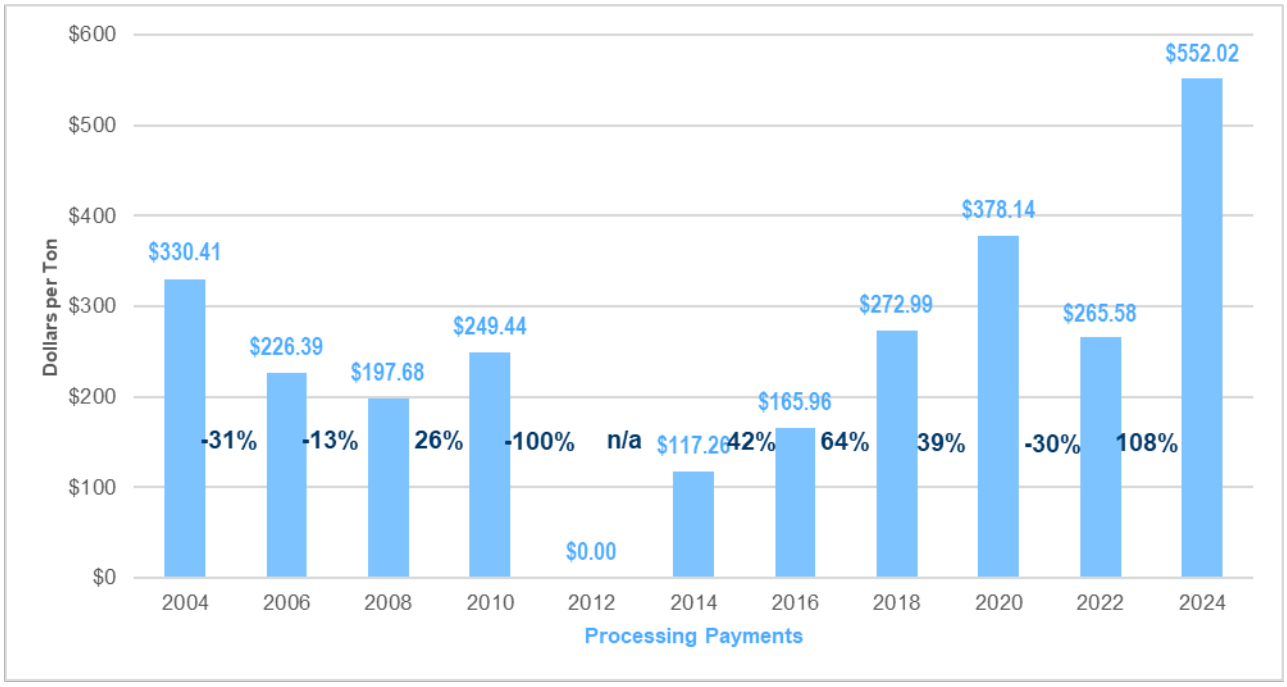


Exhibit 71
Comparison of PET #1 Processing Payments and Processing Fees (2004 to 2024)



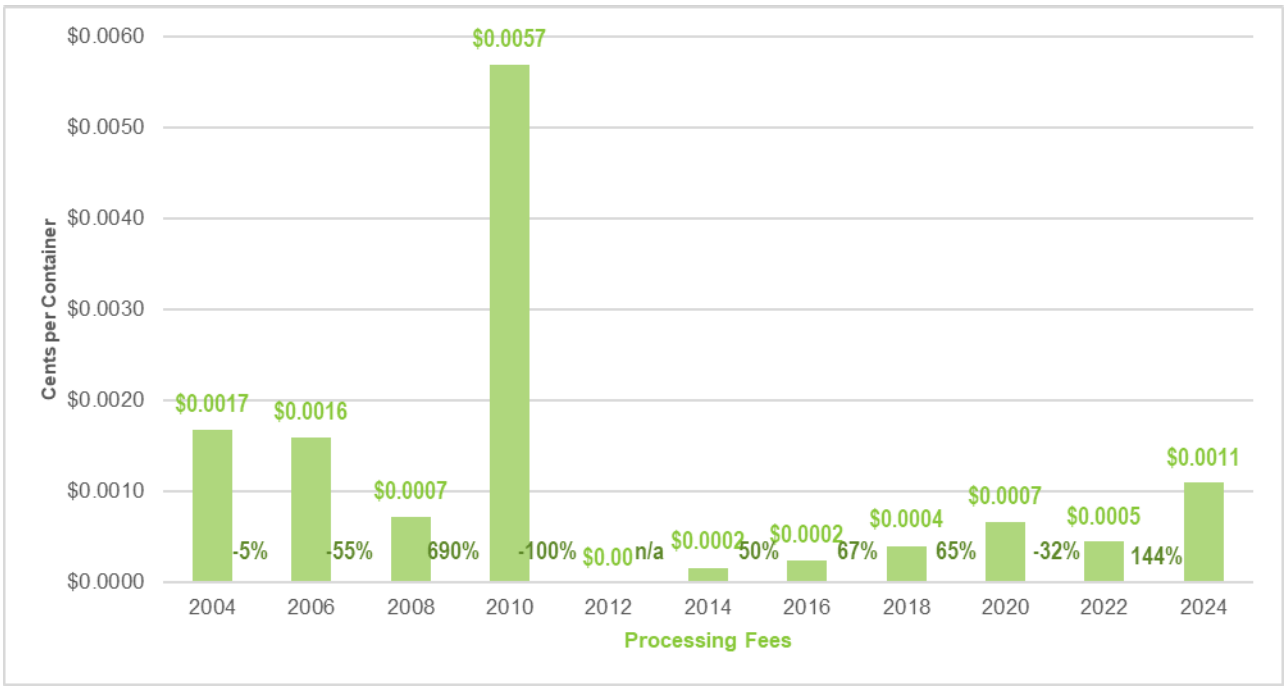
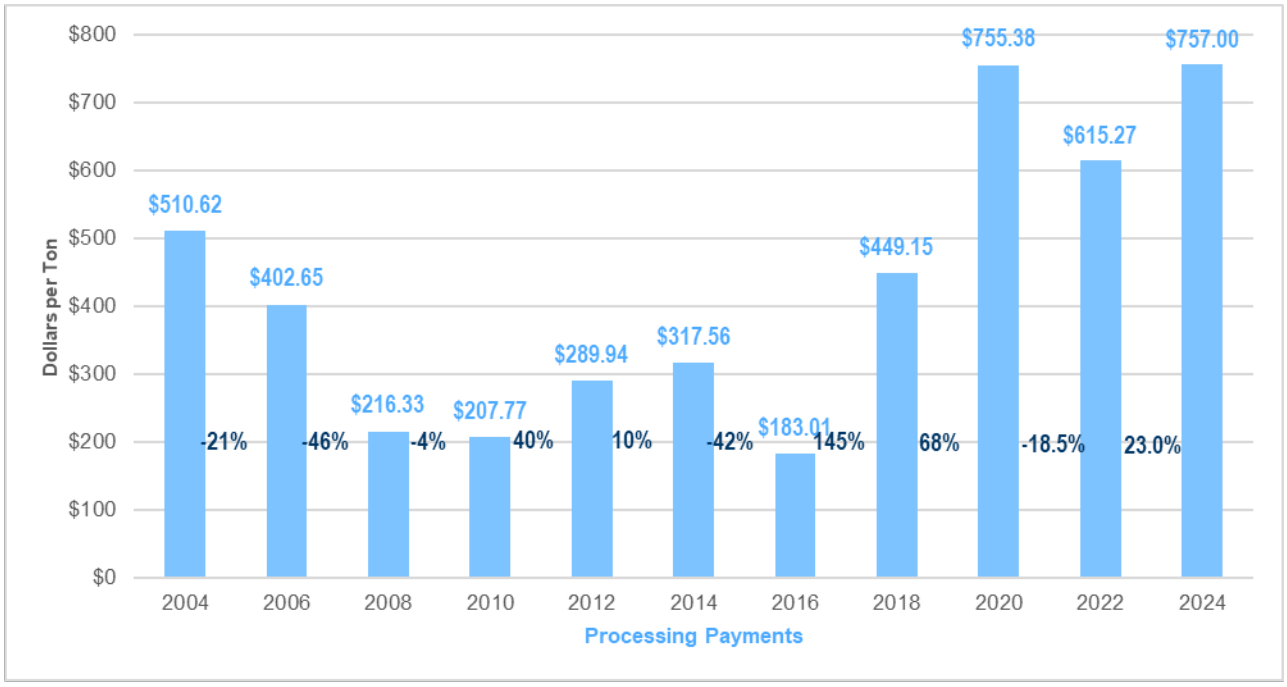
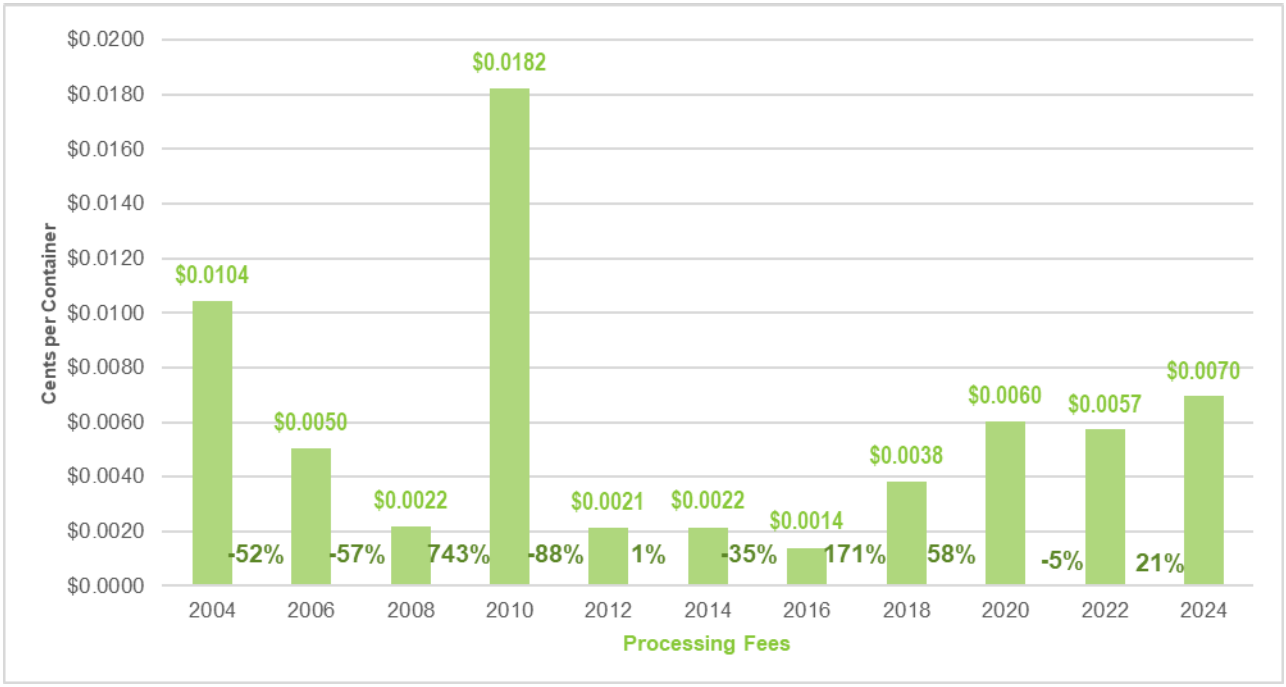


Exhibit 72
Comparison of HDPE #2 Processing Payments and Processing Fees (2004 to 2022)





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 2
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results (2002 through 2022)

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
2022	$727.46	$183.45	$605.19	$874.10

Exhibit 7
2022 Sampled Processing Fee Recyclers,
Distribution of Aluminum Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$100	0
$100–$200	3
$200–$300	14
$300–$400	9
$400–$500	17
$500–$600	23
$600–$700	14
$700–$800	19
$800–$900	9
$900–$1,000	4
$1,000–$1,100	5
$1,100–$1,200	4
$1,200–$1,300	4
$1,300–$1,400	2
$1,400–$1,500	4
$1,500–$1,600	0
$1,600–$1,700	2
$1,700–$1,800	1
$1,800–$1,900	1
$1,900–$2,000	0
$2,000–$2,100	0
$2,100–$2,200	0
>$2,200	2

Exhibit 8
2022 Sampled Processing Fee Recyclers,
Distribution of Glass Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$25	4
$25–$50	4
$50–$75	9
$75–$100	12
$100–$125	18
$125–$150	15
$150–$175	9
$175–$200	13
$200–$225	6
$225–$250	8
$250–$275	5
$275–$300	5
$300–$325	7
$325–$350	3
$350–$375	1
$375–$400	3
$400–$425	3
$425–$450	2
$450–$475	1
$475–$500	1
$500–$525	2
$525–$550	2
>$550	5

Exhibit 9
2022 Sampled Processing Fee Recyclers,
Distribution of PET #1 Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$100	1
$100–$200	11
$200–$300	14
$300–$400	23
$400–$500	24
$500–$600	14
$600–$700	13
$700–$800	3
$800–$900	10
$900–$1,000	5
$1,000–$1,100	6
$1,100–$1,200	3
$1,200–$1,300	3
$1,300–$1,400	1
$1,400–$1,500	3
$1,500–$1,600	0
$1,600–$1,700	0
$1,700–$1,800	0
$1,800–$1,900	0
$1,900–$2,000	0
$2,000–$2,100	0
>$2,100	3

Exhibit 10
2022 Sampled Processing Fee Recyclers,
Distribution of HDPE #2 Cost per Ton

Cost Per Ton	Number of Recyclers
$0–$200	3
$200–$400	26
4300–$600	28
$600–$800	21
$800–$1,000	19
$1,000–$1,200	5
$1,200–$1,400	10
$1,400–$1,600	9
$1,600–$1,800	5
$1,800–$2,000	4
$2,000–$2,200	0
$2,200–$2,400	3
$2,400–$2,600	0
$2,600–$2,800	0
$2,800–$3,000	0
$3,000–$3,200	0
$3,200–$3,400	0
$3,400–$3,600	1
$3,600–$3,800	0
$3,800–$4,000	0
>$4,000	1

Exhibit 17
Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton (1987 through 2022)

- 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
2022	$727.46	$183.45	$605.19	$874.10

Exhibit 19
Summary Comparison of Aluminum, Glass, PET and HDPE Plastic Processing Fee Recycler Cost per Ton Cost Survey Results, CPI Adjusted (2002 through 2022)

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
2022	$727.46	$183.45	$605.19	$874.10

Exhibit 20
Aluminum Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)

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%
2022	$727.46	28%

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%
2022	63,554	-2%

Exhibit 11
Glass Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)

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%
2022	$183.45	34%

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%
2022	165,599	-16%

Exhibit 22
PET #1 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)

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%
2022	$605.19	36%

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%
2022	102,429	-1%

Exhibit 23
HDPE #2 Processing Fee Recycler Cost per Ton and Tons Recycled (2002 to 2022)

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%
2022	$874.10	-1%

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%
2022	2,504	-17%

Exhibit 24
Bi-Metal and Plastics #3 to #7 Processing Fee Recycler Costs per Ton (2022)

- 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	$1,101.76
PVC #3	$1,374.85
LDPE #4	$1,961.34
PP #5	$1,759.59
PS #6	$1,089.91
Other #7	$1,194.17

Exhibit 27
Total Population Costs for Processing Fee Recyclers (2002 to 2022)

Population	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022
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	$46,232,748
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	$30,378,613
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	$61,989,422
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	$2,188,586
Bi-Metal	$23,546	$53,874	$93,333	$143,305	$126,303	$100,930	$11,485	$123,170	$157,206	$147,555	$159,397
Plastics #3 to #7	$5,405	$11,358	$21,820	$51,525	$115,964	$147,211	$196,907	$265,408	$388,410	$436,212	$463,588
Total Sites	684	674	677	729	842	763	955	778	674	581	577
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	$141,412,354

Exhibit 28
Total Population Tons for Processing Fee Recyclers (2002 to 2022)

Population	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022
Aluminum	72,297	74,656	70,762	82,299	86,261	62,374	77,350	74,391	66,714	65,104	63,554
Glass	229,489	244,557	257,139	318,697	317,030	239,837	255,763	256,637	230,671	196,273	165,599
PET #1	33,462	48,820	65,456	95,239	97,915	81,471	102,048	110,536	107,815	102,963	102,429
HDPE #2	3,316	5,720	7,325	11,943	12,117	9,053	5,170	4,775	3,783	3,005	2,504
Bi-Metal	46	89	106	227	164	131	155	178	149	132	145
Plastics #3 to #7	5	9	29	76	138	176	278	356	340	356	369
Total Sites	684	674	677	729	842	763	955	778	674	581	577
Total Tons	338,615	373,851	400,817	508,481	513,625	393,042	440,764	446,873	409,471	367,832	334,600

Exhibit 34
Aluminum Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

Strata	Costs per Ton	Sites
Stratum 1	$525.70	25
Stratum 2	$669.47	45
Stratum 3	$939.29	67
Statewide Average	$727.46	N/A

Exhibit 35
Glass Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

Strata	Costs per Ton	Sites
Stratum 1	$161.74	25
Stratum 2	$151.56	45
Stratum 3	$222.33	67
Statewide Average	$183.45	N/A

Exhibit 36
PET #1 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

Strata	Costs per Ton	Sites
Stratum 1	$439.32	25
Stratum 2	$546.25	45
Stratum 3	$811.47	68
Statewide Average	$605.19	N/A

Exhibit 37
HDPE #2 Costs per Ton and Survey Population Size by Strata for Processing Fee Recyclers (2022)

Strata	Costs per Ton	Sites
Stratum 1	$679.35	25
Stratum 2	$692.37	45
Stratum 3	$1,219.17	65
Statewide Average	$874.10	N/A

Exhibit 38
Glass, Percent of Population Tons Recycled and Percent of Total Costs (2012 to 2022)

Strata	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2020 Tons	2022 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs	2020 Costs	2022 Costs
Stratum 1	54%	42%	52%	24%	27%	25%	42%	30%	37%	18%	25%	22%
Stratum 2	37%	46%	37%	33%	35%	34%	42%	50%	45%	25%	33%	28%
Stratum 3	9%	12%	11%	42%	38%	42%	16%	20%	18%	56%	42%	50%

Exhibit 39
Aluminum, Percent of Population Tons Recycled and Percent of Total Costs (2012 to 2022)

Strata	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2020 Tons	2022 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs	2020 Costs	2022 Costs
Stratum 1	39%	33%	50%	26%	32%	32%	34%	29%	44%	21%	26%	23%
Stratum 2	43%	48%	37%	30%	33%	29%	44%	49%	38%	26%	32%	27%
Stratum 3	18%	19%	13%	44%	35%	39%	22%	22%	18%	53%	42%	50%

Exhibit 40
PET #1, Percent of Population Tons Recycled and Percent of Total Costs (2012 to 2022)

Strata	2012 Tons	2014 Tons	2016 Tons	2018 Tons	2020 Tons	2022 Tons	2012 Costs	2014 Costs	2016 Costs	2018 Costs	2020 Costs	2022 Costs
Stratum 1	46%	37%	54%	28%	32%	33%	40%	32%	45%	22%	28%	24%
Stratum 2	41%	48%	36%	33%	35%	32%	45%	50%	40%	27%	32%	29%
Stratum 3	12%	15%	10%	40%	33%	35%	15%	18%	15%	50%	40%	48%

Exhibit 41
Number of Processing Fee Recycling Centers (2002 to 2022)

- A line graph that provides the average tons of aluminum, glass, and PET #1 recycled per recycling center 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
2022	577

Exhibit 42
Average Tons of Aluminum, Glass, and PET #1 Recycled per Processing Fee Recycler (2002 to 2022)

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
2022	114	296	183

Exhibit 43
Percentage Change in Tons per Recycler, Costs per Recycler, and Statewide, Weighted-Average Processing Fee Recycler Cost per Ton (2020 to 2022)

Category	Aluminum	Glass	PET #1	HDPE #2
Tons per Recycling Center	1.5%	-12.3%	3.4%	-18%
Cost per Recycling Center	27%	7%	38%	-29%
Cost per Ton	28%	34%	36%	-1.3%

Exhibit 45
Labor and Non-Labor Costs per Ton (2018, 2020, and 2022)

Material	2018 Labor	2020 Labor	2022 Labor	2018 Non-Labor	2020 Non-Labor	2022 Non-Labor
Aluminum	$317.26	$301.58	$356.08	$309.35	$268.18	$371.38
Glass	$62.23	$75.57	$92.67	$70.45	$61.16	$183.45
PET #1	$264.01	$231.29	$289.98	$238.43	$215.05	$605.19

Exhibit 46
Average CRV Wages per Hour (2010 to 2022)

Category	2010	2012	2014	2016	2018	2020	2022
Average CRV Wages per Hour	$14.43	$13.89	$13.69	$15.09	$17.65	$19.48	$20.00
CPI Adjusted	$20.26	$18.56	$17.70	$18.92	$20.82	$21.99	–
Minimum Wage	$8.00	$8.00	$9.00	$10.00	$11.00	$13.00	$15.00

Exhibit 47
Comparison of CRV Hourly Wages Overall and by Strata (2020 and 2022)

Year	Overall	Stratum 1	Stratum 2	Stratum 3
2020	$19.48	$21.45	$19.44	$17.52
2022	$20.00	$20.90	$21.43	$17.47

Exhibit 51
Average Labor Hours per Ton of Aluminum, Glass, and All Plastic Recycled (2010 to 2022)

- 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
2022	16.8	4.3	13.9

Exhibit 52
Labor Hours per Ton CRV Material by Activity (2020 and 2022)

Year	AL/ BM DYL	AL/ BM AOL	Glass DYL	Glass AOL	Plastic DYL	Plastic AOL	CRV DYL	CRV AOL
2020	12.97	2.46	2.94	0.74	11.07	1.70	7.15	1.33
2022	13.70	3.07	3.34	0.96	11.68	2.22	8.14	1.79

Exhibit 53
Comparison of Average CRV Wages per Recycler (2020 and 2022)

Year	Overall Wages per RC	Aluminum Wages per RC	Glass Wages per RC	Plastics Wages per RC
2020	$131,957	$43,623	$32,222	$56,994
2022	$149,514	$50,801	$31,541	$70,216

Exhibit 54
Percent of Recycling Center Labor Hours by Activity (2020 and 2022)

Year	AL/ BM DYL	AL/ BM AOL	Glass DYL	Glass AOL	Plastic DYL	Plastic AOL	non-CRV DYL	non-CRV AOL
2020	17%	3%	11%	3%	24%	4%	27%	11%
2022	17%	4%	10%	3%	25%	5%	25%	11%

Exhibit 55
Comparison of Average Transportation Cost per Surveyed Recycling Center and Diesel Prices (2010 through 2022)

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
2022	$27.711	$6.03

Exhibit 56
Transportation Cost per Ton (2018 and 2020)

Year	Stratum 1	Stratum 2	Stratum 3	Overall
2020	$12.84	$25.85	$31.12	$21.78
2022	$27.21	$38.68	$52.77	$36.82

Exhibit 57
Aluminum, Glass, and Plastic Transportation Cost Per Ton (2020 and 2022)

Year	Aluminum	Glass	Plastic
2020	$38.86	$10.42	$31.47
2022	$60.72	$15.49	$53.00

Exhibit 58
Aluminum, Glass, and PET #1 Transportation with Scrap Value Deduction (2020 and 2022)

Year	Aluminum	Glass	PET #1
2020	62%	63%	60%
2022	52%	55%	44%

Exhibit 70
Comparison of Glass Processing Payments and Processing Fees (2004 to 2024)

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	24%
2020	$153.00	22%
2022	$165.32	8%
2024	$212.47	29%

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	21%
2020	$0.0038	34%
2022	$0.0043	15%
2024	$0.0058	34%

Exhibit 71
Comparison of PET #1 Processing Payments and Processing Fees (2004 to 2024)

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	64%
2020	$378.14	39%
2022	$265.58	-30%
2024	$552.02	108%

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	67%
2020	$0.0007	65%
2022	$0.0005	-32%
2024	$0.0011	144%

Exhibit 72
Comparison of HDPE #2 Processing Payments and Processing Fees (2004 to 2024)

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%
2024	$757.00	23%

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%
2024	$0.0070	21%