APPENDIX
Source Reduction Baseline Technical Report
A Plastic Pollution Prevention and Packaging Producer Responsibility Act Needs Assessment Report

CalRecycle Publication DRRR-2024-1747

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Single-Use Plastic Packaging Model

Industry Packaging Impact Prioritization

Accenture created three parameters capturing general characteristics of products and their primary packaging within each manufacturing industry group: Table A1 outlines the parameters used to assess each manufacturing industry group:

- Number of units sold,
- Weight of packaging as part of total product, and
- Component complexity.

For each manufacturing industry group, a score between one and three was given for each parameter. A score of zero indicated that the parameter was not applicable to the industry group (e.g., the primary packaging of a product is not included in the model).

The scores across the three parameters were then combined to create an average score between zero and three. Manufacturing industry groups that had an average score between 0 and 1.99 were assigned as low impact for primary packaging and those with an average score between 2.0 and 3.0 were assigned a high impact for primary packaging rating.

Manufacturing industry groups whose products are out of scope (i.e., exclusions from scope of covered material by PRC Section 42041(e)(2)) for primary packaging for SB 54 were considered non-primary. For such industry groups, a representative product was identified to extrapolate the secondary and tertiary packaging associated with that product.

The parameters were evaluated at the manufacturing industry group level, thus evaluations are not specific to a representative product, but reflect general characteristics of products within each manufacturing industry group. Sources used to aid in the categorization of manufacturing industry groups were not used in the creation of any values used in the model itself.

See Spreadsheet, Industry List and Packaging Impact Prioritization for additional details.

Table A1. Industry Primary Packaging Impact Prioritization by Manufacturing Industry Group

Parameter	Definition	High (3 points)	Medium (2 points)	Low (1 point)
Number of Units Sold	This parameter considered the cost of products within an industry group as a proxy to determine how many products may be potentially sold in comparison to the total revenue for an industry group.	Products are assumed to be generally inexpensive (e.g., less than $100) and therefore likely sold in higher volume. Examples of industry groups receiving a high score include industry groups for food items.	Products are assumed to be generally more expensive (e.g., between $100 and $5,000) and sold infrequently. Examples of industry groups receiving a medium score include Household Appliance manufacturing.	Products are assumed to be generally very expensive (e.g., over $5,000) and typically sold infrequently or purchased by commercial buyers. Examples of industry groups receiving a low score include Motor Vehicle manufacturing.
Weight of Primary Packaging as Part of Total Product	This parameter considered how much of the total weight of products within an industry group can generally be attributed to its primary packaging.	Primary packaging associated with products in the industry group were assumed to be a larger portion of overall product weight (e.g., packaging for hand soap).	Primary packaging associated with products in the industry group were assumed to be integral yet a smaller portion of total product weight (e.g., packaging for a table lamp).	Primary packaging associated with products in the industry group were assumed to be an insignificant portion of the overall weight of the product (e.g., packaging film on a car).
Component Complexity	This parameter considered the number of primary packaging components associated with products within an industry group	Primary packaging associated with products in the industry group were assumed to have a large number of plastic components (e.g., self-assembled desk)	Primary packaging associated with products in the industry group were assumed to have several components (e.g., peanut butter jar)	Primary packaging associated with products in the industry group were assumed to have single/few components (e.g., candy wrapper)

Example: Bakeries and Tortilla Manufacturing[1] - 3118

- Number of Units Sold: high = 3
    - Inexpensive cost of food may result in more products sold
- Weight of Primary Packaging as Part of Total Product: high = 3
    - Primary packaging for goods in this manufacturing industry can be a larger portion of the overall weight of the product
- Component Complexity: low = 1
    - Primary packaging can cover the product entirely in a single component or small number of components
- Total score: (3 + 3 + 1) ÷ 3 = 2.3 (high impact priority)

Example: Motor Vehicle Manufacturing[2] - 3361

- Number of Units Sold: low = 1
    - High price of product and limited customer base reduces overall frequency of purchases
- Weight of Primary Packaging as Part of Total Product: low = 1
    - Extremely heavy weight of the good makes packaging weight more likely to be negligible
- Component Complexity: medium = 2
    - Several primary packaging components/film throughout the product to reduce damage/scratching during transport
- Total score: (1 + 1 + 2) ÷ 3 = 1.3 (low impact priority)

Manufacturing Industries & Representative Products Not Included in the Single-Use Plastic Packaging Model

Some manufacturing industries and representative products were not included in the Single-Use Plastic Packaging Model for a variety of reasons including data challenges, product type or size, and prevention of double-counting of food service ware that was captured in the Single-Use Food Service Ware Model.

Sub-Industries Not Included Due to Data Challenges

As shown in Table A2, four sub-industries generated a negative calculation of overall monetary values and were thus not included in the model. When the net exports for an industry was larger than its manufacturing sales in California, calculations led to a negative monetary value (i.e., the amount exported for an industry was greater than imports plus the amount manufactured in the state). Given that the total monetary value is the basis for estimating the number of products sold, offered for sale, or distributed into California, a negative value could not be used [Spreadsheet, SRB Model, Worksheet "*Combined Overview-SUP Pkg"* (columns "Total Value")].

Table A2. Sub-Industries Not Included in the Model Due to Data Challenges

4-digit NAICS	Industry Group	5-digit NAICS	Industry	6-digit NAICS	Sub- Industry
3131	Fiber, Yarn, and Thread Mills	31311	Fiber, Yarn, and Thread Mills	313110	Fiber, Yarn, and Thread Mills
3132	Fabric Mills	31324	Knit Fabric Mills	313240	Knit Fabric Mills
3133	Textile and Fabric Finishing and Fabric Coating Mills	31331	Textile and Fabric Finishing Mills	313310	Textile and Fabric Finishing Mills
3161	Leather and Hide Tanning and Finishing	31611	Leather and Hide Tanning and Finishing	316110	Leather and Hide Tanning and Finishing

Representative Products Not Included Due to Product Type

Gasoline is the only product omitted in the model due to product type, as Accenture assumed it was delivered in reusable canisters and containers rather than in single-use plastic packaging (see Table A3).

Table A3. Representative Products Not Included in the Model Due to Product Type

4-digit NAICS	Industry group	5-digit NAICS	Industry	6-digit NAICS	Representative Product Industry	Representative Product
3241	Petroleum and Coal Products Manufacturing	32411	Petroleum Refineries	324110	Petroleum Refineries	Gasoline

Representative Products Not Included Due to Size

Four representative products (see Table A4) were not included in the model due to the very large product sizes.

It was assumed that these representative products are typically composed of many smaller goods where the associated packaging was likely already captured in the model. These representative products are also relatively infrequently produced and therefore unlikely to affect the baseline estimate significantly.

Table A4. Representative Products Not Included in the Model Due to Product Size

4-digit NAICS	Industry Group	5-digit NAICS	Industry	6-digit NAICS	Sub- Industry	Representative Product
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	33361	Engine, Turbine, and Power Transmission Equipment Manufacturing	333611	Turbine and Turbine Generator Set Units Manufacturing	Wind Turbine
3364	Aerospace Product and Parts Manufacturing	33641	Aerospace Product and Parts Manufacturing	336414	Guided Missile and Space Vehicle Manufacturing	Missiles
3365	Railroad Rolling Stock Manufacturing	33651	Railroad Rolling Stock Manufacturing	336510	Railroad Rolling Stock Manufacturing	Freight Railcars

4-digit NAICS	Industry Group	5-digit NAICS	Industry	6-digit NAICS	Sub- Industry	Representative Product
3366	Ship and Boat Building	33661	Ship and Boat Building	336611	Ship Building and Repairing	Commercial Ships (e.g., cargo ships)

Manufacturing Sub-Industry Not Included to Avoid Double-Counting

All Other Plastics Product Manufacturing (NAICS code 326199) was another sub-industry that was omitted entirely in the Single-Use Plastic Packaging Model. This sub-industry is associated with manufacturing of a wide array of goods, including inflatable flotation devices, floor coverings, and plastic hardware to name a few. It also includes businesses responsible for manufacturing plastic bowls, cups, and dinnerware, and plastic packaging materials such as bubble and blister packaging. This sub-industry was omitted to prevent double counting of packaging, which was captured elsewhere in the model where relevant (e.g. air pillows used to package representative products) and food service ware items which were estimated using the Single-Use Plastic Food Service Ware Model.

Sales & Trade Data Harmonization

Data from the North American Industry Classification System (NAICS) from 2021 was used to estimate manufacturing sales across various manufacturing industries. International import and export data for 2023 sourced from the WISERTrade database was supplemented with domestic trade data from 2023 from Oak Ridge National Labs Freight Analysis Framework to estimate the amount of goods produced within, imported to, and exported from California. Harmonization and mapping were required to reconcile these data sets as described below.

NAICS Manufacturing Data

The manufacturing sales data from NAICS was available for 2021. To scale this data to the 2023 calendar year, a growth modifier of 3.7% was applied to the total value once for 2021 to 2022, and once more for 2022 to 2023. The selection of 3.7% comes from the American Chemistry Council's *2024 Resin Review*[3], where 3.7% represents the total growth of resin production in the United States in 2023. This percentage was assumed to be a more accurate multiplier to apply to sales data compared to overall GDP growth as this reflects the amount of plastic that is available for purchase and used by manufacturers. This data can be accessed via the Spreadsheet, SRB Model (Worksheets "*% Market share*" and "*Sales & Trade Values*").

WISERTrade Data

The WISERTrade database was used to obtain 2023 annual international import and export values for various products entering and exiting California. These products were classified in WISERTrade using the Harmonized System (HS), a standardized numerical method used in the United States and by many trading partners to uniformly identify and describe traded products. California import and export data for 2023 were pulled for all HS codes that had available data in the state.

To incorporate the WISERTrade data into the Single-use Plastic Packaging Model, the HS codes were first mapped to their respective NAICS codes using concordance tables from the United States Census Bureau[4] (Spreadsheet, International Trade, Worksheets "*Export'23*" and "*Import'23*"). Once HS codes were aligned to NAICS codes, the total international exports and imports values for each HS code were allocated to NAICS codes and subsequently allocated across the representative products via the employee headcount proxy (Spreadsheet, SRB Model, Worksheet "*Sales and Trade Value*"). Manufacturing sales were not available beyond a 4-digit NAICS code level, so employee counts, which were available at more detailed, higher-digit NAICS levels, were used as a proxy for manufacturing sales.

Domestic Trade Data

Data on domestic import and export values for commodities were retrieved from the Oak Ridge National Labs Freight Analysis Framework[5] via 42 Standard Classification of Transported Goods (SCTG) codes.

A published methodology to allocate the domestic export and import values to each of the 4-digit NAICS codes was unavailable. SCTG codes were manually aligned to NAICS by cross-referencing their descriptions and sub-SCTG codes with the relevant 4-digit NAICS industry groups.

For example, SCTG code "01 – Live animals/fish" was reviewed and aligned to two individual NAICS codes:

- 3116 (Animal Slaughtering and Processing)
- 3117 (Seafood Product Preparation and Packaging).

SCTG codes were often aligned with multiple NAICS codes. For example, SCTG 07-Other Foodstuffs was aligned with four manufacturing industry groups (see Table A5). Ratios were created to apply the total domestic export and import values for each SCTG code to the 4-digit NAICS codes. The manufacturing sales associated with each manufacturing industry group aligned with a single SCTG code were summed to estimate total sales across those industry groups. To create a ratio, the manufacturing sales for each industry group was divided by the sum of the manufacturing sales. This ratio for each manufacturing industry group was applied to the net domestic trade value for the SCTG code to estimate the net domestic trade value for that industry group.

Table A5 demonstrates how domestic import values for SCTG code 07 – Other Foodstuffs were apportioned across four NAICS codes – 3113, 3115, 3119, and 3121.

Table A5. Example – SCTG code 07: Import Values Apportioned to NAICS Codes

SCTG Code & Industry	Industry Group	2021 Manufacturing Sales ($M)	Ratio of Manufacturing Sales	2023 Imports: Total Un-apportioned ($M)	Imports: Apportioned ($M)
07 – Other Foodstuffs	Sugar and Confectionery Product Manufacturing (3113)	4,100	6%		1,252
07 – Other Foodstuffs	Dairy Product Manufacturing (3115)	16,839	23%		5,140
07 – Other Foodstuffs	Other Food Manufacturing (3119)	22,356	31%	22,040	6,824
07 – Other Foodstuffs	Beverage Manufacturing (3121)	28,910	40%		8,825
Total		**72,205**	**100%**	**22,040**	**22,040**

The allocation of export and import values was conducted for each SCTG code individually, with the totals subsequently aggregated for each NAICS code. This iterative process ensured a comprehensive and accurate summation of trade values across the respective industry groups.

The details of the alignment of SCTG codes to NAICS can be found in the Spreadsheet, Domestic Trade Data (Worksheets "*Export '23*" and "*Imports '23*").

Market Share

Representative products were identified at the level of the 6-digit NAICS code, while the total monetary output (i.e., manufacturing sales adjusted for net trade) was calculated at the level of the 4-digit NAICS code. Using estimates of market share, the total monetary output per manufacturing industry group (i.e., 4-digit NAICS code) was allocated across the representative products identified for that industry group.

Manufacturing sales data were available by manufacturing industry group (i.e., 4-digit NACIS code). To estimate manufacturing sales by manufacturing industry (i.e., 5-digit NAICS code), the market share was estimated for each manufacturing industry within

an industry group. Then, to estimate manufacturing sales by representative product (i.e., 6-digit NAICS code), the market share was estimated for each representative product within a sub-industry. The market share estimates developed to calculate sales per representative product were also used to allocate net trade values.

First, the relationship between the 4-digit, 5-digit, and 6-digit NAICS codes and their respective representative products was established. Table A6 illustrates the relationship between 4-, 5-, and 6-digit NAICS codes.

Three representative products were assigned to each high-impact industry. For some manufacturing industries (e.g., 31151), there were three unique sub-industries (i.e., 6-digit NAICS codes) associated (e.g., 311511, 311513, and 311514) with the manufacturing industry. In this case, one representative product was chosen for each sub-industry. For other high-impact manufacturing industries (e.g., 31152), there was only one sub-industry associated (e.g., 311520) with the manufacturing industry. In this case, three representative products were chosen from the single sub-industry. In both cases, three representative products were identified per manufacturing industry (i.e., 5-digit NAICS code) for high-impact industries. For low-impact and non-primary industries, one representative product was selected and assigned 100% of the market share for that manufacturing industry (i.e., 5-digit NAICS code).

Table A6. Example of 4 to 6 Digit NAICS Code Relationship for Dairy Product Manufacturing

4-Digit NAICS (Manufacturing Industry Group)	5-Digit NAICS (Manufacturing Industry)	6-Digit NAICS (Sub-Industry)	Representative Product
3115 Dairy Product Manufacturing	31151 Dairy Product (except Frozen) Manufacturing	311511 Fluid Milk Manufacturing	Fluid Milk
		311513 Cheese Manufacturing	Block Cheese
		311514 Dry, Condensed, and Evaporated Dairy Product Manufacturing	Evaporated Milk
	31152 Ice Cream and Frozen Dessert Manufacturing	311520 Ice Cream and Frozen Dessert Manufacturing	Ice Cream
		311520 Ice Cream and Frozen Dessert Manufacturing	Frozen Custard
		311520 Ice Cream and Frozen Dessert Manufacturing	Popsicles

To determine the market share that each manufacturing industry (i.e., 5-digit NAICS code) had within a manufacturing industry group (i.e., 4-digit NAICS code), the number of employees was used as a proxy for industry sales and trade values. The percentage of employees for each selected 5-digit NAICS code was determined by dividing the employee count for the 5-digit NAICS code by the total employee count for the corresponding 4-digit NAICS code. For example, for Dairy Product Manufacturing Industry Group (3115), it was estimated that 84% of employees, and thus market share, were associated with Dairy Product (except Frozen) Manufacturing (31151), while the remaining 16% were associated with Ice Cream and Frozen Dessert Manufacturing (31152) (see Table A7).

Table A7. Example of Market Share for Dairy Product Manufacturing Industry (5-digit NAICS Code) Based on Employee Headcount

4 Digit NAICS	5 Digit NAICS	# of Employees	Proportion of Total Employees
3115	31151 Dairy Product (except Frozen) Manufacturing	15,240	84%
3115	31152 Ice Cream and Frozen Dessert Manufacturing	2,960	16%
3115 Total		18,200	100%

Same as the previous step, to determine the market share that each representative product had within a manufacturing industry (i.e., 5-digit NAICS code), the number of employees was used as a proxy for industry sales and trade values.

The percentage of employees for each selected 6-digit NAICS code (i.e. sub-industry) was determined by dividing the employee count for the 6-digit NAICS code by the total employee count for the corresponding 5-digit NAICS code. If a single representative product was associated with a single sub-industry, that representative product was assigned the same market share as that sub-industry. If multiple representative products were associated with a single sub-industry, the market share of the sub-industry was split evenly among the representative products.

There were multiple instances where the number of sub-industries (i.e., 6-digit NAICS code) associated with a particular 5-digit NAICS code industry was greater than three. In such instances, the three sub-industries with the highest market share were chosen to represent the manufacturing industry and the market share of the omitted sub-industries was re-distributed across the three chosen ones.

For example, as shown in Table A8, the 5-digit NAICS code, Dairy Product (except Frozen) Manufacturing industry included four 6-digit NAICS codes, representing Fluid Milk Manufacturing; Cheese Manufacturing; Dry, Condensed, and Evaporated Dairy Product Manufacturing; and Creamery Butter Manufacturing. Creamery Butter Manufacturing was identified as the sub-industry with the least number of employees and was thus not included in the model, and the market share associated with it was reallocated to the other sub-industries.

Also illustrated in Table A8, Ice Cream and Frozen Dessert Manufacturing was the only sub-industry under the manufacturing group of the same name. The entire market share for that manufacturing industry was allocated to that sub-industry. Given that it was a high priority industry, three representative products were chosen for this sub-industry with the market share allocated equally across the three representative products.

Table A8. Example of Market Share for Sub-Industries (6-digit NAICS Code) under Dairy Product Manufacturing Industry Based on Employee Headcount

6 Digit NAICS	6 Digit NAICS	# of Employees	Employee %	Percent Adjustment	Estimated Market Share
311511	Fluid Milk Manufacturing	5,801	38.06%	2.96%	41.03%
311513	Cheese Manufacturing	7,163	47.00%	3.66%	50.66%
311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing	1,175	7.71%	0.60%	8.31%
311512	Creamery Butter Manufacturing	1,101	7.22%	-7.22%	0.00%
31151 Total		**15,240**	**100%**	**0%**	**100%**
311520	Ice Cream and Frozen Dessert Manufacturing	2,960	100%	0%	100%
31152 Total		**2,960**	**100%**	**0%**	**100%**

Once market shares were estimated (Table A8), they were applied to manufacturing sales and trade values to calculate approximate sales by representative product in two steps. As shown in Table A9, the market shares were applied to each manufacturing industry group (i.e., 4-digit NAICS codes) to estimate monetary value at the manufacturing industry level (i.e., 5-digit NAICS code). For example, manufacturing sales for Dairy Product (except Frozen) Manufacturing (NAICS code 3115) were about $18 billion, split between 31151 ($15.2 billion) and 31152 ($2.9 billion).

Table A9. Example of Applying Market Share to Monetary Values for Dairy Product Manufacturing Industries (amounts are rounded)

Type of Monetary Value	3115 Monetary Values ($M)	31151 Dairy Product (except Frozen) Manufacturing 84% of market share ($M)	31152 Ice Cream and Frozen Dessert 16% of market share ($M)
Manufacturing Sales	18,108	15,211	2,897
Net International Imports	-2,461	-2,067	-394
Net Domestic Imports	-770	-647	-123
Total Monetary Output	**14,877**	**12,497**	**2,380**

The market share values established for the 6-digit NAICS codes were then applied to estimated values at the 5-digit NAICS code level in order to get the estimated monetary values for each representative product. As shown in Table A10, milk was the representative product for the sub-industry of Fluid Milk Manufacturing (311511) with an estimated market share of 41% of the total value of Dairy Product (except Frozen) Manufacturing industry (31151). Manufacturing sales were about $15.2 billion for 31151, and accounting for 41% of the market share, milk had an estimated manufacturing sales value of $6.2 billion.

Table A10. Example of Applying Market Share to Monetary Values to Dairy Product (except Frozen) Manufacturing*

Type of Monetary Value	31151 Monetary Values ($M)	311511 Representative Product: Milk 41% of market share ($M)	311513 Representative Product: Block Cheese 51% of market share ($M)	311514 Representative Product: Evaporated Milk 8% of market share ($M)
Manufacturing Sales	15,211	6,221	7,682	1,260
Net International Imports	-2,067	-845	-1,044	-171
Net Domestic Imports	-647	-265	-327	-54
Total Monetary Output	**12,497**	**5,111**	**6,311**	**1,035**

*Values listed in the table may differ due to rounding; see the “Spreadsheet, SRB Model” for exact values.

B2B and B2C Assumptions and Allocations

The total monetary output of a representative product was allocated to either B2B (business to business) and B2C (business to consumer) categories to estimate the proportion of products being sold in B2B and B2C format packaging. To estimate those proportions, Accenture made the following assumptions:

- Some types of representative products were packaged with consumers in mind, including goods received in B2C format packaging that were purchased in bulk by businesses. As a result, those representative products were estimated to have all of their sales sold in B2C format packaging, including the following types of representative products:
    - Apparel and accessories (e.g., clothing, bags)
    - Computer and consumer electronics (e.g., laptop)
    - Consumer goods (e.g., tobacco)
    - Consumer transport (e.g., tires)
    - Home appliances or goods (e.g., washing machine)
    - Personal care (e.g., shaving cream, deodorant)
    - Toys and hobby (e.g., action figures)
- Some types of representative products were packaged primarily with consumers in mind and businesses chose to purchase both B2C and B2C formats. As a result, those representative products were estimated to have 80% of sales associated with B2C format packaging and 20% associated with B2B format packaging, including the following types of representative products:
    - Beverage (liquid) [e.g., beer – only secondary and tertiary packaging applicable as SB 54 covered material (PRC Section 42041(e)(2))]
    - Pet food
- Some types of representative products were split evenly between B2B or B2C format packaging. As a result, those representative products were estimated to have 50% of sales associated with both B2C and B2B format packaging, and included the following types of representative products:
    - Office equipment and supplies (e.g., virgin paper)
    - Mixed chemicals (e.g., bleach)
- For food-based representative products, Accenture assumed consumers only purchased B2C formats while businesses only purchased B2B formats. The USDA's report on American eating habits[6] details that the percentage of Americans eating away from home is greater than the number of Americans preparing food at home. That value was used as a proxy for the proportion of food purchased in B2B and B2C format packaging. As a result, those representative products were estimated to have 44% of sales associated with B2C format packaging and 56% of sales associated with B2B format packaging, including the following types of representative products:
    - Frozen food (e.g., frozen burritos, frozen vegetables)
    - Non-frozen food (e.g., rice)
- Some types of representative products were packaged primarily with businesses in mind, with a smaller portion purchased by consumers. As a result, those representative products were estimated to have 20% of their sales associated

with B2C format packaging and 80% of sales associated with B2B format packaging, including the following types of representative products:
    - Large animal food (e.g., poultry feed)
    - Mixed auto (e.g., car batteries)
    - Fabrics and leather (e.g., polyester yarn)
    - Mixed construction (e.g., lumber)
- Some types of representative products were packaged with businesses in mind, including goods received in B2B format packaging that were purchased by consumers. As a result, those representative products were estimated to have all of their sales sold in B2B format packaging, including the following types of representative products:
    - Commercial apparel (e.g., uniforms)
    - Commercial food (e.g., frozen soup)
    - Construction (e.g., single-ply roofing)
    - Industrial (e.g., stage lights)

E-commerce for B2C Products

For the purposes of this model, e-commerce refers to the buying and selling of goods and services over the internet which are then shipped from a distribution center to the buyer. Each representative product was assessed to determine if that good would likely be sold through B2C e-commerce. For example, Accenture assumed industrial stage lights were not purchased by individual consumers through B2C e-commerce, while deodorant would have some fraction sold via B2C e-commerce. If a product was assumed to be sold through e-commerce, the proportion of B2C products sold through e-commerce was estimated using data from Mobiloud[7]. This assessment allowed Accenture to estimate additional packaging, used to protect the product through multiple stages of shipping and handling, that was previously unaccounted for. A full listing of which representative products were assumed to be sold through e-commerce, and the proportion of B2C sales going through e-commerce, can be found in the Spreadsheet, SRB Model (Worksheet, "*B2C E-commerce*").

The following lists the percentage of sales for each product category that can be attributed to B2C e-commerce sales:

- Computer and consumer electronics (e.g., wireless router): 21.2%
- Apparel and accessories (e.g., leggings): 19.7%
- Furniture and home furnishings (e.g., curtains): 12.5%
- Health and personal care (e.g., shaving cream): 10.7%
- Auto and parts (e.g., motor oil): 8.3%
- Food and beverage (e.g., rice, canola oil): 7.6%
- Toys and hobby (e.g., soccer ball): 7.2%
- Books/music/video (e.g., CDs): 5.2%
- Office equipment and supplies (e.g., virgin paper): 1.90%
- Other [average] (e.g., pet food): 10.48%

B2C E-commerce Packaging Assumptions

Accenture made the following assumptions about how B2C products were shipped through e-commerce to determine their associated tertiary packaging.

- Products ship as one unit per box or mailer
- Products were shipped in either a standard cardboard box or a plastic mailer:
    - All food and beverages were transported in a standard cardboard box
    - A standard box was chosen if:
        - The surface area of the product was greater than the surface area of the mailer
        - The product height was greater than 3 inches (i.e., maximum height for mailer)
- Attributes of standard cardboard box:
    - Standard e-commerce boxes were 20 x 12 x 15 in^3
    - All boxes had two pieces of plastic tape that seal the top and bottom center seams, with 2.5 inches of tape overlapping the edges of the box on each side, for a total of 25 inches per piece of tape
    - All boxes had 7 plastic air pillows for cushioning
- Attributes of a mailer:
    - Average length, width, and weight of four common mailer sizes were used to ensure multiple mailer sizes are represented
    - The mailer was plastic with the designated dimensions of 9.6 x 14.1 x 3 in^3
    - All mailers could fit products up to a maximum height of 3 inches

Developing Packaging Profiles

A digital “packaging library” was created to collect information on different types of packaging, including weights, dimensions, and other relevant information. This information was used to estimate average weights (lbs. or lbs./in^2) for primary packaging and estimate standard dimensions for packaging that was used in the model (see in Spreadsheet, SRB Model, Worksheet “*Packaging Library*”).

Packaging Library

Packaging Library Data Sources

CalRecycle

CalRecycle provided data on plastic component weight and dimensions from a collection of various types of packaging and food service ware donated by staff. CalRecycle staff collected data in October and November 2024.

If packaging was comprised of multiple components that were easily separated, each component was weighed and recorded separately.

All weights were measured in grams and converted to pounds as needed, and all dimensions were measured in centimeters. Larger components were generally weighed with standard kitchen scales and smaller components were weighed using scales with higher precision.

Accenture

Accenture collected data in October 2024 on plastic component weight and dimensions from packaging collected by the members of the Accenture team.

If a component's weight was too small to be registered by a scale, multiple components of the same type were weighed together. The total weight was then divided by the total number of components weighed to get the average weight per component.

The weights were all measured in grams and converted to pounds as needed. All items were weighed with kitchen scales.

Packaging Supplier

A packaging supplier provided Accenture historical data on secondary and tertiary packaging ready for immediate integration (e.g., weight of tape) or as a data range (e.g., a range for the dimensions and weight of secondary packages). The packaging supplier also provided guidance on determining a standard size to be used in the model (i.e., all secondary packaging across representative products, wherever applicable, have the same dimensions) and on how representative products are placed within master cases, trays, or directly on the pallet.

Other Online Sources

Supplementary data from life-cycle assessments (LCAs), product catalogs and retailer websites, and other academic sources were also used.

LCAs are studies designed to observe the total impact of a product on the environment. This includes the materials used to create it, how the product is disposed of, and any health or environmental impacts it may have throughout its life. These sources follow a standard procedure and often include both the weight and type of material the product is made of. Weights given in grams were converted to pounds as needed.

Product catalogs from plastic manufacturers included details on a range of plastic packaging including weights and dimensions. Weights were given in a range of units of measurements and were converted to pounds as needed.

Wrap-Around Packaging included in Packaging Library

- Rigid containers
- Flexible Film
- Foam
- Metallized

Auxiliary Components included in Packaging Library

- Air pillow
- Anti-static packaging
- B2C tape
- Bottom twist mechanism
- Bread clip
- Bubble wrap
- Bulk bag
- Cap
- Cap & ring
- Foam film
- Handle
- Label
- Mailer
- Metalized wrapper

- One-way degassing valve
- Plastic coated tamper seal
- Plastic fastener
- Plastic film
- Plastic flat pouch
- Plastic foam
- Plastic lid
- Plastic ribbon
- Plastic spool
- Plastic spray nozzle with tube
- Plastic window
- Plastic wrapper
- Polyester strapping
- Power plug dust cap
- PP board
- Ring
- Rubber bands
- Screen film
- Shrink-wrap
- Tape
- Twist tie
- Zip tie

Secondary and Tertiary Packaging included in the Packaging Library

- Master box
- Master tray
- Pallet
- Stretch film
- Pallet straps
- Tape
- E-commerce mailer

Primary Packaging Assumptions

For both B2C and B2B formats, product specifications (length, depth, height, weight, and shape) for the best-selling product were captured from retailer websites or catalogs for manufacturers of plastic packaging. Each product was assigned a shape (rectangular prism, pouch, or cylinder) for its wrap-around packaging to calculate the product's volume and surface area. The shape determined whether additional wrap-around packaging needed to be accounted for due to folds, creases, and bends, and how many products fit within secondary and tertiary packaging. Accenture assumed that prism and pouch shapes required additional adjustment while other shapes did not. The adjustment allowed for an estimated surface area of wrap-around packaging associated with each product. The formulas used are outlined below (Table A11).

For B2B format products that were packaged in multi-unit offerings, the surface area calculation was adjusted to capture the surface area of the individual packaged units to generate the primary packaging volume.

If the primary plastic packaging type was not rigid container, flexible film, foam, or metallized (i.e., wrap-around packaging) then a surface area calculation was not used. Instead, the primary packaging associated with this product was estimated by capturing the auxiliary components that made up the primary packaging.

If a representative product's specifications were unavailable, a similar product's specifications were used. For example, an athletic uniform top was selected as one of the representative products for the Other Cut and Sew Apparel Manufacturing sub-industry (NAICS code 315280). If the specifications for the best-selling athletic uniform top were unavailable (i.e. a basketball jersey at the time of data capture), specifications from an alternative basketball jersey were used.

Table A11. Product Volume and Surface Area Calculations for Wrap-Around Packaging

Shape	Volume	Surface Area B2C	Surface Area B2B
Rectangular Prism	L×D×H	2×[(L×D)+(D×H)+(H×L)]	2×{(H×L)+[H×(D÷#)]+[L×(D÷#)}
Pouch	(L×D×H) ÷2	[(L×D)+(L×H)] ×2	[L×(D÷#)]+[(L×H) ×2]
Cylinder	Pi× [(D÷2) ×(D÷2)] ×H	2×Pi×(D÷2) ×[(D÷2)+H]	2×Pi×(D÷2) ×[(D÷2)+(H÷#)]

Key: L = Length; D = Depth; H = Height; Pi = 3.14; # = Number of units of wrap-around packaging included in B2B multi-unit offerings

Weight of Wrap-Around Packaging

The surface area of the representative product in primary packaging was used to estimate the associated packaging weight of the wrap-around packaging.

The following bullet points outline the steps for determining the weight of wrap-around plastic packaging used per representative product:

- *Surface Area of Product:* The surface area (in.^{2}) was estimated as described in the previous section.
- *Weight per Unit Surface Area:* The average weight per unit surface area was estimated for the various types of wrap-around plastic packaging (i.e., rigid containers, flexible films, foams, and metallized packaging). This was calculated by averaging the plastic packaging weights of multiple sample products representative of each packaging type. This information can be found in the Spreadsheet, SRB Model (Worksheet “Packaging Library”).
- *Weight per Unit Surface Area multiplied by Surface Area of Product*: The calculated average weight per unit surface area for the relevant packaging type was multiplied by the surface area of the representative product to estimate its initial weight.
- *Wrap-Around Packaging Surface Area Adjustment:* For pouches and prisms, a standardized surface area adjustment of 25% was applied to the initial weight to derive the final weight of the wrap-around packaging for the representative product. The model uses a relatively conservative rate of 25% based on identified packaging guidelines[8] [9]. The analysis is outlined below in Table A12.

Table A12. Wrap-Around Packaging Surface Area Adjustment Analysis for Block Cheese (Representative Product for NAICS code 311513)

	Length (in.)	Depth (in.)	Height (in.)	Surface area (in^2)
[Without Additional Length] Block Cheese	2.25	5.50	1.00	40.25
[Adjustment] End Seal-Top	0.20			
[Adjustment] End Seal-Bottom	0.20			
[Adjustment] Film Overlap	0.39			
Revised Parameters	**3.04**	**5.50**	**1.00**	**50.49**
Surface Area Increase				**25%**

Secondary and Tertiary Packaging Assumptions

This section captures the assumptions associated with secondary and tertiary packaging in the model. Data sourced from a packaging supplier and the surface area estimation for wrap-around packaging were used to drive the secondary and tertiary packaging estimations.

The standard packaging types shown in Table A13 were assumed to be representative of all secondary and tertiary packaging.

Table A13. Standard Secondary and Tertiary Packaging Types & Characteristics

Standard Packaging Type	Item
Master Case	20 x 12 x 15 in^3
Master Tray	20 x 12 x variable in^3
Pallet	40 x 48 x 60 in^3
Stretch film	Variable based on pallet weight
Poly Strapping*	1⁄2 in x .024 in x 7,200 ft, Black
Tape for Master Case, E-Commerce, and B2B Packaging**	72mm x 100 meters x 1.2 mil thickness
Tape for B2C Packaging	0.5 x 2.8 x 0.05 in^3
E-commerce mailer	9.6 x 14.1 x 3 in^3

*Uline Poly Strapping; **3M™ Scotch® Industrial Box Sealing Tape 371

Secondary Packaging

To calculate secondary packaging for B2C products, representative products were assessed to determine if they would likely be packaged in a regular slotted container (RSC) corrugated case (i.e., master case), a corrugated tray with shrink-wrap (i.e., master tray), or placed directly on a pallet without secondary packaging. For each

representative product, Accenture calculated the number of products that would fit per master case or master tray, given weight and volume constraints of each.

The product was assumed to be shipped directly on the tertiary pallet, without secondary packaging if either of the following were true:

- One of the measurements of the product (length, depth, or height) was larger than 20 inches (the maximum length of the master case), or
- The volume of the representative product was larger than the volume of the master case.

As confirmed by a packaging supplier, Accenture assumed that heavier food and beverage products were typically packed in a master tray (cardboard rectangular base) with shrink-wrap wrapping and no more than one layer of products included in each master tray. Other representative products were assumed to use a master case contingent on the weight and fit of the product.

Master Case

For the purposes of the model, a “master case” was used as a standardized representation of secondary packaging for representative products that use a box. The master case was assigned a weight of plastic and number of plastic components for the tape used for sealing the case given that the box was assumed to be made of cardboard (and thus not counted towards the estimation of the baseline).

A packaging supplier provided data for an average master case’s dimensions- 18-20 inches long, 12-15 inches wide, and 10-15 inches deep and weighing approximately 40 pounds. Since this master case was also used to calculate tertiary packaging estimates, the master case was optimally designed to fit on the standard pallet. The standard pallet is 40 inches by 48 inches by 60 inches. Given this, a master case was defined as 20 inches by 12 inches by 15 inches to allow for layers of 8 cases to be stacked 4 cases high and a maximum total of 32 cases per pallet.

Accenture assumed the tape used to create and seal the master case was made of plastic. A packaging supplier stated that an industry standard was to extend tape across the length of the case and include 2.5 inches overlapping the edges of the box at the end of each side.

Accenture assumed that 50 inches of tape were associated with each master case given that the master case length was 20 inches and the top and bottom of the case used 25 inches of tape (20 in + 2.5 in + 2.5 in = 25 in) each.

Based off the dimensions of the master case (20 inches x 12 inches x 15 inches), the calculated standard volume was 3,600 cubic inches [volume = length (L) × width (W) × height (H)].

Master Tray

Accenture assumed that heavier products, such as food and beverage products, were packaged in master trays with shrink-wrap. The master tray was assigned a weight of plastic packaging and number of plastic components for the shrink-wrap used for

sealing the tray given that the tray was assumed to be made of cardboard (and thus not counted towards the estimation of the baseline).

Using the guidance provided by a packaging supplier, the following products were assigned to the master tray secondary packaging profile:

- Bed linens
- Beer
- Bleach
- Brown sugar
- Canned peaches
- Canned tuna
- Carbonated soft drink bottle
- Chewing tobacco
- Cold-pressed olive oil
- Corn flakes
- Deodorant
- Evaporated Milk
- Finishing agents, textile and leather
- Flavored syrups (e.g., vanilla)
- Fluid Milk
- Generic detergents
- Generic table salt
- Granulated white sugar
- Hard candy
- High-quality maple syrup
- Instant coffee
- Luxury curtains
- Malt flour
- Cane sugar
- Sun-dried tomatoes
- Wheat flour
- Peanut butter
- Pickled cucumbers
- Popsicles
- Poultry feed
- Refined soybean oil
- Rice
- Salad dressing
- Sausage casings
- Shaving cream
- Soda syrup
- Synthetic motor oil
- Virgin paper

Accenture assumed that all items packed on the master tray were packaged in a single layer as shown in Figure A1. It was also assumed that machines wrapped the master trays and due to their efficiency, a single plastic packaging component was counted for each master tray, and a standard sized piece of shrink-wrap was used per master tray.

The volume of a master tray was calculated by multiplying the standard length (20 inches) and width (12 inches) of the master tray by the height of the representative product. While in reality the amount of shrink-wrap associated with a master tray varied, the model assumed a consistent usage of shrink-wrap across all products. Based on guidance from Uline[10] a height of 9.5 inches was used for the master tray to calculate the volume of shrink-wrap used per master tray.

Based on this guidance, Accenture determined the width of shrink-wrap needed for rectangular items, such as the master tray, could be calculated by “summing the width and height, adding 2 inches for shrinkage, and rounding up to the next whole number.

A single heavy duty shrink-wrap made of polyethylene,[11] which has a width of 24 inches, was assumed for the standard tray (see calculations below).

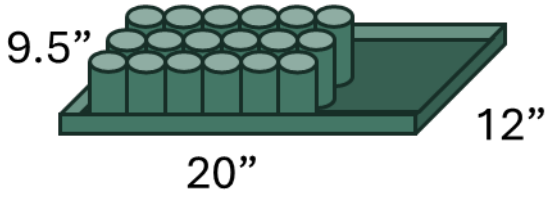
The Master Tray is 20 inches (L) × 12 inches (W) × 9.5 inches (H)

Add the width and height: 12 inches (W) + 9.5 inches (H) = 21.5 inches

Add 2 inches for shrinkage: 21.5 inches + 2 inches = 23.5 inches

Round up to the next whole number: 23.5 inches rounded up to 24 inches

Figure A1. Master Tray Height Adjusted



The total volume of shrink-wrap needed per master tray was calculated as the surface area of a master tray where the width was the width of the shrink-wrap, (see calculations below).

Master Tray Adjusted Surface Area

Base and Top = 2 (L × W) = 2 (20 in × 24 in) = 960 in^2

Two Sides = 2 (H × W) = 2 (9.5 in × 24 in) = 456 in^2

Total Adjusted Surface Area = 1,416 in^2

The referenced shrink-wrap had a weight per surface area of 0.097 grams of plastic per square inch of shrink-wrap bundling film. The master tray used 1,416 square inches of film, which weighed 138 grams (or 0.306 pounds) per item of shrink-wrap associated with a master tray.

A master tray had a standard length and width of 20 inches by 12 inches, respectively, and a variable height based on the product height. Accordingly, the available volume of a master tray calculated in the model varied by representative product.

Products per Master Case or Tray

The number of products packaged within each master case or master tray was calculated using the maximum weight capacity and volume of the master case or master tray (L × W × H) and the volume and weight of the product being contained.

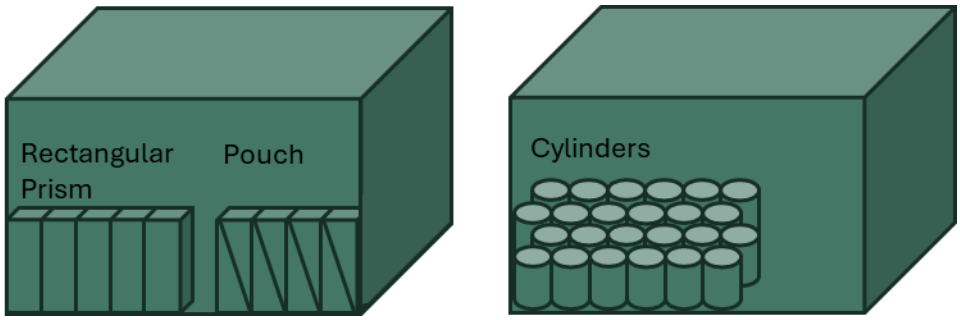
In addition to weight and density, product shape was assumed to affect the packing efficiency (e.g., cylindrical products compared to products that come in boxes).

Figure A2 below depicts the assumptions made by Accenture based on the shape of a product in primary packaging:

- Rectangular prism – Surface area was used to determine the volume of products that can fit neatly in a master case.
- Pouches – The volume of pouches that fit in a master case was maximized by alternating the orientation of the pouches.
- Cylinder – Cylindrical products had gaps even when maximizing the volume of products due to their shape. A 21% loss was applied when there was an anticipated volume loss due to cylindrical packaging inside of a master case (see

calculation below). Accenture assumed that cylinders were stacked and arranged such that the cylinders were touching all faces of the case as much as possible.

Figure A2. Volume Loss Per Master Case or Tray Assumptions



Calculations for Loss Associated with a Cylinder

Volume of a Cylinder

Radius (r): 2.50 in

Pi (π): 3.14

Area (πr^2): 19.6 in^2

Height (h): 5 in

Volume of Oval Cylinder ($\pi r^2 h$): 98.2 in^3

Volume of a Cube

Length (L): 5 in

Width (W): 5 in

Height (H): 5 in

Volume of Box (L×W×H): 125 in^3

Overall Loss: 125-98.2 = 26.8 in^3 or 21%

The number of units that fit into a master case or master tray was limited by both weight and volume. The volume limitations were outlined above, and Accenture assumed the weight limit of a master case or master tray was 40 pounds based on information provided by a packaging provider.

Within the model, the maximum number of products that fit in a master case or master tray by volume, and by weight, was calculated and rounded down. The number of products per master case or master tray was found by taking the minimum of these two values. The weight of a master case or master tray was calculated for use in the tertiary packaging calculations by multiplying the weight of the product by the number of products per master case or master tray.

Special Considerations for B2B Format Packaging

Some B2B versions of representative products were assessed as "very heavy" and thus Accenture assumed they were shipped directly on a pallet, without secondary packaging. The following products were assumed to be "very heavy:"

- Aluminum bar
- Conveyor belting
- Cylinders, fluid power
- Fencing
- Floor truss
- Gypsum wallboard
- Hydraulic valves
- Industrial PVC pipes
- Semiconductor machinery
- Tractors
- Wine

All B2B versions of representative products (not including the "very heavy" products listed above) were evaluated based on their size and volume to determine if the product would fit in a master case or master tray. To avoid having only one or two products being packaged per master case or tray for B2B, an interim calculation was done to ensure that at least four products could fit within a master case. In instances where fewer than four products could fit, they were assumed to be shipped directly on a pallet.

Tertiary Packaging

The plastic components associated with tertiary packaging were stretch wrap and straps on pallets. Master cases were designed to maximize their efficiency on a standard pallet.

Accenture assumed that a pallet had the dimensions of 40 inches (length) by 48 inches (width) by 60 inches (height). Pallet weights were limited to 4,600 pounds per pallet.

Number of Representative Products per Pallet

To determine the number of representative products per pallet, Accenture estimated the number of master cases, master trays, or products placed directly on the pallet. The results from the secondary packaging assessment were used to estimate the amount of tertiary packaging.

For representative products placed in a master case or master tray, two calculations were performed and the minimum of these two calculations was used as the maximum number of master cases or master trays that could fit on the pallet without exceeding space or weight constraints:

1. The number of products, by master case or master tray, that could fit given the weight capacity of the pallet (4,600 lbs.)
2. The number of products, by master case or master tray, that could fit given the volume capacity of a pallet (115,200 cubic inches). Given the standard size of the

master case, Accenture assumed that that a maximum of 32 master cases could be transported on each pallet. Given that the master trays can be variable in height, a different number was assessed based on the height of the representative product.

For products that were placed directly on the pallet, the total volume of the pallet (115,200 in^3) was divided by the volume of the product to determine the number of products that could fit on each pallet.

Plastic Wrap & Strapping per Pallet

Accenture assumed a piece of stretch film and 4 plastic packaging straps were used for each pallet, and the weight of plastic and number of components was estimated for each.

A packaging supplier provided guidance on the volume of stretch film that was used for different weight ranges of pallets (see Table A14 below). The packaging supplier provided this data both with and without optimization. Accenture used the optimized film estimates assuming that pallets were wrapped optimally using machinery. The weight calculations using the steps above determined the amount of stretch film applied per pallet in the model.

Table A14. Pallet Weight Range (Packaging Manufacturer)

Pallet Weight Label	Pallet Weight Range (lbs.)	Approximate weight of stretch film, without optimization (oz)	Approximate weight of stretch film, if optimized (oz)
Very Light	150-600	6	4.3
Light	600-1200	7	5
Medium	1200-2000	8	5.6
Heavy	2000-3000	9	6.5
Very Heavy	3000+	10	7

Special Considerations for B2B Format Packaging

B2B products that are single unit transport (assumed to be on their own pallet or transported individually), were given the “very heavy” designation for stretch wrap, and four plastic pallet straps are applied. This was likely an underestimate of the volume of protective stretch wrap that is used to transport these large expensive products. Alternatively, there may be more reusable packaging used with these products.

Single-Use Plastic Food Service Ware Model

Representative Meals Descriptions

The following table (Table A15) provides an overview of each type of representative meal, a description, and types of avenues associated with each representative meal.

Table A15. Representative Meals by Avenue

Representative Meals	Description of Representative Meal	Associated Avenues
Meal – Food & Drink (Meal – F&D)	Includes at least one large primary food serving, drink (plus lid and potential straw), plastic cutlery, and additional side food dishes and/or supplementary containers for condiments or other toppings. Components may include: • Cutlery • Clamshells • Containers + Lids • Sandwich box/stable packaging • Wraps or Wrappers • Condiment Cups + Lids • Cups (Hot) + Lids • Straws • Bags	Full-Service Restaurants; Food Trucks; Ghost Kitchens;
Meal – Cafeterias	Includes a large primary food serving, drink, supplementary food containers, and cutlery. Components may include: • Cutlery • Clamshells • Condiment Cups + Lids • Cups + Lids • Straws • Plates • Bowls	Workplaces; Schools/Colleges; Hospitals; Prisons; Retirement Centers

Representative Meals	Description of Representative Meal	Associated Avenues
Meal – Event	Includes a large primary food serving or supplementary food item, plastic cutlery, and a drink. Components may include: • Cutlery • Clamshells • Containers + Lids • Sandwich box/stable packaging • Wraps or Wrappers • Condiment Cups + Lids • Cups (Hot) + Lids • Straws • Plates • Bowls	Sports Events, Catering Services
Meal – Quick-service Restaurant (Meal – QSR)	Includes a large primary food serving, drink (plus lid and potential straw), plastic cutlery, and additional side food dishes and/or supplementary containers for condiments or other toppings. Components may include: • Cutlery • Clamshells • Containers + Lids • Sandwich box/stable packaging • Wraps or Wrappers • Condiment Cups + Lids • Cups (Hot) + Lids • Straws • Bags	Quick-Service Restaurants
Drink + Supplementary Food Order	Includes a drink (plus lid, potential straw, and stirrer) and supplementary food item. Components may include: • Sandwich box/stable packaging • Wraps or Wrappers • Cups (Hot) + Lids • Straws • Stirrer	Cafes; Bakeries; Ice-cream trucks; Hotels; Motels; Museums; Zoos and Botanical Gardens; Theme Parks; Farmer's Markets; Holiday Events
Drink Only	Includes a drink (plus potential straw). Components may include: • Cups (Hot) • Straws	Bars/Pubs; Concerts

Representative Meals	Description of Representative Meal	Associated Avenues
Other – Grocery	Includes a large primary food serving, drink (plus lid and potential straw), plastic cutlery, and additional side food dishes and/or supplementary containers for condiments or other toppings. Components may include: • Cutlery • Clamshells • Containers + Lids • Food trays • Sandwich box/stable packaging • Wraps or Wrappers • Condiment Cups + Lids • Cups (Hot) + Lids	Grocery Store
Other – Travel	Includes a drink (plus lid and potential straw) and supplementary food item. This meal captures both airline and railway travel. Components may include: • Sandwich box/stable packaging • Wraps or Wrappers • Cups (Hot) + Lids • Straws • Stirrer	Transportation
Personal Consumption	Includes a large primary food serving, plastic cutlery, and a drink. Components may include: • Cutlery • Cups (Hot) • Straws • Plates • Bowls	Personal Consumption

Assumptions by Food Service Ware Avenue

To estimate the number of meals per year per type of avenue, Accenture made some assumptions. Further details on assumptions and calculations can be found in the Spreadsheet, SRB Model (Worksheet "*Combined Overview - SUP FSW*").

Avenue Category: Food & Drinks

1. **Full-Service Restaurants**: A source providing the number of meals served per day at full-service restaurants was not found. The total number of meals served at *quick-service* restaurants was used as the basis for estimating the number of meals served at *full-service* restaurants (see Spreadsheet, SRB Model, Worksheet "*Combined Overview-SUP FSW*"). Based on the total average time for an individual to be served and consume a meal at full-service compared to a quick-service restaurant, Accenture assumed that approximately one person was served at a full-service restaurant in the time a quick service restaurant served four people. Therefore, the model assumed that full-service restaurants serve 1/4 the people as a quick service restaurant daily.
2. **Ghost Kitchens**: A source providing the number of meals produced by ghost kitchens per day was not found. Data showed that a full-service restaurant can provide approximately 20 delivery orders per hour while a ghost kitchen can provide 60 meals per hour[12]. The total number of people served by a ghost kitchen was calculated by multiplying the total number of people served at full-service restaurants by three.
3. **Museums**: A source providing the number of attendees at museums per year was not found. Survey data on the average annual attendance by museum operating cost was used to classify museums into five categories: under $5 million in operating budget, between $5 and $10 million, between $10 and $20 million, between $20 and $45 million, and greater than $45 million. Each category was assigned an overall percent share of total museums surveyed. For example, 8% of museums surveyed had an operating budget of greater than $45 million; and the average attendance for a museum with an operating budget of greater than $45 million was 1.2 million attendees. The percent share of the total number of museums for a given category was multiplied by the average attendance for that category. For example, when creating an average attendance for all museums, 8% of the average attendance was to museums with 1.2 million attendees. This provided the total annual average attendance to museums across multiple different sizes: 245,400 people per museum per year.
4. **Zoos and Botanical Gardens**: A source providing the number of attendees at zoos per day was not found. Accenture assumed that zoos and botanical gardens were open 5 days a week (52 weeks multiplied by 5 days is equal to 260 days). The annual attendance of zoos and aquariums across the U.S. (183 million people) was divided by 260 days to get the daily attendance of all locations (703,846 attendees per day). This value was then divided by 213 (the total number of U.S. accredited zoos and aquariums) to calculate the daily

attendance for a single location (3,304). This assumed that the average attendance for the entirety of the U.S. can be applied to California.

5. **Grocery Stores**: A source providing the number of people visiting the grocery store per day was not found. The number of households in California served as the basis for this estimate. Accenture assumed that one person per household visited a grocery store one time per week.

Avenue Category: Cafeterias

1. **Hospitals**: A source providing the total number of patients in a hospital per day was not found. The number of occupied beds was multiplied by the percentage of visitors a patient receives to capture the number of guests in a hospital on a single day.

Avenue Category: Events

1. **Sports events**: A source providing the total number of collegiate sports stadiums in California was not found. Stadiums for professional and collegiate sports in California were included. It was assumed that each public college in California had a single stadium that generated food service ware items, given the significant number of students that attend those universities. Accenture assumed half of private colleges had a single stadium each that generated food service ware, given the more variable number of students that attend those universities. Each value was added together to capture the expected total number of stadiums in California.
2. **Holiday Events** (e.g., parades): A source providing information on attendance at holiday events was not found. Parades were used to represent all holiday events using data on national trends on attendance at holiday markets (~91% of all households attend holiday events) and California population data (35,458,326 people). Of the total population of people attending holiday events, ~32% were estimated to attend holiday parades. This 32% was applied to the total portion of the population to estimate the number of people attending parades (11,346,664 people). This assumed that the attendance trends for holiday events for the U.S. can be applied directly to California. It was assumed that people who attended a holiday parade only attended one in a given year.

Avenue Category: Transportation

The transportation avenue category covered the food service ware used on planes and trains that are traveling through or remaining in California. Cruise ships were not included in the model due to the high volume of reusable food service ware utilized on-board cruise ships. Buses were also not included in the model due to their lack of food service. Few, if any, buses provide food at a large enough scale to be included in the model.

Trains: The number of unique train routes in California was used as the number of avenues, which was estimated by taking the Amtrak schedule for all trains departing for California to determine their frequency of departures[13]:

- California Zephyr: 1/day
- Pacific Surfliner: 10/day
- Sunset limited: 0.3/day (leaves once every three days)
- Capitol Corridor: 5/day
- San Joaquins: 5/day
- Texas Eagle: 1/day
- Coast Starlight: 1/day
- Southwest Chief: 1/day

The number of unique people per avenue per day for trains was estimated by taking the average annual ridership of each of the three intra-state rail lines[14], dividing it by the number of trains per rail line as determined above and then dividing by 365 days per year:

- Capitol Corridor: (731,239 people per rail line per year)/(5 trains per rail line)/(365 days per year) = ~401 passengers per train per day
- Pacific Surfliner: (1,632,978 people per rail line per year)/(10 trains per rail line)/(365 days per year) = ~447 passengers per train per day
- San Joaquin: (767,368 people per rail line per year)/(5 trains per rail line)/(365 days per year) = ~420 passengers per train per day

An average of the above was taken for an average daily ridership of a single train assumed to be 423 passengers per train per day.

Planes: The number of unique airplanes traveling through or staying in California is not required for this model. The number of airline passengers was used as the basis for estimating the number of Representative Meals. The data utilized captured the total commercial air traffic passenger count for California in 2022. Accenture assumed half of commercial air traffic was leaving California so only half the potential travelers who may generate food service ware were included in the model. This value was divided by 365 to get the daily air traffic for all air traffic.

Single-use Plastic Food Service Ware Packaging

Developing Packaging Profiles

Primary Packaging Assumptions for B2B Format Packaging

All food service ware items that use a B2B packaging profile used one of the following packaging profiles:

- Bulk cutlery; 1,000 items per package
- Bulk bowl; 1,000 items per package
- Bulk cup; 900 items per package
- Bulk lids; 1,000 items per package
- Bulk bag; 500 items per package

Accenture assumed that the dimensions of different food service ware items were similar to one another (e.g., clamshells, plastic bowls, and plastic containers having similar shapes) and therefore shared similar packaging profiles. It was also assumed that there was no interior packaging for products (e.g., no film to separate stacks of cups from one another).

Primary Packaging Assumptions for B2C Format Packaging

All food service ware items that use a B2C packaging profile will use one of the following packaging profiles:

1. Consumer cutlery; 24 items per package
2. Consumer cups; 100 items per package
3. Consumer straws; 100 items per package
4. Consumer plates; 16 items per package
5. Consumer bowls; 45 items per package

Accenture assumed that the packaging profile for products are similar to one another. The weight of packaging was applied across product profiles as long as the dimensions were the same (e.g., the plastic packaging for cups is assumed to be similar to bowls).

Abbreviations and Acronyms

Abbreviation	Description
B2B	Business-to-Business
B2C	Business-to-Consumer
F&D	Food and Drink
Food service ware	Single-use plastic food service ware, unless otherwise stated
FSW	Food service ware
Ft	Feet
GDP	Gross Domestic Product
HS code	Harmonized System codes
In	Inches
In^2	Squared inches
In^3	Cubic inches
Lbs.	Pounds
LCA	Life-Cycle Assessment
mil	Thousandths of an inch (material thickness)
mm	Millimeters
NAICS	North American Industry Classification System
Oz	Ounces
Packaging	Single-use plastic packaging, unless otherwise stated
PP	Polypropylene
PVC	Polyvinyl chloride
QSR	Quick-service restaurant
RSC	Regular slotted container (box)
SA	Surface area
SB 54	Senate Bill 54
SCTG	Standard Classification of Transported Goods
SRB	Source Reduction Baseline
USDA	United States Department of Agriculture
U.S.	United States
Weight	Weight of plastic only, unless otherwise stated

References

The complete list of sources is included in the Spreadsheet, Data Audit and Gap Analysis. Sources specifically referenced in this document are included below.

[1] NAICS North American Industry Classification System for Code 3118. https://www.naics.com/code-search/?trms=3118&v=2022&styp=naics&qid=2e036c5650

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