

Source Reduction Baseline Technical Report

**A Plastic Pollution Prevention and
Packaging Producer Responsibility Act
Needs Assessment Report**

Produced Under Contract By:

accenture

State of California

Gavin Newsom
Governor

California Environmental Protection Agency

Yana Garcia
Secretary

DEPARTMENT OF RESOURCES RECYCLING AND RECOVERY

Zoe Heller
Director

Public Affairs Office

1001 I Street (MS 22-B)

P.O. Box 4025

Sacramento, CA 95812-4025

www.calrecycle.ca.gov/Publications/

1-800-RECYCLE (California only) or (916) 341-6300

Publication # DRRR-2024-1747

Copyright © [2024] by the California Department of Resources Recycling and Recovery (CalRecycle). All rights reserved. This publication, or parts thereof, may not be reproduced in any form without permission.

Prepared as part of contract number DRR24011

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

Disclaimer: This report was produced under contract by Accenture. By providing this report, Accenture does not waive any legal rights or otherwise accept liability for any actions undertaken in reliance on the recommendations or information contained in this report, including the actions of third parties. The statements and conclusions contained in this report are those of the contractor and not necessarily those of the Department of Resources Recycling and Recovery (CalRecycle), its employees, or the State of California and should not be cited or quoted as official Department policy or direction.

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

Table of Contents

Table of Contents	i
Listing of Tables	ii
Introduction	1
Baseline Estimate	1
Overall Approach	2
Background	3
Definitions and Terminology	3
Single-Use Plastic Packaging Model	6
Overall Model Approach	6
Single-Use Plastic Packaging Model Methodological Details	7
Results	27
Single-Use Plastic Food Service Ware	29
Overall Model Approach	29
Single-Use Plastic Food Service Ware Model Methodological Details	30
Results	41
Single-Use Packaging for Single-Use Plastic Food Service Ware	42
Overall Approach	42
Packaging for Single-Use Plastic Food Service Ware Methodological Details	43
Results	45
Abbreviations and Acronyms	47
Confidential Data	49
References	50

Listing of Tables

Table 1. Source Reduction Baseline Estimate	2
Table 2. Average Price and Characteristics of Sliced White Bread	15
Table 3. Estimated Weight of Single-Use Plastic Packaging (Million tons)	27
Table 4. Number of Plastic Components Associated with Single-Use Plastic Packaging (Billion Components)	28
Table 5. Total Amount of Packaging: B2C vs. B2B	28
Table 6. Types of Avenues by Category	32
Table 7. Representative Meals and Associated Avenues	36
Table 8. Representative Meals and Single-Use Food Service Ware Component Types	38
Table 9. Weight and Plastic Components of Food Service Ware	41
Table 10. Total Weight and Number of Plastic Components Used in Single- Use Plastic Food Service Ware by Avenue Type (tons).....	41
Table 11. Weight (Million tons) and Plastic Components (Billions) of Packaging for Food Service Ware	46

Introduction

CalRecycle must establish a source reduction baseline — a measurement of single-use plastic packaging and food service ware sold, offered for sale, and distributed in the state in 2023 — by January 1, 2025, under the Plastic Pollution Prevention and Packaging Producer Responsibility Act (SB 54, Allen, Chapter 75, Statutes of 2022, the Act). The Needs Assessment Report of Findings: Plastic Pollution Prevention and Packaging Producer Responsibility Act Source Reduction Baseline, produced under [contract](#), outlines the methodologies utilized by Accenture in estimating the source reduction baseline.

This technical report is not the final baseline adopted by CalRecycle. Formal establishment of the baseline is an action that must be taken separately by CalRecycle, based on its own expertise and statutory authority, and may be informed by this report and any other relevant information in the department's records.

The baseline is the estimated amount of plastic covered material that was sold, offered for sale, or distributed in the state in the 2023 calendar year (see more information in Public Resources Code (PRC) Section 42057(a)(1), (b)). Plastic covered material includes single-use plastic packaging (primary, secondary, tertiary) and single-use plastic food service ware, including both items made fully of plastic and items made partially of plastic (see Definitions and Terminology below and definitions under [PRC Section 42041](#)). The baseline is comprised of separate figures for the weight and the number of plastic components of plastic covered material. The estimate for weight only includes the plastic portion of plastic covered material.

To estimate the baseline, Accenture developed three models that rely primarily on publicly available data:

- (1) Single-Use Plastic Packaging Model
- (2) Single-Use Plastic Food Service Ware Model
- (3) Single-Use Plastic Food Service Ware Packaging Model.

Accenture combined outputs from these models to formulate the estimated baseline.

Baseline Estimate

Using these models, Accenture estimates **2.9 million tons of plastic and 171.4 billion plastic components** across both single-use plastic packaging and single-use plastic food service ware were sold, offered for sale, or distributed in California during the calendar year 2023.

Table 1. Source Reduction Baseline Estimate

Single-Use Plastic Model	Total plastic components (Billion)	Total weight of plastic (Million tons)
Packaging*	84	2.4
Food Service Ware	87.4	0.5
Total	171.4	2.9

*Packaging values include estimates from both the Single-Use Plastic Packaging Model and the Packaging for Single-Use Plastic Food Service Ware Model.

Overall Approach

The models rely primarily on publicly available data supplemented with additional information collected to fill in gaps. Accenture collected confidential data during the study, but no confidential data was ultimately used in generating the model. Please see the Confidential Data section for further discussion on this topic.

Each model is detailed in the following sections, with additional detail in the Appendix and spreadsheet files (available separately through a California Public Records Act request. See Definitions and Terminology section, “Spreadsheet, [Name]”).

Background

Definitions and Terminology

The following definitions and terminology are provided to aid readers in understanding the context and conclusions within this report. Some terms may differ from those in common usage. The definitions and terminology below apply only to usage in this report, and do not relate to statutory definitions or terms, unless specifically stated.

Auxiliary component: Used in this analysis and the models defined herein to describe primary packaging elements, such as zip ties and clips, that are not wrap-around packaging types (e.g., rigid containers and film). See [PRC Section 42041\(s\)\(1\)](#) for the statutory definition of “primary packaging.”

Avenues: Unique locations that serve prepared food ready for public consumption. Examples include restaurants, school cafeterias, and concert venues.

Business-to-consumer (B2C): Products and packaging that are designed to be purchased by individual consumers.

Business-to-business (B2B): Products and packaging that are designed to be purchased by larger customers (e.g., businesses) and often includes goods sold in larger format packaging or bulk sizes.

Food service ware or single-use food service ware: refers to single-use plastic food service ware, unless otherwise stated. See [PRC Section 42041\(e\)\(1\)\(B\)](#), [\(t\)](#), and [\(ai\)](#) for statutory definitions of “food service ware,” “plastic,” and “single-use.”

Harmonized System (HS) codes: codes used for classifying products entering or leaving California from international trade.

Industry impact prioritization terms (used in the single-use plastic packaging model):

High impact: Products and/or industries that are expected to generate a high volume of packaging due to a high volume of products sold at a low price, a high volume of packaging or packaging components per product, or both (e.g., toys, food, clothing).

Low impact: Products and/or industries that are expected to generate a low volume of packaging due to a low volume of products sold, often at a premium price, a low volume of packaging or packaging components per product, or both (e.g., appliances, furniture).

Non-primary: Products of industries whose primary packaging is considered out of scope for the Act [i.e., exclusions from [PRC Section 42041\(e\)\(2\)](#) such as beverage containers subject to the California Beverage Container Recycling and Litter Reduction Act].

Manufacturing sales: The monetary output (USD) of an industry from products sold by California manufacturers.

Master case: A standard cardboard box used to contain multiple products from a manufacturer.

Master tray: A standard cardboard tray with shrink wrap around products used to contain multiple products from a manufacturer.

North American Industry Classification System (NAICS): A hierarchical system which classifies business establishments by type of economic activity. NAICS uses a series of increasing length codes (i.e., moving from 4 to 5 to 6 digits), which offer increasing granularity on the type of business activity as the number of digits increase.

Manufacturing Industry Group: A group of manufacturing industries identified by a 4-digit NAICS code.

Manufacturing Industry: An industry identified by a 5-digit NAICS code.

Sub-Industry: An industry identified by a 6-digit NAICS code.

Packaging or single-use packaging: refers to single-use plastic packaging, unless otherwise stated. See PRC Section [42041\(s\)](#), [\(t\)](#), and [\(ai\)](#) for statutory definitions of “packaging,” “plastic,” and “single use.”

Personal consumption: The purchase and use of food service ware by individual consumers.

Price point: The average price charged for a representative product across multiple retailers.

Primary packaging: Statute defines primary packaging (or sales packaging) as the packaging “intended to provide the user or consumer the individual serving or unit of the product and most closely containing the product, food, or beverage” ([PRC section 42041\(s\)\(1\)](#)). For this study, primary packaging includes wrap-around packaging (i.e., the wrapper or other primary container of a product) and auxiliary components (i.e., additional plastic components that contribute to the total primary packaging).

Product: Refers to a good (e.g., a consumer item) and its associated packaging.

Representative meal: A grouping of food service ware items based on the expected amount of food and/or drinks a single consumer receives from a given avenue.

Representative product: Product selected under the assumption that it appropriately reflects the packaging profiles utilized by a manufacturing industry.

Secondary packaging: Grouped packaging, intended to bundle, sell in bulk, brand, or display the product [[PRC Section 42041\(s\)\(2\)](#)].

Standard Classification of Transported Goods (SCTG) codes: A coding system that is based on HS code product classification and is used to collect data on products transported.

Spreadsheet, [Name]: Refers to spreadsheets with additional information related to this report that can be requested via a California Public Records Act request. Worksheets within a specific spreadsheet may be listed within the report, as needed, and are formatted as: Worksheet, “Name”. Requests may be initiated through the [CalRecycle Public Records Portal](#).

- Spreadsheet, SRB Model
- Spreadsheet, Industry List and Packaging Impact Prioritization
- Spreadsheet, Data Audit and Gap Analysis
- Spreadsheet, Domestic Trade Data
- Spreadsheet, International Trade Data

Tertiary packaging: Transport packaging intended to protect the product during transport [[PRC Section 42041\(s\)\(3\)](#)]. For this study, tertiary packaging includes e-commerce packaging.

Units: A total number of representative products sold obtained by dividing the manufacturing sales by the price point of a product.

B2C units: The total number of units of representative products sold to consumers.

B2B units: The total number of units of representative products sold to businesses.

Weight: refers to the weight of plastic only, unless otherwise stated.

Wrap-around packaging: Used in this analysis and the models defined herein to describe primary packaging that directly contains a good (i.e., the wrapper or other primary container of a product). Examples include rigid containers and metallized wrappers (e.g., granola bar).

Single-Use Plastic Packaging Model

Overall Model Approach

Accenture used a manufacturer-first approach to construct the Single-Use Plastic Packaging Model. The quantity of products sold, offered for sale, and distributed into California in 2023, by manufacturing industry, was estimated to then determine the amount of packaging associated with those products.

High-Level Steps:

Step 1: Classifying Representative Manufacturing Industries

Using the North American Industry Classification System (NAICS) from the year 2021, which classifies business establishments by type of economic activity, Accenture identified manufacturing industry groups in California (e.g., Animal Food Manufacturing). Some manufacturing industries are more likely to produce goods associated with packaging (e.g., consumer food and beverages, clothing), while others (e.g., industrial solvents) are more likely to be associated with non-plastic or reusable packaging.

Additionally, some manufacturing industries are likely to have packaging excluded as covered material under the Act (e.g., primary packaging of beverage containers subject to the California Beverage Container Recycling and Litter Reduction Act). To account for this, Accenture classified each manufacturing industry group as high, low, or non-primary with respect to the type of impact their packaging would have on the source reduction baseline.

For every manufacturing industry group, Accenture estimated the total monetary output per industry group in California by adjusting the manufacturing sales in 2021 to estimate sales in 2023 and then adjusting for imports and exports.

Step 2: Establishing Representative Products

Each manufacturing industry has different sets of products and uses of packaging (e.g., Breakfast Cereal Manufacturing compared to Animal Food Manufacturing). To address this, Accenture identified representative products for each manufacturing industry, whose consumption, price, physical characteristics, and packaging profile were reflective of the output of that manufacturing industry.

Step 3: Estimating the Number of Representative Products Using Plastic Packaging per Manufacturing Industry

For each manufacturing industry, Accenture estimated the total number of representative products using packaging. To do this, Accenture estimated the monetary output (i.e., manufacturing sales adjusted for net trade) associated with each representative product using the market share of each representative product within a manufacturing industry. In order to estimate the number of representative products using packaging, the monetary output was divided by the

average price of that representative product and adjusted for the proportion of products estimated to use packaging. The average price of the representative product accounted for both business-to-consumer (B2C, e.g., items purchased at grocery stores) and business-to-business (B2B, e.g., items sold to restaurants) versions of the product.

Step 4: Developing a Plastic Packaging Profile for Each Representative Product

For each representative product, Accenture researched multiple versions of the product using data from online resources. Accenture created a plastic packaging profile to address B2C packaging and B2B packaging and included primary, secondary and tertiary (including e-commerce) packaging. The plastic packaging profiles included values for both the weight and number of plastic components for each representative product.

Step 5: Estimating Number of Plastic Components and Weight of Plastic Packaging

To estimate the total number of plastic components and weight of plastic associated with packaging for a representative product, the total number of units of a representative product sold by the manufacturing industry per year (from Step 3) was multiplied by the number of plastic components and weight associated with its primary, secondary, and tertiary packaging profiles (from Step 4).

The total number of plastic components and weight of plastic used in packaging for each representative product was summed across all representative products across all manufacturing industries.

Single-Use Plastic Packaging Model Methodological Details

The following sections provide details on each of the high-level steps outlined in the previous Overall Model Approach section, including information on data sources, assumptions, and limitations. Further details on the methodology and assumptions can be found in the Appendix (Single-Use Plastic Packaging Model) and the Spreadsheet, SRB Model (Worksheets under section “SUP Pkg Inputs >” and Worksheet “*Combined Overview - SUP Pkg.*”

Step 1: Classifying Representative Manufacturing Industries

The NAICS uses a series of codes to classify business establishments by type of economic activity. As NAICS codes increase in number of digits (i.e., moving from 4 to 5 to 6 digits), they provide greater granularity on the type of business activity. Each NAICS code has descriptions and other information on the types of goods manufactured by the industry that can be found at NAICS.com.

Prioritization of Packaging Impact by Manufacturing Industry Group

As the first step of estimating the quantity of products sold in California in 2023, the industries that manufacture those products (e.g., Animal Food Manufacturing) were first identified using NAICS. To identify manufacturing industry groups that manufacture products that are likely to use packaging, Accenture conducted a review of the manufacturing industry groups (4-digit NAICS codes) to select which of those should be included in the model.

Accenture categorized each manufacturing industry group (4-digit NAICS code) included in the model into three industry impact categories: (1) high impact; (2) low impact, and (3) non-primary. This categorization was based on the likely impact of the primary packaging associated with goods manufactured in that industry group on the model outcome. The products manufactured by each manufacturing industry group were assessed on three main parameters: number of units sold, weight of packaging as part of total product, and component complexity.

- **High-impact** industries tended to manufacture products that are typically sold at lower cost and higher volume (e.g., toys, food, clothing). They may also have a high number of anticipated packaging components.
- **Low-impact** industries tended to manufacture products that are more expensive and purchased less frequently, resulting in a smaller contribution to packaging. The packaging weight may be lower compared to the weight of the product (e.g., appliances, furniture).
- **Non-primary** industries include industries whose primary packaging are considered out of scope for the Act (e.g., beverage containers subject to the California Beverage Container Recycling and Litter Reduction Act) (see [PRC Section 42041\(e\)\(2\)](#)). Note that while primary packaging for non-primary industries was excluded in the model, secondary and tertiary packaging associated with these industries were included.

The Spreadsheet, Industry List and Packaging Impact Prioritization (Worksheet “*Packaging Impact Prioritization*”) provides further detail on the assessment of each industry against the three parameters. The variables and assessment of industry groups are outlined further in the Appendix (Industry Packaging Impact Prioritization).

Example: Bakeries and Tortilla Manufacturing

Bakeries and Tortilla Manufacturing (NAICS 3118) is an example of a manufacturing industry group included in the model. This industry group is described by the NAICS Association (NAICS.com) as comprising establishments primarily engaged in one of the following:

- Manufacturing fresh and frozen bread and other bakery products,
- Retailing bread and other bakery products not for immediate consumption made on the premises from flour, not from prepared dough,

- Manufacturing cookies, crackers, and dry pasta,
- Manufacturing prepared flour mixes or dough from flour ground elsewhere, or
- Manufacturing tortillas.

According to this assessment, the products from this industry group were rated as follows:

- “High” in terms of number of units sold and generally at a cost per unit less than \$100.
- “High” in terms of weight of packaging as a part of total product (i.e., packaging may be a larger portion of the weight of the product)
- “Medium” in terms of component complexity given that a product such as a pack of saltine crackers has more than two but less than eight components (i.e., four individual wrappers).

The average scoring of the assessment resulted in categorizing Bakeries and Tortilla Manufacturing as a high packaging impact industry group.

Estimating Total Monetary Output Per Manufacturing Industry Group

The total monetary output for each manufacturing industry group (4-digit NAICS code) was estimated by adjusting California manufacturing sales by net domestic and international trade (i.e., imports and exports).

Industries associated with net trade values were mapped against industries identified through 4-digit NAICS codes to allow comparison of trade values with manufacturing sales values (see Appendix section Sales & Trade Data Harmonization for more details). However, domestic trade (imports and exports) values for commodities classified under 42 Standard Classification of Transported Goods (SCTG) codes were manually aligned to 4-digit NAICS codes. This alignment was achieved by cross-referencing the descriptions and sub-SCTG codes with the corresponding industries at 4-digit NAICS codes.

Example: Bakeries and Tortilla Manufacturing Industry Group

In 2021, NAICS estimated that manufacturing sales for the Bakeries and Tortilla Manufacturing Industry Group (NAICS 3118) in California were about \$9.1 billion (Spreadsheet, SRB Model, Worksheet “% Market share”). To estimate the net sales per manufacturing industry group, the \$9.1 billion in sales was adjusted twice by 3.7%, for the years 2022 and 2023. The selection of 3.7% represents the total growth of resin production in the United States in 2023 as reported by the American Chemistry Council’s *2024 Resin Review*¹ and is assumed to best reflect the amount of plastic that is available for purchase and used by manufacturers. The modified manufacturing sales are then adjusted for domestic and international imports, which were estimated to be about \$1 billion in net imports (Spreadsheet, SRB Model, Worksheet “Sales & Trade Value”). This resulted in a total monetary output of approximately \$10.8 billion for the Bakeries and Tortilla Manufacturing industry group for the year 2023.

Bakeries and Tortilla Manufacturing Industry Group (NAICS 3118)

- 2021 Manufacturing Sales: \$9,145,863,000
- Estimated Manufacturing Sales:
 - 2022: $\$9,145,863,000 + (\$9,145,863,000 \times 3.7\%) = \$9,484,259,931$
 - 2023: $\$9,484,296,931 + (\$9,484,296 \times 3.7\%) = \$9,835,177,548$
- Net International Imports: \$804,233,864
- Net Domestic Imports: \$116,983,740

2023 Total Monetary Output: (2023 Manufacturing Sales) + (Net International Imports) + (Net Domestic Imports)

2023 Total Monetary Output for Bakeries and Tortilla Manufacturing Industry Group (NAICS 3118): $\$9,835,177,548 + \$804,233,864 + \$116,983,740 = \$10,756,395,152$

Step 2: Establishing Representative Products

Representative products were established for each manufacturing industry to estimate the number of products sold by that industry and to estimate the amount of packaging associated with products in that industry.

Identifying Representative Products by Manufacturing Industry

For each manufacturing industry group identified by a 4-digit NAICS code, manufacturing industries and sub-industries with unique sets of products and packaging uses were identified using the more granular 5-digit and 6-digit NAICS codes, respectively. Using information on the products manufactured by each sub-industry (6-digit NAICS code), representative products were established using criterion such as wide anticipated usage. Additionally, for each representative product, as applicable, a B2C and B2B version was established.

As described in Step 1, Accenture classified manufacturing industry groups (4-digit NAICS codes) as high, low, or non-primary. Accenture selected three representative products for each manufacturing industry (5-digit NAICS codes) that were categorized into high impact manufacturing industry groups, and one representative product was selected for each manufacturing industry within low impact or non-primary manufacturing industry groups. Accenture created a total of 258 representative products for the model.

General Considerations for Determining the Appropriate Representative Products

When identifying representative products, the following were considered:

- U.S. Census Bureau NAICS data
 - Each NAICS code had a name and description detailing the most prevalent products manufactured by that industry as defined by the U.S. Census Bureau (can be found on the NAICS website²).

- Considering Wide Anticipated Product Usage
Using best professional judgment, Accenture selected items that were expected to be used by a wide range of consumers.

Additional Considerations for High-Impact Manufacturing Industries

When there were more than three sub-industries (6-digit NAICS codes) within a manufacturing industry (5-digit NAICS codes), additional information was used to identify which three sub-industries best represented the entire manufacturing industry. Accenture selected the three sub-industries with the highest levels of employment to represent the manufacturing industry.

When there were fewer than three sub-industries (6-digit NAICS codes) within a manufacturing industry, Accenture identified three representative products from the one or two sub-industries identified in NAICS. Where multiple products were selected from a single 6-digit NAICS code, Accenture identified representative products that used different types of packaging to include a diverse range of packaging within a sub-industry. For example, Accenture chose wild-caught smoked salmon, frozen shrimp, and canned tuna as representative products from the 6-digit NAICS code for Seafood Product Preparation and Packaging (311710) to represent a diverse range of packaging.

Additional Considerations for Low-Impact Manufacturing Industries

For low-impact and non-primary industries, Accenture identified only one representative product. Accenture selected representative products from the largest sub-industry (6-digit NAICS code) for a manufacturing industry group (4-digit NAICS code), by employment. If the largest 6-digit NAICS code was considered “Other Products,” Accenture selected the next largest sub-industry since “Other Products” was considered too broad to support selection of a representative product.

Example: Bakeries and Tortilla Manufacturing – High Impact

The 4-digit NAICS code Bakeries and Tortilla Manufacturing industry group (NAICS code 3118) consists of three manufacturing industries at the 5-digit NAICS:

- Bread and Bakery Product Manufacturing (NAICS code 31181),
- Cookie, Cracker, and Pasta Manufacturing (NAICS code 31182), and
- Tortilla Manufacturing (NAICS code 31183).

Three different sub-industries (6-digit NAICS codes) make up the 5-digit Bread and Bakery Product Manufacturing:

- Retail Bakers (NAICS code 311811),
- Commercial Bakeries (NAICS code 311812), and
- Frozen Cakes, Pies, and Other Pastries Manufacturing (NAICS code 311813).

Given the high packaging impact classification, three representative products were chosen for the manufacturing industry, one from each sub-industry (6-digit NAICS code).

Commercial Bakeries (NAICS code 311812) manufacturing is described, per the U.S. Census Bureau³, as “manufacturing fresh and frozen bread and bread-type rolls and other fresh bakery (except cookies and crackers) products.” Using best professional judgment and consideration of the industry name and description, Accenture identified sliced white bread as the representative product for the Commercial Bakeries sub-industry for both the B2C and B2B markets. This process was repeated for Retail Bakers and Frozen Cakes, Pies, and Other Pastries Manufacturing sub-industries.

Step 3: Estimating the Total Number of Representative Products Using Plastic Packaging

Accenture estimated the total number of representative products using packaging for each manufacturing industry. First, the market share of each representative product within a manufacturing industry was estimated. Then, the total monetary output per manufacturing industry group established in Step 1 was multiplied by the estimated market share of each representative product to estimate monetary output associated with each representative product (see Appendix section Market Share for more details). The total monetary output associated with each representative product was divided by the average price of that representative product and adjusted for the proportion of products estimated to use single-use packaging in order to estimate the number of representative products using packaging. The average prices of the representative product took B2B and B2C versions of the product into account.

Estimating Market Share of Each Representative Product

Since sales and trade data for each representative product were not available, Accenture used employee share percentages at the 5- and 6-digit NAICS code level as a proxy for market share. Employee share percentages at the 5-digit NAICS code level reflect the number of employees at the 5-digit NAICS code level in proportion to the total employee count at the 4-digit NAICS code level. Similarly, 6-digit NAICS code level employee share percentages reflect the number of employees at the 6-digit NAICS level in proportion to the total employee count at the 5-digit NAICS code level.

Example: Market Share of Sliced White Bread within Bakeries and Tortilla Manufacturing Group

Accenture estimated the Bakeries and Tortilla Manufacturing industry group (3118; 4-digit NAICS code) to have over \$9.1 billion in manufacturing sales in 2021 and over 36,000 employees in California (Spreadsheet, SRB Model, Worksheet “% Market Share”). Within that industry group, the Bread and Bakery Product Manufacturing industry is one of three manufacturing industries (31181; 5-digit NAICS code), which accounts for 75% of employees within that industry group and is thus assigned 75% of the market share for that industry group. Within that industry, Commercial Bakeries is the sub-industry (311812; 6-digit NAICS code) with the representative product of sliced

white bread. Based on the proportion of employees in the Commercial Bakeries sub-industry, Accenture assigned sliced white bread 43% of the market share within Commercial Bakeries. Overall, within the Bakeries and Tortilla Manufacturing industry group (3118), Accenture assigned sliced white bread about 32% of the market share.

Bakeries and Tortilla Manufacturing industry group (NAICS code 3118)

Bread and Bakery Product Manufacturing industry (NAICS 31181) employs 75% of the employee count of NAICS code 3118

Commercial Bakeries (NAICS code 311812) employed 43% of the employees of NAICS code 31181

Representative Product: Sliced white bread

Sliced white bread market share: **(75% Bread and Bakery Product Manufacturing industry) × (43% Commercial Bakeries sub-industry)** is equal to **32% of the Bakeries and Tortilla Manufacturing industry group (NAICS 3118)**

Estimating Monetary Output Per Representative Product

Accenture multiplied the total monetary output per manufacturing industry group (established in Step 1) by the market share estimated at the 6-digit NAICS level, from the previous sub-step, to estimate the total monetary output per representative product.

Example: Monetary Output Associated with Sliced White Bread within Bakeries and Tortilla Manufacturing Group

As shown in Step 1, Accenture estimated the Bakeries and Tortilla Manufacturing industry group (4-digit NAICS code) to have over \$10.8 billion in sales after being adjusted for trade. With an estimated 32% of the market share of the Bakeries and Tortilla Manufacturing industry group, Accenture assigned sliced white bread \$3.4 billion in monetary output as a representative product.

(\$10.8 billion in monetary value for Bakeries and Tortilla Manufacturing industry group) × (32% market share of sliced white bread within manufacturing industry group) = \$3.4 billion in total monetary output associated with sliced white bread.

Establishing B2C and B2B Representative Products

For each representative product, as applicable, Accenture established two versions of packaging: a B2C and B2B version. B2C products are sold directly to individual consumers and include products sold via e-commerce. B2B products are sold from one company to another, such as a distributor to a restaurant. Buyers may resell B2B products to individual consumers or use the products as inputs for their manufacturing or business operations. Since B2B products are often sold in higher volumes and used by both businesses and individual consumers, these products often consist of a greater quantity, or number, of goods packaged, also known as bulk packaging.

Given that B2B and B2C products vary in packaging styles and formats, Accenture established a B2C and B2B version of each representative product and identified by percent how much product is expected to be sold as B2B or B2C.

The total monetary output of a representative product was allocated to B2B and B2C version by multiplying it by the percentage share of B2B and B2C versions (see Appendix section B2B and B2C Assumptions and Allocations).

Example: Monetary Output Associated with B2B and B2C Sliced White Bread

The total monetary output associated with sliced white bread from the sub-step above is \$3.4 billion. The percentage share of B2B and B2C versions sold for sliced white bread are 56% and 44% respectively (see Appendix B2B and B2C Assumptions and Allocations). Therefore,

\$1.9 billion in monetary output associated with B2B sliced white bread = (\$3.4 billion in total monetary output associated with sliced white bread) x (56% B2B share of sliced white bread sold)

\$1.5 billion in monetary output associated with B2C sliced white bread = (\$3.4 billion in total monetary output associated with sliced white bread) x (44% B2C share of sliced white bread sold)

Estimating the Average Price of Representative Products

For each representative product, Accenture estimated average prices for both B2B and B2C versions, as applicable. Based on information gathered from retailer webpages, Accenture used the most purchased versions of each representative product to estimate average prices and identify other important characteristics, such as size.

The following steps were used to determine average prices for representative products:

1. Specific versions of representative products for both B2C (Amazon, Walmart, Target) and B2B formats (Alibaba, Costco, Amazon) were identified on retailer websites and product data were collected on them. If products were not available on the common retailer sites, Accenture researched other unique retailers selling those products. Accenture researched more than 20 unique online retailers for B2C products and more than 30 unique online retailers for B2B products.
2. For each B2B and B2C representative product, Accenture calculated the average price of the top 10 best-selling items on a retailer website using regular, non-sale prices. If possible, SKUs of the same product sold in different quantities resulting in different prices were avoided (e.g., a can of tuna versus a four-pack of the same brand of canned tuna).

Example: Average Price & Characteristics of Sliced White Bread

Table 2 summarizes the characteristics of the B2B and B2C versions of the representative product sliced white bread.

Table 2. Average Price and Characteristics of Sliced White Bread

	Average Price (\$)	Weight
B2B sliced white bread	\$58.19	18 pounds
B2C sliced white bread	\$4.64	20 oz

Determining the Percentage of Representative Products using Single-Use Plastic Packaging

For both B2B and B2C versions of representative products, the monetary output was adjusted by the percentage of that representative product that used single-use plastic packaging. Using retailer websites, Accenture visually assessed the top 10 best-seller versions of the representative product to estimate the percentage that used single-use plastic packaging compared to non-plastic packaging or packaging that was not single-use. For example, if six out of the top 10 best-selling versions of the representative product used single-use plastic packaging, then 60% of the representative product was estimated to utilize single-use plastic packaging.

Example: Percentage of Sliced White Bread Using Packaging

Based on the top 10 best-selling versions, it was assumed that all sliced white bread, including both B2B and B2C versions, use plastic film bag and plastic closure packaging. For the B2C format, Accenture assigned a single 20-ounce loaf of bread packaged in a flexible plastic film bag with a plastic bread clip. For the B2B format, Accenture assigned a case of 6 individual 8-ounce loaves of bread, each packaged in a flexible film plastic bag and plastic bread clip (for additional details, see Spreadsheet, SRB Model (Worksheet “*Combined Overview – SUP Pkg*”).

Estimating Number of B2B and B2C Representative Products Using Packaging

The total number of representative products using packaging was estimated separately for each B2B and B2C version. The estimated monetary output for the B2B version of the representative product was divided by the average price of the B2B representative product and then multiplied by the percentage of representative products with packaging.

Example: Estimating the Number of Sliced White Bread Sold

B2B Sliced White Bread

- Estimated Monetary Output: \$1.9 billion
- Average Price per unit: \$58.19
- Ratio of products in single-use plastic packaging: 1 (or 100%)
- **Number of Products = (\$1.9 billion) ÷ (\$58.19) × (1) = 33 million units of B2B sliced white bread that use packaging**

B2B Sliced White Bread

- Estimated Monetary Output: \$1.5 billion
- Average Price per unit: \$4.64
- Ratio of products in single-use plastic packaging: 1 (or 100%)
- **Number of Products = (\$1.4 billion) ÷ (\$4.64) × (1) = 323 million units of B2C sliced white bread that use packaging**

Step 4: Developing a Plastic Packaging Profile for Each Representative Product

To estimate the amount of packaging associated with each representative product, Accenture created a packaging profile for each representative product's B2C and B2B versions. To establish the packaging profile, Accenture established the type of primary packaging and the size, shape, weight, and other characteristics of the product using information from retailer websites for the top-selling versions of the representative product. Accenture estimated secondary and tertiary packaging based upon the size, shape, weight, and other characteristics of the primary packaging. See Appendix section within Packaging Model called Developing Packaging Profiles for more information.

Identifying the Types of Primary Packaging

Primary packaging, defined in statute in [PRC Section 42041\(s\)\(1\)](#), is packaging intended to provide the user or consumer with the individual serving or unit of the product, and most closely contains the product, food, or beverage. For the purposes of this model, primary packaging was characterized as either wrap-around packaging or an auxiliary component.

For example, the packaging for a loaf of sliced white bread includes a flexible film bag that contains the entire loaf of bread and the plastic bread clip to close the film bag. Accenture considered the flexible film bag that contains the bread as wrap-around packaging and considered the bread clip, which is also part of the primary packaging, an auxiliary component. Additional examples of auxiliary components would be the label, cap, and ring on a gallon of milk.

To develop the primary packaging profile, Accenture established primary packaging characteristics for both B2C and B2B versions of each representative product. See Appendix section Primary Packaging Assumptions for more information.

Identifying the Wrap-Around Packaging

To develop the packaging profile, Accenture identified the wrap-around packaging type using the retailer websites and visual assessments of the best-selling version of the representative product. For example, if six versions of the representative product were in a rigid plastic container, two were in flexible plastic film, and two were not in plastic packaging, then Accenture identified the rigid plastic container packaging as the wrap-around packaging in the profile.

Accenture categorized wrap-around packaging into four types:

- **Rigid Container:** A plastic rigid container refers to a type of packaging that maintains its shape and structure even when empty. These containers are made from a variety of plastics, including PET (polyethylene terephthalate) and HDPE (high-density polyethylene). They are commonly used for products that require extra protection, such as food products and cosmetics.
- **Flexible Film:** Plastic flexible film refers to thin layers of plastic that are flexible and can be molded to fit the shape of the product they are packaging. These films are used for a variety of applications and include bags, pouches, and wrappers.
- **Foam:** Plastic foam is a lightweight material made by trapping gas bubbles in a plastic matrix. This type of packaging is employed for its cushioning properties, protecting fragile items during shipping. Common types of plastic foam include polyurethane foam and polystyrene foam.
- **Metallized:** Plastic metallized film is a polymer film coated with a thin layer of metal, usually aluminum. This coating gives the film a shiny, metallic appearance and enhances its barrier properties against moisture, gases, and light. For this study, the weight of the metallized fraction was not included in the total weight of packaging.

Identifying the Auxiliary Components

Auxiliary components refers to primary packaging other than wrap-around packaging types described previously.

Accenture created an inventory of auxiliary components for each representative product by researching each product on the same retailer websites and performing a visual assessment of the top best-selling model.

A list of these auxiliary components can be found in the Appendix and includes caps, rings, twist ties, bread clips, zip ties, and ribbons. See appendix section Developing Packaging Profiles.

Example: Types of Primary Packaging for Sliced White Bread

B2C Sliced White Bread Primary Plastic Packaging Profile

- Accenture identified the B2C format as a single 20-ounce white bread loaf packaged in a flexible film bag with a bread clip. For the purposes of the model, researchers identified the wrap-around packaging as flexible film and the plastic bread clip as an auxiliary component.

B2B Sliced White Bread Plastic Primary Packaging Profile

- Accenture identified the B2B format as a cardboard box of six individually-wrapped 48-ounce rustic bread loaves. Each loaf was packaged in a rectangular bag of flexible plastic film with a plastic bread clip. Accenture identified the

flexible film as wrap-around packaging and the six bread clips as auxiliary components. Accenture omitted the box containing the six loaves of bread because it was not made of plastic.

Estimating the Amount of Primary Packaging, per Representative Product

After determining the average price in Step 3, Accenture determined the size of a representative product (e.g., the shipping dimensions of a product) from the same retailer website using the best-selling version of the most prevalent packaging profile. If product dimensions were not listed, Accenture determined them using alternative retailer websites. If dimensions were unavailable across multiple websites, an equivalent product size was found under the assumption that all physical dimensions and weight were comparable across brands and between products that were the same size and used the same packaging profile. Accenture calculated the surface area and volume of the representative product using the product dimensions (see Appendix section Primary Packaging Assumptions for more information).

Accenture collected physical dimensions and weights for both wrap-around packaging and auxiliary components were collected from a range of sources, which are detailed further in the Appendix (Packaging Library Data Sources). Accenture used these sources to create average weights for each type of auxiliary component, in pounds (lbs), and for the wrap-around packaging, in pounds per square inch (lbs/in²), for each representative product. The auxiliary component weights were not adjusted to account for sizing differences.

Weight of Wrap-Around Packaging

Accenture assumed a weight per square inch for each of the following types of plastic wrap-around packaging assessed in this study:

- Rigid containers
- Flexible film
- Foam
- Metallized

Within this model, the weight of wrap-around packaging was determined by multiplying the estimated surface area (in²) of the representative product by the weight per square inch (lbs./in²) estimated by the type of wrap-around packaging.

The packaging of a product often exceeds the surface area of the actual good due to additional packaging material required to accommodate folds, seals, and other physical aspects of a product and to properly protect the product. Examples of where packaging extends beyond the exact surface area of a good include:

- Side seals
- End seals
- Overlap
- Gusseting
- Tear notches
- Perforations

Accenture integrated a factor into the model for products packaged in flexible film and metallized wrappers of a rectangular prism or pouch shape to account for additional packaging material that was larger than the packaged product. This calculation is detailed in the Appendix (Weight of Wrap-Around Packaging).

Weight of Auxiliary Components

The total weight of auxiliary components for a given representative product was determined by summing the weight of each auxiliary component used in the primary packaging of a representative product. Accenture assumed that each auxiliary component had the same weight across representative products.

Estimating the Total Weight of Primary Packaging per Representative Product

The wrap-around packaging and the auxiliary component weights were summed to form the primary packaging weight for a single representative product. Products that were not fully encapsulated in plastic-based wrap-around primary packaging had their plastic component and weight calculations based on auxiliary components only.

Estimating the Number of Plastic Components per Representative Product

The number of plastic components of a representative product's primary packaging was found by adding the number of auxiliary components identified per representative product to the number of components associated with the wrap-around packaging. In general, Accenture assumed the wrap-around primary packaging was a single plastic component. Variations in this can be found in the individual representative product rows of the model.

Example: Primary Packaging for Sliced White Bread

The calculation for total primary packaging weight and number of plastic components for a single B2C and B2B sliced white bread product is demonstrated below:

B2C Sliced White Bread Primary Plastic Packaging Profile

- Accenture identified the B2C format as a single 20-ounce (1.25 lb) white bread loaf packaged in a flexible film bag with a bread clip. For purposes of the model, the Accenture captured wrap-around packaging as flexible film and a plastic bread clip as an auxiliary component.
- The retailer website indicated the measurements of the sliced white bread as 14.5 inches long, 4.5 inches wide, and 4.25 inches high.
- The weight of the wrap-around primary packaging was calculated using the surface area (292 square inches) and applying a pounds-per-square-inch factor for the weight of the flexible film (0.0002 pounds per square inch) plus a 25% surface area adjustment. This resulted in an estimated weight of **0.07 pounds for the flexible film bag**.
- The weight of auxiliary components was calculated using the identified weight of the bread clip captured through direct measurement and assuming one bread

clip per bag. This resulted in an estimated weight of **0.00075 pounds for the bread clip.**

- The total primary packaging weight was calculated by adding the wrap-around packaging and auxiliary component weights, resulting in an **estimated total weight of primary packaging of 0.072 pounds per B2C Sliced White Bread.**
- The total number of plastic components was calculated by adding the component counts of the wrap-around primary packaging to those of the auxiliary components. For Sliced White Bread, **the number of plastic components for primary packaging was 2**, one for the plastic bag and one for the bread clip.

B2B Sliced White Bread Primary Plastic Packaging Profile

- Accenture identified the B2B format as a cardboard box of six individually-wrapped 48-ounce rustic bread loaves. Each loaf was packaged in a rectangular bag of flexible film with a bread clip. For purposes of the model, Accenture only considered the flexible film as wrap-around packaging, while the box containing the six loaves of bread was not considered because it was non-plastic. Accenture identified six bread clips and two pieces of tape on the box as auxiliary components.
- The retailer website indicated the measurements of the sliced white bread box as 22.75 inches long, 16.88 inches wide, and 8.2 inches high.
- The weight of the wrap-around primary packaging was calculated using the surface area (547 square inches) and applying a pounds-per-square-inch factor for the weight of the flexible film (0.0002 pounds per square inch) plus a 25% surface area adjustment. This estimate was then multiplied by six to account for the six packages of bread included in the B2B estimate. This resulted in an estimated weight of **0.80 pounds for flexible film bags.**
- The weight of auxiliary components was calculated using the identified weight of the bread clip captured through direct measurement and assuming one bread clip (6 bread clips at 0.00075 pounds per bread clip) plus tape (2 pieces of tape that are 0.003 pounds each). This resulted in an estimated weight of **0.01 pounds for auxiliary components.**
- The total primary packaging weight was calculated by adding the wrap-around packaging and auxiliary component weights, resulting in an **estimated total weight of primary packaging of 0.81 pounds per B2B Sliced White Bread.**
- The total number of plastic components was calculated by adding the component counts of the wrap-around packaging to those of the auxiliary components. For sliced white bread, **the number of plastic components for primary packaging was 14**, six for the plastic bag and six for the bread clips, and two for tape.

Estimating the Amount of Secondary and Tertiary Packaging

Secondary and tertiary packaging are defined in statute in PRC Section 42041(s)(2) and (s)(3). Secondary packaging is packaging intended to bundle, sell in bulk, brand, or display the product whereas tertiary packaging is packaging intended to protect the product during transport.

To calculate secondary and tertiary packaging, Accenture assumed each representative product was to be put in a case, tray, or shipped directly on the pallet. Accenture also calculated e-commerce packaging into this model and combined it with a representative product's tertiary packaging totals. See Appendix section Secondary and Tertiary Packaging Assumptions for more information.

Secondary and Tertiary Packaging

For each representative product, Accenture determined whether the representative product would be packaged in an RSC (regular slotted container) corrugated box (i.e., case), a corrugated tray with shrink wrap, or placed directly on a pallet. Once this was determined, Accenture calculated the number of products that would fit in a given secondary or tertiary packaging using determined weight and volume constraints.

Cases, trays, and pallets can vary in size. A packaging supplier provided insights on an average size and amount of packaging that is used for each secondary packaging type. These standard sizes, tape, and shrink wrap measurements can be found in the Appendix (Secondary Packaging).

Accenture developed a "master case" as a standardized representation of an RSC corrugated box sealed with tape and a "master tray" as a standardized representation of a corrugated cardboard rectangular base upon which representative products were packaged and shrink wrapped. Accenture then assigned packaging weight and units to the tape used for sealing the case and to the shrink wrap for the tray. The number of cases and trays that fit on a standardized pallet was then calculated.

For each representative product, Accenture estimated the maximum number of products that could be packaged using a master case, master tray, or placed directly on the pallet considering the volume, surface area, and weight of representative products and the limits of the packaging format in terms of volume and weight.

To determine whether a representative product goes in a case, on a tray, or is placed directly on a pallet, Accenture assumed the following:

- Heavier food and beverage products are packaged in master trays. A table of these products can be found in the Appendix (Master Tray).
- The representative product's ability to fit in a case was limited by any representative products whose length, width, or depth measurements were larger than the master case measurements or by those products which exceeded the weight capacity of the case. Further detail on the placement and positioning of products is detailed in the Appendix (Products per Master Case or Tray). The maximum weight of a master case or tray was 40 pounds.

- Representative products are placed directly on the pallet if they were not packaged on a tray or in a case. The number of products that fit on a pallet was determined by dividing the volume of the pallet by the volume of the representative product and limiting the total number of units by the weight limit of the pallet.
- Accenture identified some products for single item transport if they were too heavy or large for pallets. Further detail can be found in the Appendix (Special Considerations for B2B Format Packaging).

To estimate the weight of plastic and number of plastic components of packaging associated with each master case, master tray, and pallet, Accenture assumed the following:

- Each master tray was wrapped in shrink film. A standard piece of shrink film was calculated using packaging guidelines and details that can be found in the Appendix (Master Tray). Accenture also assumed that all items that are packed on the master tray were packaged in a single layer, were not stacked, and that one standard sized piece of shrink wrap was used per master tray.
- Each master case had two pieces of tape. Their corresponding weight was calculated using guidance received from a packaging manufacturer. Details can be found in the Appendix (Master Case).
- Each pallet featured four straps and a piece of stretch wrap. The total weight of the pallet with the weight of representative products was used to determine the amount of stretch wrap needed to wrap the pallet. Lighter pallets required less stretch wrap as compared to heavier pallets. Further detail can be found in the Appendix (Plastic Wrap & Strapping per Pallet). The pallet weight maximum was 4,600 pounds. The pallet volume was 115,200 cubic inches.

Example: Secondary & Tertiary Packaging for Sliced White Bread

The following examples calculate secondary and tertiary packaging (B2C and B2B) for sliced white bread.

B2C Secondary & Tertiary Packaging for Sliced White Bread

B2C sliced white bread loaves are too soft to be packaged in trays without protection and are instead packaged in master cases, which enables stacking when on a pallet.

For B2C, the number of loaves per master case was calculated by dividing the volume of the master case (3,600 cubic inches) by the volume of the loaf (277 cubic inches), resulting in a maximum number of 12 loaves of sliced white bread per master case.

For B2C secondary packaging, there are two pieces of tape to close the master case, resulting in an estimated weight of 0.006 pounds of tape per master case. Note that the weight of the box is not included because it is not plastic. The two pieces of tape count as two plastic components.

The weight of a master case along with the weight of the sliced white bread was then calculated by multiplying the number of products per master case by the weight of the product (15 pounds).

To determine the number of master cases that could fit on a pallet, the volume of the pallet was divided by the volume of the master case and was limited to the maximum weight capacity of a pallet. The estimated volume of the pallet was 115,200 cubic inches and the estimated volume of a master case was 3,600 cubic inches, meaning that 32 master cases could theoretically fit on the pallet, by volume. To ensure that the pallet weight limit is not exceeded, the weight is estimated to be 480 pounds, which does not exceed the weight limit of the pallet.

Accenture estimated stretch film weight based on the weight of the pallet with the representative product, and as such is variable across products. With a weight of 480 pounds, this is categorized as very light for pallets (i.e., less than 600 pounds) and thus the appropriate amount of stretch film is added for a very light categorization.

To calculate the weight of tertiary plastic packaging per pallet, the weight of the stretch film (0.3 pounds) is added to the weight of the straps (0.07 pounds each). All pallets have four straps. This results in an estimate of five plastic components and 0.5 pounds of plastic associated with tertiary packaging.

B2B Secondary & Tertiary Packaging for Sliced White Bread

For the B2B version of sliced white bread, the loaves of sliced white bread product are already packaged in a box as part of the estimation of their primary packaging. It is therefore modeled as “direct to pallet” and no secondary packaging layer is applied.

To determine the number of B2B boxes that could fit on a pallet, the volume of the pallet was divided by the volume of the B2B box and was limited to the maximum weight capacity of a pallet. The estimated volume of the pallet was 115,200 cubic inches and the estimated volume of a B2B box was 3,149 cubic inches, meaning that 36 master cases could theoretically fit on the pallet, by volume. To ensure that the pallet weight limit is not exceeded, the weight is estimated to be 648 pounds, which does not exceed the weight limit of the pallet.

Accenture estimated stretch film weight based on the weight of the pallet with the representative product, and as such is variable across products. With a weight of 648 pounds, this is categorized as light for pallets (i.e., between 600 pounds and 1,200 pounds) and thus the appropriate amount of stretch film was added for a light categorization.

To calculate the weight of tertiary plastic packaging per pallet, the weight of the stretch film (0.31 pounds) is added to the weight of the straps (0.07 pounds each). All pallets have four straps. This results in an estimate of five plastic components and 0.58 pound of plastic associated with tertiary packaging.

E-Commerce Packaging

The proportion of representative products identified as sold via e-commerce were estimated to have additional tertiary packaging associated with shipping the product from a distribution center to a home or business. See appendix section E-commerce for B2C Products for more information.

E-commerce, short for "electronic commerce," refers to the buying and selling of goods and services over the internet. This digital transaction process typically involves online marketplaces, websites, or mobile apps where consumers can browse, select, and purchase products or services remotely. E-commerce inherently drives higher packaging usage compared to traditional retail because a product purchased online requires packaging that will protect the product through multiple stages of shipping and handling from the distribution center to a home or business.

This model assumed that products sold via e-commerce were shipped to a distribution center in the primary, secondary, and tertiary packaging identified previously in the packaging profiles. E-commerce products were associated with additional (i.e., not previously accounted for) tertiary packaging, such as shipping pouches, boxes, and filler materials, to safeguard items as they are shipped from a distribution center to the consumer.

Using publicly available data from MobiLoud⁴, which provided projections and growth opportunities for each e-commerce category, the percentage of e-commerce sales was applied to each representative product's B2C units to estimate the number of representative products sold via e-commerce and to determine which proportion should have that additional packaging associated with it. This allocation can be found in the Appendix (E-commerce for B2C Products).

To identify the types of packaging and their frequency of use in e-commerce, publicly available statistics from e-retailer Amazon were used.⁵ In 2023, Amazon shipped 5.86 billion packages in the U.S., 38% of which were corrugated boxes. Based on a recent study,⁶ Amazon uses 15 billion plastic air pillows yearly, resulting in an average of seven plastic air pillows for each corrugated box.

Accenture assessed products to determine whether they would fit in a box, or a flat mailer based on the height and volume of the representative product. Specific assumptions on the size of mailers and boxes are detailed in the Appendix (E-commerce for B2C Products) Similar to the calculations of auxiliary components for primary packaging, the weight of plastic components associated with a box (e.g., air pillows and tape) or flat plastic mailer were summed to arrive at the tertiary packaging weight (plastic only) and the number of plastic components associated with tertiary packaging for a representative product through e-commerce.

Example: E-Commerce Packaging for Sliced White Bread

It was assumed that sliced white bread shipped through e-commerce was shipped in a box with seven air pillows for cushioning and two pieces of tape on the box, for a total of nine plastic components associated with the e-commerce packaging. The weight of the

air pillows and tape are estimated to be 0.04 pounds per box. This amount of additional tertiary packaging associated with sliced white bread was only associated with sliced white bread purchased through e-commerce, which was estimated at 7.6% of B2C sales.

Step 5: Estimating Number of Plastic Components and Weight of Plastic Packaging

To estimate the total number of plastic components and weight of plastic associated with packaging for a representative product, the total number of units of a representative product sold by the manufacturing industry per year (from Step 3) was multiplied by the number of plastic components and weight of plastic associated with its primary, secondary, and tertiary packaging profiles (from Step 4) and combined.

Accenture summed the total number of plastic components and weight of packaging for all representative products across all manufacturing industries to calculate the total number of plastic components and weight of plastic associated with single-use plastic packaging.

Estimating Number of Plastic Components & Weight Used in Primary Packaging

Primary packaging estimates per representative product were applied only to the number of B2C and B2B units that used plastic packaging, as calculated in Step 3. The total amount of primary packaging associated with each representative product was estimated by multiplying the weight and plastic component estimates per representative product by the number of representative products sold in packaging.

Estimating Number of Plastic Components Used in Secondary and Tertiary Packaging

Accenture applied all secondary and tertiary packaging estimates to all B2C and B2B units, regardless of whether their primary packaging was made of plastic. The amount of secondary and tertiary packaging estimated in Step 4 was associated with a certain number of units of the representative product (e.g., a master case may contain 12 units of a representative product). The weight of secondary and tertiary packaging was adjusted to a per representative product basis and multiplied by the number of representative products sold. For tertiary packaging, additional packaging associated with e-commerce sales was estimated using the proportion of B2C units sold via e-commerce and multiplying by the e-commerce packaging estimates for weight and number of plastic components estimated in Step 4 by representative product.

Example: Total Weight and Number of Plastic Components of Packaging for Sliced White Bread

In Step 3, it was estimated that 33 million units of B2B sliced white bread and 323 million units of B2C sliced white bread were sold in California in 2023.

B2B Sliced White Bread Plastic Components and Weight

In Step 4, it was estimated that each unit of B2B Sliced White Bread was associated with 14 plastic components and 0.81 pounds of primary packaging. 100% of B2B bread was assumed to use primary packaging. B2B sliced white bread did not have any secondary packaging. Every 36 units of B2B sliced white bread was associated with five plastic components and 0.58 pounds for tertiary packaging. This resulted in a total of about 468 million plastic components and 27 million pounds of plastic associated with packaging for all units of B2B sliced white bread.

B2C Sliced White Bread Plastic Components and Weight

In Step 4, Accenture estimated that each unit of B2C sliced white bread was associated with 2 plastic components and 0.07 pounds of plastic for primary packaging. Accenture assumed 100% of B2C sliced white bread used primary packaging. Accenture clustered 12 units of B2C sliced white bread for secondary packaging and associated them with 2 plastic components and 0.006 pounds for secondary packaging. Accenture clustered every 384 units of B2C sliced white bread for tertiary packaging (i.e., 32 master cases each with 12 units of B2C sliced white bread) and associated them with 5 plastic components and 0.5 pounds for tertiary packaging. Additionally, in Step 3, Accenture estimated that 7.6% of B2C sales were through e-commerce and associated with 9 plastic components and 0.04 pounds of plastic per B2C sliced white bread sent through e-commerce.

This resulted in a total of about 926 million plastic components and about 25 million pounds of plastic associated with packaging for all units of B2C sliced white bread.

Results

Using the Single-Use Plastic Packaging Model, Accenture estimated that 2.4 million tons of plastic and 84 billion plastic components were associated with single-use plastic packaging sold, offered for sale, or distributed into California for the calendar year 2023 (Table 3). A majority of both weight and number of plastic components is associated with primary packaging, followed by tertiary packaging and then secondary packaging (see Tables 3 and 4).

Table 3. Estimated Weight of Single-Use Plastic Packaging (Million tons)

	Primary	Secondary	Tertiary	Total
Estimated Total	2.1	0.1	0.2	2.4
Percent of Total	87%	5%	8%	100%

Table 4. Number of Plastic Components Associated with Single-Use Plastic Packaging (Billion Components)

	Primary	Secondary	Tertiary	Total
Estimated Total	69	1.6	13	84
Percent of Total	82%	2%	16%	100%

Packaging associated with B2B products accounted for a larger portion of the total weight, whereas B2C products accounted for a larger portion of the total number of plastic components (see Table 5).

Table 5. Total Amount of Packaging: B2C vs. B2B

Amount of Plastic	B2C	B2B	B2C and B2B
Total Weight (Million Tons)	1.0	1.4	2.4
Number of Plastic Components (Billion)	45	39	84

Single-Use Plastic Food Service Ware

Overall Model Approach

Using the Single-Use Plastic Food Service Ware Model, Accenture estimated the amount of food service ware sold, offered for sale, or distributed in California in 2023 using a combination of approaches to capture food service ware used in association with several types of avenues.

High-Level Steps:

Step 1: Identifying Types of Avenues Where Food Service Ware is Used

Accenture developed a list of 31 types of avenues where food service ware was used by researching a variety of sources (e.g., NAICS codes, California legislation such as SB 1383, industry associations). Accenture then categorized the list of avenues into 5 categories.

- 1) **Food and Drinks** establishments, such as restaurants, hotels, and theme parks where food and drinks are served.
- 2) **Cafeterias**, such as those in schools, hospitals, and correctional facilities.
- 3) **Events**, including those at established avenues (e.g., concerts and sports events) and those at temporary avenues (e.g., farmer's market and holiday events).
- 4) **Transportation services** (e.g., trains) that move through California and serve meals within the state.
- 5) **Personal consumption** (e.g., use of food service ware items at home) of trays, plates, bowls, clamshells, lids, cups, utensils, stirrers, hinged or lidded containers, and straws.

Step 2: Estimating Total Number of Meals Served at Each Avenue Where Food Service Ware Is Likely Used

Accenture estimated the number of meals served by each avenue per year using available information, such as the number of customers visiting each avenue. Accenture also estimated the likelihood that a meal served at a type of avenue would result in the use of both plastic and non-plastic single-use food service ware. For example, the use of single-use food service ware was assumed to be less likely at a full-service restaurant (i.e., sit down restaurant) compared to a quick-service restaurant (i.e., fast food).

Step 3: Classifying Representative Meals and Associated Food Service Ware

Based on the list of avenues identified in Step 1, Accenture created nine types of representative meal options based on the types of items likely to be purchased at those avenues. For example, Accenture created one representative meal called "drink and supplementary food order," which was used for avenues such as cafés, museums, and

theme parks, where people predominantly purchase drinks with a portion of orders including a small food item on the side.

For each representative meal, Accenture assumed the frequency of use for each type of food service ware item. For example, for a café, Accenture assumed single-use plastic cups were used in every representative meal, plastic straws were used in half, while condiment cups were not associated with a representative meal from a café. Accenture accounted for the use of single-use *non-plastic* food service ware (e.g., paper containers) and did not include them in the results of the model.

For each item of food service ware associated with a representative meal, Accenture assigned a value for weight and number of plastic components for each item.

Step 4: Estimating the Amount of Food Service Ware

Based on the estimated number of meals per type of avenue per year (Step 2) and the representative meal assigned to a type of avenue, and the food service ware associated with that representative meal (Step 3), Accenture estimated the weight and number of plastic components of food service ware items used per type of avenue per year.

The estimates per type of avenue were summed to estimate the weight and number of plastic components of food service ware across all avenues, including personal consumption, in 2023.

Single-Use Plastic Food Service Ware Model Methodological Details

Step 1: Identifying Types of Avenues Where Food Service Ware is Generated

Accenture developed a list of 31 types of avenues where food service ware is used by researching a variety of sources (e.g., NAICS codes, California legislation such as SB 1383, industry associations). This list was used as the basis for estimating the number of meals served in California as well as the food service ware associated with those meals.

Accenture then categorized the list of avenues into 5 categories. See Table 6 below.

1. **Food and Drink:** Avenues whose primary purpose is to serve meals. This does not include cafeteria-style avenues or events. Examples include:
 - a. Full-service restaurants
 - b. Quick-service restaurants
 - c. Cafés
 - d. Bakeries
 - e. Hotel and theme park restaurants
2. **Cafeterias:** Types of avenues with pre-prepared food that diners may select from along a serving line or counter. Examples include:
 - a. Schools
 - b. Hospitals

- c. Correctional Facilities
- 3. **Events:** Events at both established avenues that include permanent infrastructure and temporary avenues that lack permanent infrastructure to sell food and drinks. The presence of single-use plastic food service ware at temporary events may be higher due to a lack of on-site sanitation infrastructure.
 - a. Established event venues include:
 - i. Concerts
 - ii. Sports events
 - b. Temporary events include:
 - i. Farmer's markets
 - ii. Holiday events and parades
 - iii. Privately catered events
- 4. **Transportation:** Transportation services that travel through or within California and serve meals. Examples include:
 - a. Trains
 - b. Planes
- 5. **Personal consumption:** Use of food service ware items at home or at special events outside of any other avenues. Only certain food service ware items are estimated through personal consumption, specifically:
 - a. Trays
 - b. Plates
 - c. Bowls
 - d. Clamshells
 - e. Lids
 - f. Cups
 - g. Utensils
 - h. Stirrers
 - i. Hinged or lidded containers
 - j. Straws

Table 6. Types of Avenues by Category

Category of Avenue	Type of Avenue
Food and Drink	Full- Service Restaurants
	Quick-Service Restaurants (QSR)
	Food Trucks
	Ghost Kitchens
	Cafes
	Bakeries
	Ice-cream Trucks
	Bars/Pubs
	Hotels
	Motels
	Museums
	Zoos and Botanical Gardens
	Theme Parks
	Grocery Stores (prepared meals)
Cafeterias	Workplaces
	Schools: Pre-K – High School
	Higher Education: Public Colleges
	Higher Education: Private Colleges
	Higher Education: Community Colleges
	Hospitals
	Prisons
	Retirement Centers
Events	Concerts
	Sports Events
	Farmer's Market
	Holiday Events (e.g., parades)
	Private Events (catering services)
Personal Consumption	Individual Purchases
	Parties Hosted by Households
Transportation	Air Travel (leaving/staying in California)
	Rail Travel

Example: Food Trucks as a Type of Avenue under Food and Drink

Accenture identified food trucks as one of 14 types of avenues within the food and drink category. While food trucks are similar to quick-service restaurants, they often provide more single-use food service ware compared to restaurants due to the lack of on-site sanitation infrastructure.

Step 2: Estimating Total Number of Meals Served at Each Type of Avenue that Provide Single-Use Food Service Ware

For each type of avenue, Accenture estimated the total number of meals served per year and the number of meals served that resulted in the use of single-use food service ware. For example, full-service restaurants (i.e., sit-down restaurants) often use reusable dinnerware and provide single-use food service ware to consumers only for takeout orders and leftovers. More information can be found in Appendix section Assumptions by Food Service Ware Avenue.

Generally, Accenture used four main variables to calculate the number of meals served per year for each type of avenue, including only those that result in the use of single-use food service ware:

1. Number of locations for each type of avenue in California

Accenture identified an estimated number of locations across California (e.g., the number of hotels in California) for most types of avenues. Since Accenture was able to identify the number of people served daily across California for some avenue types (e.g., theme parks), the total number of locations was not needed. For example, Accenture identified data on annual theme park attendance to estimate the number of people served daily (see #2).

2. Number of people served daily per type of avenue

Accenture identified an estimated “number of people served daily” value, which represents the total number of people a single avenue of that type serves each day and does not necessarily reflect the total number of meals served that use single-use food service ware.

For example, at hotels, only a small number of nightly occupants will consume a meal associated with single-use food service ware.

For avenues where data sources provided a range of people served per day, the middle of the range was used to account for large and small avenues of the same type.

3. Number of operational days in a year

Accenture estimated a number of operational days in 2023 for all avenue types. Some types of avenues were assumed to be open daily (365 days), while others are assumed to operate only five days per week (260 days).

4. Number of meals resulting in use of single-use food service ware per person served

Accenture estimated the number of meals per person served at each avenue that resulted in the use of single-use food service ware, both plastic and non-plastic. Due to limited data availability, Accenture assumed a default value of one meal using single-use food service ware per person per day across most avenues. For some types of avenues, Accenture assumed that not all people served by an

avenue consumed a meal. For example, Accenture estimated that only 1 in 2.8 people at theme parks and zoos consumed a meal.⁷ For example, Accenture assumed that 1 in 4 customers of full-service restaurants use single-use food service ware for takeout or leftovers, while the remainder use reusable food service ware.

For each type of avenue, the number of avenues was multiplied by the number of people served daily, the number of operational days per year, and the number of meals resulting in the use of single-use food service ware per person served to result in an estimate of the number of meals per type of avenue associated with single-use food service ware.

Whenever possible, Accenture used data specific to California. If data for a type of avenue applied to the entirety of the United States, Accenture used a population-based proxy to determine what percentage of avenues were in California. A population-based proxy assumed demand for avenues at a macro-level was driven by population centers.

If data for a type of avenue was provided for a city within California (e.g., Los Angeles), Accenture used a gross domestic product (GDP)-based proxy to determine the percentage of avenues in California. A GDP-based approach assumed demand for avenues within California was driven by where there was a more concentrated generation of revenue and economic output.

More information on special considerations for some categories of avenues can be found below and in Appendix Assumptions by Food Service Ware Avenue.

Events

- For events in established avenues, Accenture calculated the total number of avenues using a proxy. For example, Accenture calculated sports events by using the total number of professional stadiums and stadiums at universities in California. For sports events at universities, Accenture assumed each California public college had a single stadium that generated food service ware items and only one in two private colleges were large enough to have a single stadium that could generate food service ware items.
- For events in temporary types of avenues (farmer's markets, holiday events, private events), Accenture used the total number of companies that host events and the number of temporary events hosted per year.

Transportation

- Accenture estimated the number of transit events based on published schedules and ridership on planes and trains traveling through or within California.

Personal Consumption

- Accenture used the number of households in California as the number of avenues in California.

- Accenture assumed that 1% of households in California use single-use food service ware for 2 meals per day.
- Special occasion use refers to parties hosted at a personal household where single-use food service ware is used to serve several guests. Accenture assumed that 31% of households host parties using single-use food service ware each year and that each household that hosts parties hosts on average a total of 4 parties per year⁸ with an average of 12 guests each.

Example: Number of Meals at Food Trucks Resulting in Use of Single-Use Food Service Ware

Accenture assumed that 1,023 food trucks across California are operational 260 days per year. Each food truck is assumed to serve 450 customers per day that resulted in the use of single-use food service ware. Based on these assumptions, it was estimated that nearly 120 million meals per year were served at food trucks that used single-use food service ware.

Step 3: Classifying Representative Meals and Associated Single-Use Food Service Ware

Based on the types of avenues identified in Step 1, Accenture created nine types of representative meal options (see Appendix section Representative Meals Descriptions for more information). Accenture created representative meals to apply across different types of avenues with similar characteristics and only assigned each type of avenue one type of representative meal. Accenture based the different types of representative meals on the type of food items that are likely to be purchased at different avenues.

For example, Accenture created a representative meal called “drink and supplementary food order.” This representative meal type is used for types of avenues such as cafés, museums, and theme parks, where people were assumed to predominantly purchase drinks with a portion of orders including a small food item on the side.

Accenture assumed that types of avenues associated with full meals included at least one large primary food serving, one drink, and additional side food dishes, condiments, or other toppings. For a list of types of avenues associated with each type of representative meal, see Table 7.

Table 7. Representative Meals and Associated Avenues

Representative Meal Types	Associated Types of Avenues
Meal – Food and Drink	Full-service restaurants, food trucks, ghost kitchens
Meal – Cafeteria	Schools/colleges (pre-K – 12 schools, public colleges, private colleges, community colleges), hospitals, workplaces, prisons, retirement centers
Meal – Event	Sports events, temporary events at private venues
Meal – Quick-Service Restaurant (Meal – QSR)	Quick-service restaurants
Drink + Supplementary Food Order	Cafes, bakeries, ice cream trucks, hotels, motels, museums, zoos and botanical gardens, theme parks, farmer’s markets, temporary holiday events
Drink Only	Bars/pubs, concerts
Other – Grocery	Ready-to-eat meals from grocery stores
Other – Travel	Planes, trains
Personal Consumption	Daily use, special occasion use

Types of Single-Use Food Service Ware in Representative Meals

Accenture identified the types of single-use food service ware associated with each type of representative meal, including both plastic and non-plastic options (see Table 8).

Accenture identified the following types of food service ware potentially associated with representative meals:

- Cutlery
- Food containers
- Supplementary food containers
- Drinks
- Tableware
- Others food service ware items.

Within each type of single-use food service ware, Accenture also included items that are supplementary to that food service ware (e.g., lids, straws, stirrers) and estimated their frequency of use.

- **Cutlery:** Food service ware items designed to aid in the eating or serving of food and included plastic and non-plastic:
 - Knives
 - Forks
 - Spoons
- **Food Container:** These food service ware items are designed to contain the largest portion of food:

- Clamshells
- Plastic containers and lids (lids included as a supplementary item)
- Food trays
- Non-plastic containers
- **Supplementary Food Containers:** These food service ware items are designed to contain other food outside of the main container (e.g., sauces, rice, etc.):
 - Sandwich boxes and stable packaging
 - Wraps or wrappers
 - Condiment cups and lids (included as supplementary items)
 - Non-plastic containers
- **Drinks:** These food service ware items are designed to contain liquids for consumption:
 - Cups and lids for cold products (lids included as supplementary items)
 - Cups and lids for hot products (lids included as supplementary items)
 - Straws and stirrers (included as supplementary items)
 - Non-plastic containers
- **Tableware:** These food service ware items are designed for eating meals outside of the other food service ware containers and included:
 - Plates
 - Bowls
 - Non-plastic containers
- **Other:** Bags associated with food service establishments and included plastic bags and non-plastic bags.

Table 8. Representative Meals and Single-Use Food Service Ware Component Types

	Meal - F&D	Meal - Cafeterias	Meal - Event	Meal - QSR	Drink and Supplementary Food	Drink only	Other - Grocery	Other - Travel	Personal Consumption
Plastic Cutlery	X	X	X	X			X		X
Non-Plastic Cutlery		X							
Clamshell	X	X	X	X			X		
Plastic Cups	X	X	X	X	X	X	X	X	X
Plastic Cup Lids	X	X	X	X	X		X	X	
Plastic Cups for Hot Products	X	X	X	X	X	X	X	X	X
Plastic Cup Lids for Hot Products	X	X	X	X	X		X	X	
Non-Plastic Drink Container		X							
Straws	X	X	X	X	X	X		X	X
Plastic Containers	X	X	X	X			X		
Plastic Container Lids	X	X	X	X			X		
Non-Plastic Food Containers	X	X	X	X					
Plastic Condiment Cups and Lids	X	X	X	X			X		X
Stirrers					X			X	
Plastic Plates		X	X						X
Plastic Bowls		X	X						X
Non-Plastic Plates & Bowls		X	X						X
Plastic Food trays							X		
Plastic Sandwich Box/ Stable Packaging	X		X	X	X		X	X	
Plastic Wraps or Wrappers	X		X	X	X		X	X	
Non-Plastic Supplementary Container	X			X					
Plastic Bags	X			X					
Non-Plastic Bags	X			X					

Estimated Use of Single-Use Food Service Ware per Representative Meal

For each representative meal, Accenture assumed the frequency of use of each type of food service ware item within each food service ware category. For example, for a drink and supplementary food order representative meal, Accenture assumed:

- Single-use plastic cups for cold products and their associated lids were provided in 90% of meals.
- Plastic cups for hot products and their associated lids were provided in 10% of meals.
- Plastic straws were provided in 50% of meals.
- Plastic stirrers were provided in 50% of meals.

Accenture estimated the use of single-use non-plastic food service ware and omitted them from the results of the model.

For example, Accenture assumed that a drink and supplementary food order representative meal did not include non-plastic drink cups. Accenture also assumed that 60% of cafeteria meals included a non-plastic drink container.

A complete list of representative meals and their associated components can be found in the Spreadsheet, SRB model (Worksheet "*Rep Meal & Proxy Indices- FSW*").

Estimated Weight and Number of Plastic Components of Food Service Ware per Representative Meal

Accenture assigned each item of food service ware associated with a representative meal a value for weight of plastic. Each item of food service ware was considered one plastic component. Accenture determined the weight of a type of food service ware by averaging the weight of several different versions of that item. For example, the assumed weight of a clamshell was the average weight of nine different versions of common sizes and resin types.

Example: Food Service Ware Per Representative Meal at a Food Truck

Food trucks were associated with the food and drink type of representative meal (see Table 9 for food service ware items included within that representative meal type). Accenture estimated that food truck meals included two food containers. Accenture identified three types of food containers likely to be provided by food trucks:

- Plastic clamshells,
- Plastic food containers, and
- Non-plastic food containers.

For each representative meal, 0.8 plastic clamshells, 0.8 plastic food containers, and 0.4 non-plastic food containers were assigned, which add up to two total food containers per meal.

The average weight of a plastic clamshell was 0.07 pounds and the average weight of a plastic container was 0.05 pounds. To estimate the weight of plastic containers per representative meal, the 0.8 clamshells were multiplied by 0.07 pounds and the 0.8 plastic food containers were multiplied by 0.05 to equal 0.1 pounds of plastic food containers in each representative meal. The portion associated with non-plastic containers was not considered in estimating the weight and number of plastic components.

Accenture calculated every type of food service ware included within a representative meal to identify a total weight of food service ware per representative meal.

Step 4: Estimating the Amount of Food Service Ware

The weight and number of plastic components of food service ware items used per type of avenue per year was estimated based on the estimated number of meals per type of avenue per year estimated in Step 2 and information on the representative meal associated with that type of avenue as established in Step 3.

For each type of food service ware (e.g., plastic cutlery), the number of meals per type of avenue per year was multiplied by the estimated frequency of that type of food service ware, as established in the representative meal in Step 3. This resulted in the estimated number of each type of food service ware used per avenue per year.

Accenture assumed that each food service ware item (e.g., fork, tray, lid) represented one plastic component. The number of plastic components for each type of food service ware was summed across all types of avenues to estimate the total number of plastic components for each type of plastic food service ware across all types of avenues.

The total number of plastic components across all avenues for each type of food service ware was multiplied by the weight of each type of food service ware resulting in the weight for *each* type of plastic food service across all avenues. This weight was totaled across *all* the types of plastic food service ware to estimate the total weight of all food service ware across all avenues.

Example: Weight and Number of Plastic Components of Food Service Ware Associated with Plastic Clamshells

In Step 3, Accenture estimated that 0.8 clamshells were used per representative meal at a food truck. This estimate was multiplied by the almost 120 million meals per year served at food trucks that used food service ware in California to estimate about 9.5 million clamshells are used per year by food trucks. This estimate and calculation were repeated across all types of avenues for clamshells to estimate 2 billion clamshells across all avenues, which was assumed to also be the number of plastic components. The number of clamshells was multiplied by the estimated weight of a clamshell (0.07

pounds) resulting in an estimate of 67,000 tons from clamshells used across all avenues.

Results

According to the results of the Single-Use Plastic Food Service Ware Model:

- The total weight of food service ware was 0.49 million tons (Table 9) and contributed 17% to the overall weight generated (see Table 1).
- The number of plastic components estimated for food service ware totaled to 87 billion (Table 9) and contributed approximately 50% of the total plastic components generated (see Table 1).
- The weight and number of plastic components of food service ware is presented by avenue type in Table 10.

Table 9. Weight and Plastic Components of Food Service Ware

Amount	Total
Weight (Million Tons)	0.49
Plastic Components (Billions)	87

Table 10. Total Weight and Number of Plastic Components Used in Single- Use Plastic Food Service Ware by Avenue Type (tons)

	Food and Drinks	Cafeterias	Events	Personal Consumption	Transportation	Total
Weight (Thousand Tons)	339	105	23	17	2.9	487
Plastic Components (Billion)	64	17	3.5	2.6	0.32	87

Single-Use Packaging for Single-Use Plastic Food Service Ware

Overall Approach

Accenture used the Single-Use Packaging for Single-Use Plastic Food Service Ware Model to estimate the amount of plastic packaging (primary, secondary, and tertiary) used to package single-use plastic food service ware. Accenture used the amount of food service ware estimated in the Single-Use Plastic Food Service Ware Model to estimate the weight and number of plastic components of associated packaging.

In order to avoid double-counting of food service ware, the Single-Use Plastic Packaging Model described previously in the report excludes the NAICS code 326199, which is associated with some types of plastic manufacturing, including manufacturing of food service ware. Therefore, that model did not estimate packaging used for food service ware. The Single-Use Packaging for Single-Use Plastic Food Service Ware model addresses this gap.

High-Level Steps:

Step 1: Establishing Packaging Profiles for Food Service Ware

Accenture assigned a packaging profile with both B2B and B2C versions for each type of food service ware estimated in the Single-Use Plastic Food Service Ware Model. The packaging profiles included:

- The number of food service ware items per package.
- The type of primary, secondary, and tertiary packaging used
- The weight and number of plastic components.

Step 2: Estimating the Amount of Packaging for Food Service Ware

Accenture estimated the amount (i.e., weight and number of plastic components) of packaging associated with each type of food service ware item. The estimated number of food service ware items (e.g., number of cutlery) used in California in 2023 established in the food service ware model was used to estimate the amount of primary, secondary, and tertiary packaging associated with those items. Food service ware associated with personal consumption in the food service ware model used the packaging profile associated with B2C food service ware. Food service ware associated with all other avenue types used the packaging profile associated with B2B food service ware. This was repeated for each type of food service ware and summed to get a statewide total.

Packaging for Single-Use Plastic Food Service Ware Methodological Details

Step 1: Establishing Packaging Profiles for Food Service Ware

Similar to the Single-Use Plastic Packaging Model, packaging profiles were created for each type of food service ware estimated in the Single-Use Plastic Food Service Ware Model (e.g., plastic cutlery, plastic clamshells). The packaging profiles included the number of food service ware items per package as well as the type of packaging used for food service ware items (e.g., plastic film bag for plastic bowls or paperboard box with plastic window for plastic forks). To establish the packaging profile, the type of primary packaging, size, shape, weight, and other characteristics of the food service ware product were established using information from retailer websites for the top-selling versions.

Food service ware products under all avenues (excluding personal consumption) were assigned a B2B packaging profile; assuming that these products were distributed in bulk formats directly to the end user operating the avenue (e.g., restaurant). For B2B food service ware products, only primary packaging was included in the packaging profiles. Food service ware for personal consumption were assigned a B2C packaging profile, assuming that these products were distributed to consumers only. The B2C packaging profile included primary, secondary, and tertiary packaging. Secondary and tertiary packaging was estimated based upon the size, shape, weight, and other characteristics of the primary packaging as described in the Single-Use Plastic Packaging Model (see Single-Use Plastic Packaging Model, Step 4: Developing a Plastic Packaging Profile for Each Representative Product; Estimating the Amount of Secondary and Tertiary Packaging).

The total weight and number of plastic components was estimated for each packaging profile. Physical dimensions and weights were collected from a range of sources, which are detailed further in the Appendix (Packaging Library Data Sources).

The packaging profiles are further detailed in the Appendix (Single-Use Plastic Food Service Ware Packaging) and the Spreadsheet, SRB model (Worksheet “*SUP Packaging – FSW.*”)

Example: Single-Use Plastic Cutlery Packaging Profile

Packaging for B2C single-use plastic cutlery (personal consumption avenue types)

The packaging profile assumed B2C single-use plastic cutlery was sold in a 24-count paperboard box with a plastic window. The plastic window was identified as a plastic component with a weight of 0.001 pounds.

Master cases, designated as secondary packaging, included a RSC cardboard box with two pieces of tape to seal the box. The weight of the box was not included because it is not plastic, but the weight of the two pieces of tape was estimated to be 0.006 pounds.

Accenture assumed tertiary packaging was a pallet with stretch film and four plastic straps. Stretch film weight was estimated based on the weight of the pallet with the representative product, and as such is variable across products. Each plastic strap was estimated to be 0.07 pounds each.

Packaging for B2B single-use plastic cutlery (all other avenue types, excluding personal consumption)

The packaging profile assumed that B2B single-use plastic cutlery was sold in a 1,000-count box. Two pieces of tape to close the box were identified as plastic components with an estimated total weight of 0.006 pounds. B2B customers of food service ware were assumed to be ordering directly from a manufacturer or distributor who provides the items directly; therefore, there were no secondary or tertiary packaging as all shipments were made directly to the end user on an as-needed basis.

Step 2: Estimating the Amount of Packaging for Each Type of Food Service Ware

Accenture separately estimated the amount of primary, secondary, and tertiary packaging associated with each type of food service ware item sold, offered for sale, or distributed in 2023.

To estimate primary packaging for each type of food service ware, the estimated number of each type of food service ware item established in the Single-Use Plastic Food Service Ware model was divided by the estimated number of items per package as established in the packaging profile. This resulted in an estimated number of primary packages of food service ware. The weight and number of plastic components per primary packaging established in the packaging profile were multiplied by the estimated number of packages to estimate the amount of primary packaging for each food service ware type.

To estimate secondary packaging associated with B2C food service ware, the volume of a master case was divided by the volume of the primary packaging to estimate the number of master cases used by food service ware type. The weight and number of plastic components per master case established in the packaging profile were each multiplied by the number of master cases to estimate the amount of secondary packaging for each food service ware type.

To estimate tertiary packaging associated with B2C food service ware, Accenture estimated the number of master cases that could fit on a pallet. The volume of the pallet was divided by the volume of the master case and was limited to the maximum weight capacity of a pallet. This resulted in an estimated number of pallets which was then multiplied by the weight and number of plastic components for tertiary packaging established in the packaging profile.

Example: Packaging for B2C Single-Use Plastic Cutlery

The Single-Use Plastic Food Service Ware Model estimated that about 1.5 billion single-use plastic cutlery were sold in California. In the packaging profile, Accenture assumed that B2C cutlery was sold in packs of 24. Dividing the number of cutlery by the count per box resulted in an estimated 61 million 24-count boxes. For each box, a plastic window was the plastic component, estimated to weigh 0.001 pounds which resulted in an estimate for primary packaging of 61 million plastic components and 70,000 pounds of plastic.

The number of boxes of cutlery per master case was calculated by dividing the volume of the master case (3,600 cubic inches) by the volume of the box of cutlery (23 cubic inches), resulting in a maximum number of 154 boxes of cutlery per master case. By dividing the total number of boxes of primary packaging by the number of boxes per master case, it was estimated that about 394,000 master cases were used as secondary packaging. For each master case, two pieces of tape were used, i.e., two plastic components estimated to weigh 0.0006 pounds each, which resulted in an estimate of secondary packaging of 2,300 pounds of plastic and 788,000 plastic components.

To determine the number of master cases that could fit on a pallet, the volume of the pallet was divided by the volume of the master case and was limited to the maximum weight capacity of a pallet. The estimated volume of the pallet was 115,200 cubic inches and the estimated volume of a master case was 3,600 cubic inches, meaning that 32 master cases could theoretically fit on the pallet, by volume.

The weight of a master case was calculated by multiplying the number of products per master case (154) by the weight of the product (0.2 pounds). The weight of a master case (33.88 pounds) was multiplied with the number of master cases that could fit on a pallet (32) to arrive at the weight of a pallet with the product. A pallet weight of about 1,000 pounds, is categorized as light for pallets (i.e., between 600 and 1,200 pounds) which determines the appropriate amount of stretch film is added for a light categorization.

The number of pallets of master cases was estimated by dividing the 394,000 master cases by the capacity of the pallet (32) to estimate that about 12,000 pallets were used. To calculate the weight of tertiary plastic packaging per pallet, the weight of the stretch film (0.31 pounds) was added to the weight of the straps (0.07 pounds each), with all pallets having four straps. This resulted in an estimate of five plastic components and 0.58 pounds of plastic associated with tertiary packaging. Multiplying each of these numbers by the number of pallets resulted in an estimated 62 thousand plastic components and 7,000 tons of plastic associated with tertiary packaging.

Results

According to the results of the Single-Use Plastic Food Service Ware Packaging model (Table 11), packaging associated with food service ware contributed approximately 410 tons, or less than 1% to the estimated total packaging weight generated in 2023. By

plastic component, food service ware packaging contributed 0.29 billion plastic components, or less than 1% of the total number of packaging components generated.

Table 11. Weight (Million tons) and Plastic Components (Billions) of Packaging for Food Service Ware

	Total
Weight (Tons)	410
Plastic Components (Billions)	0.29

Abbreviations and Acronyms

Abbreviation	Description
AB	Assembly Bill
B2B	Business-to-Business
B2C	Business-to-Consumer
CA	California
CIRT	Can I Recycle This
DC	Distribution center
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
HDPE	High Density Polyethylene
HS code	Harmonized System codes
In	Inches
In ²	Squared inches
In ³	Cubic inches
Lbs.	Pounds
LCA	Life-Cycle Assessment
Mfg.	Manufacturing
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
PET	Polyethylene terephthalate
PP	Polypropylene
PVC	Polyvinyl chloride
QSR	Quick-service restaurant
RP	Representative product
RSC	Regular slotted container (box)
SA	Surface area
SB 54	Senate Bill 54
SCTG	Standard Classification of Transported Goods

Abbreviation	Description
SKU	Stock-Keeping Unit
SRB	Source Reduction Baseline
USDA	United States Department of Agriculture
U.S.	United States
Weight	Weight of plastic only, unless otherwise stated

Confidential Data

Accenture collected and reviewed confidential data sources during the collection of potential data to use in the estimation of the source reduction baseline. Ultimately while this confidential data was sourced and analyzed to develop an approach to the model, no confidential data sets or points were used in the final generation of any of the models.

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 American Chemistry Council, Resin Review 2024, American Chemistry Council, Washington DC, 2024, pp. 9.

² NAICS North American Industry Classification System <https://www.naics.com/>

³ Bread and Bakery Product Manufacturing, NAICS, <https://www.naics.com/naics-code-description/?code=311812>

⁴ MobiLoud, Top 9 eCommerce Categories Fueling US Online Shopping Growth, October 29, 2024, <https://www.mobiloud.com/blog/top-e-commerce-categories-in-the-us>

⁵ Amazon, Packaging Innovation <https://sustainability.aboutamazon.com/waste/packaging>

⁶ Packaging World, Amazon Close to Eliminating All Plastic Air Pillows From Packaging, June 20, 2024, <https://www.packworld.com/sustainable-packaging/article/22913164/amazon-nearly-eliminates-plastic-air-pillows-from-packaging>

⁷ For Rec, Theme Parks by the Numbers, For Rec, June 2018, <https://forrec.com/theme-parks-by-the-numbers/>

⁸ SWNS Digital, Here's how much the average American spends a year to host parties, SWNS Digital, September 2021, <https://swnsdigital.com/us/2019/11/heres-how-much-the-average-american-spends-a-year-to-host-parties/>