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GUIDE TO POST-CONSUMER RECYCLED (PCR) CONTENT IN PLASTIC PACKAGING

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INTRODUCTION

At Berlin Packaging, we partner with our customers to unpack their full sustainability potential by creating packaging solutions that optimize sustainability, functionality, performance, brand impact, cost, and material availability.

Collaborating with qualified suppliers, we source PCR materials, some with no upcharge, and work with our customers to seamlessly integrate PCR into their product portfolios and advance their sustainable packaging goals. In 2023, we sold more than **900 metric tons** of PCR plastic, reducing the amount of virgin material in our customers' packaging.

This Guide provides a useful overview of PCR plastic:

- Polymer types
- Environmental benefits
- Manufacturing methods
- Market drivers
- Regulations
- Supply and end uses
- Applications and success stories
- Specifications



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WHAT IS PCR?

Post-consumer recycled (PCR) content refers to materials recovered from the waste stream after consumer use, such as plastic and glass bottles, aluminum beverage cans, and other packaging waste. The recycled content is reused to make new packaging. Types of PCR content include plastic, glass (referred to as cullet), aluminum, steel, and paperboard (fiber).



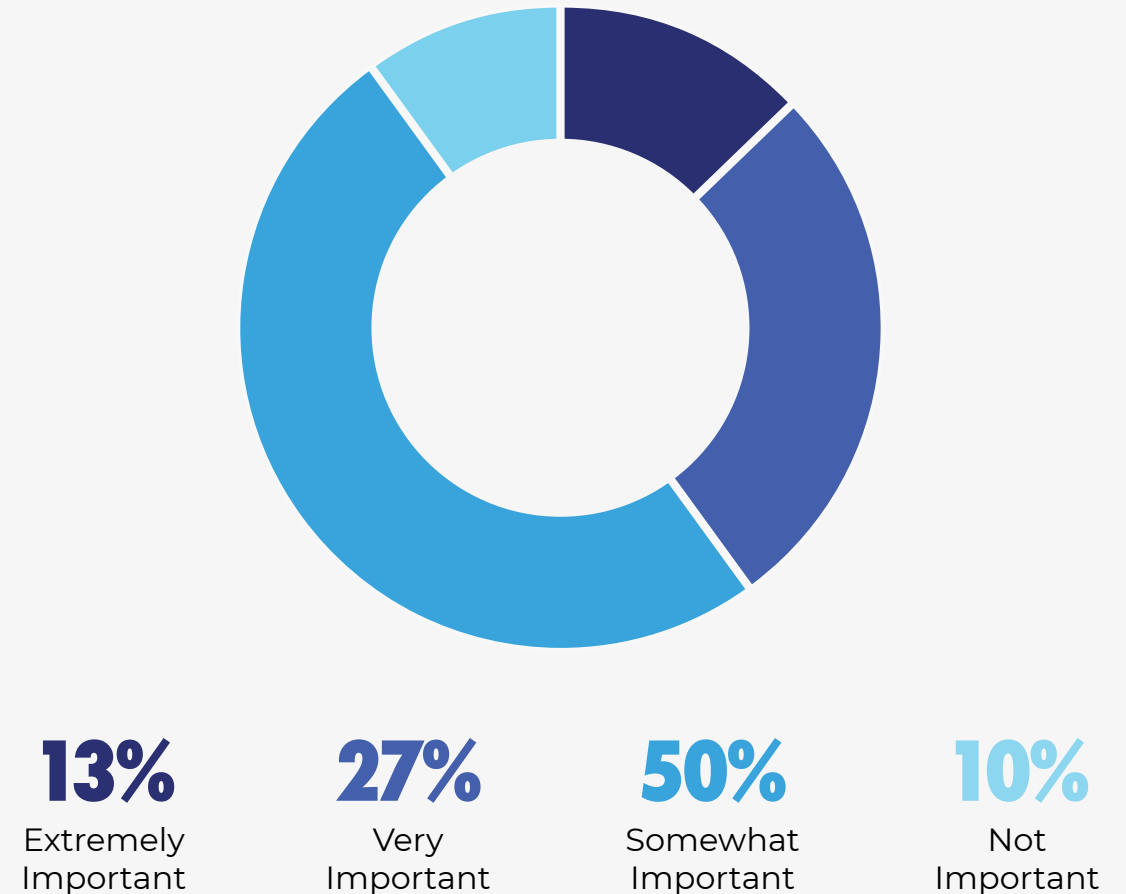
WHAT ARE THE BENEFITS OF PCR PLASTIC?

Recycling plastic (mostly PET, HDPE, and PP) diverts waste from landfills or incineration, conserves natural resources, and reduces the need for virgin materials. Incorporating PCR content in plastic packaging extends material life cycles, saves energy, lowers greenhouse gas emissions, reduces the carbon footprint, and contributes to the circular economy, according to the [U.S. Plastics Pact](#).

PCR plastic is an integral part of sustainable packaging solutions. Around two-thirds of U.S. consumers say sustainable packaging is at least somewhat important when making a purchase, according to a [2023 survey from McKinsey](#). About half of consumers are willing to pay more for sustainable packaging. Over half (53%) of survey respondents view “plastic bottles and containers made out of recycled plastic materials” as “extremely/very sustainable”.

In an earlier [McKinsey study \(2020\)](#), U.S. consumer concerns about the environmental impact of product packaging were spread almost equally among several factors like water pollution, marine litter, air pollution, climate change, deforestation, and resource depletion. However, the 2023 McKinsey survey revealed a surprising change. U.S. consumers overwhelmingly rank marine litter as their top environmental worry for packaging.

Consumer Purchase Factor: Environmental Impact of Packaging



Source: McKinsey 2023 Survey

OCEAN-BOUND PLASTIC

This growing concern over marine litter may be a boon to ocean-bound plastic, which is plastic waste recovered from within 30 miles of a coastline or collected from beaches and coastal waterways that pose a risk of entering the ocean. It is not plastic waste salvaged from the ocean.

Ocean plastic waste can also be recovered and recycled into PCR plastic. However, sunlight, salt water, marine organisms, and other factors can degrade ocean plastic waste, which may require extensive processing, sorting, and cleaning, and limit its end uses.

Ocean-bound plastic is typically collected from locations in developing countries lacking solid waste management systems. The recovered plastic can then be sent to recycling facilities and repurposed into new materials. To ensure the validity of ocean-bound plastic, several organizations certify that plastic waste is correctly collected and managed. These certification providers can verify where the material was collected, who collected it, and how and where it was sorted to ensure it meets quality, ethical, environmental, and labor standards.





Berlin Packaging has partnered with Prevented Ocean Plastic™, the world's leading ocean plastic prevention program, to offer our customers high-quality recycled plastic packaging that makes a difference for the environment and local communities. Choosing Prevented Ocean Plastic™ helps mitigate plastic pollution while meeting PCR packaging goals, supporting brand sustainability and social governance, and promoting a circular economy.

Because PCR content from ocean-bound plastics is considerably more expensive than virgin resins, the applications for these recycled resins tend to be in products with higher price margins, such as personal care and beauty.

Berlin Packaging's innovation and design center, [Studio One Eleven®](#), helped hair-care brand DevaCurl introduce more responsible packaging by using 50% ocean-bound HDPE in a custom bottle with the brand's signature green color. The matte-finish bottles are topped with custom curly disc-top caps made with 100% PCR plastic.



HOW IS PCR PLASTIC MADE?

PCR plastic resins are produced by one of two methods: mechanical recycling or advanced (chemical) recycling. Most PCR plastic resins are made by mechanical recycling, which involves waste collection (e.g., curbside recycling programs, drop-off centers), sorting, cleaning, grinding/shredding, melting, and extrusion.

Sorting at material recovery facilities (MRFs) separates the plastic waste by type (e.g., PET, HDPE, LDPE, PP) and color. Clear PET generally garners the highest value because it can be used in a variety of end-use applications and is cost-effective to process through the recycling system.

Transparent light green PET is also valued, comprising up to 30% of recycled PET. Transparent light blue PET can be blended with the clear PET stream to add a subtle blue tint and offset some yellowing of the material. It can also be added to the light green stream with minimal effects. Opaque-colored and white PET reduces its value and is normally not recycled, while other colors used for transparent PET bottles can be sorted and recycled into lower value, dark-colored fiber or sheet products.

Similar to PET, MRFs prize white and natural HDPE (e.g., milk jugs), but they will accept different colors.





Cleaning helps to remove any product residues, contaminants, dirt, labels, adhesives, etc. to ensure the purity and quality of the recycled material. After washing, the plastic is shredded into smaller pieces called flakes. Melting the flakes removes further impurities, and the molten plastic can be extruded into pellets.

Fun Fact: Consumers do not need to not rinse bottles containing shampoos or detergents before dropping them into the recycling bin. The detergent residues support the washing process.

Additives help reduce the degradation of the PCR due to the reheating and melting. The PCR plastic pellets can be used alone and blended at the molding machine or already blended with virgin resin by the PCR supplier for better consistency when manufacturing new packaging. PCR-based masterbatches are available that allow creating packaging with 100% PCR in a wide range of colors.

MARKET DRIVERS OF PCR PLASTIC

Three factors are driving the demand for PCR resin in plastic packaging:



Consumer preferences for sustainable packaging



Consumer packaged goods (CPG) companies' commitments to increase the recyclability and recycled content of their packaging



State legislation mandating greater amounts of recycled content in plastic packaging

PCR PLASTIC REGULATIONS

Five U.S. states mandate [minimum PCR content requirements](#) in plastic packaging:

[California](#): Plastic beverage bottles sold by beverage manufacturers are currently required by law to contain 15% PCR. That percentage will increase to 25% PCR by 2025 and 50% by 2030.

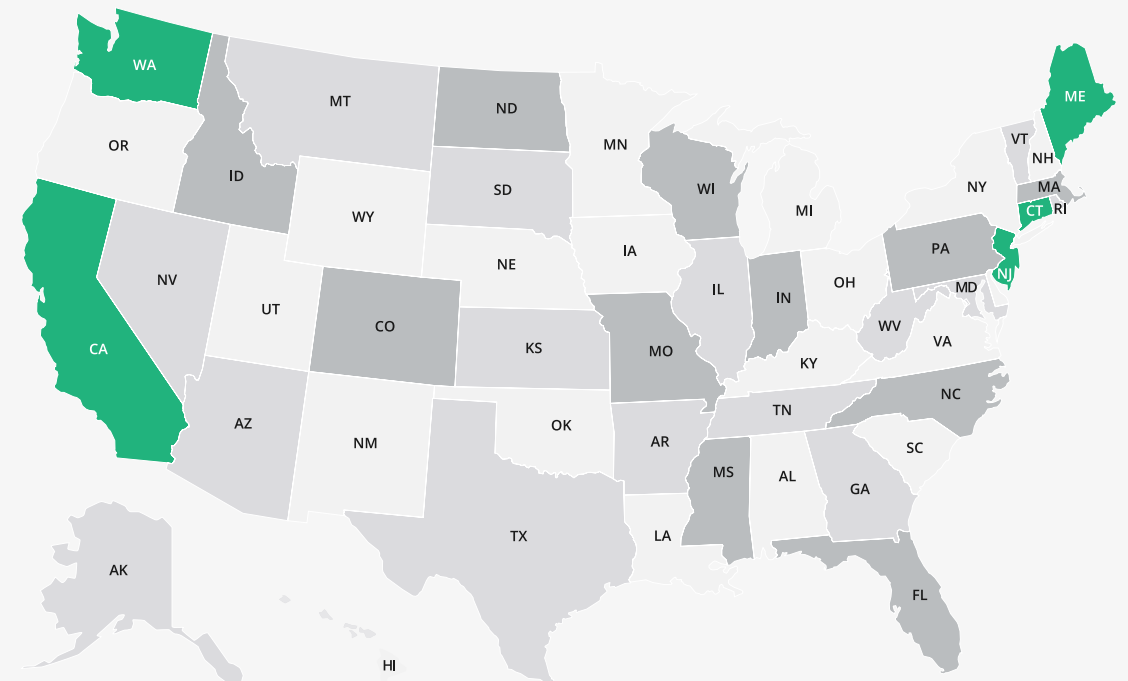
[Connecticut](#): Plastic beverage containers sold in the state must contain at least 25% PCR content by 2027 and 30% by 2032.

[Maine](#): Plastic beverage containers must contain at least 25% PCR content by 2026 and 30% by 2031.

[New Jersey](#): Single-use plastic beverage bottles sold in the state must contain at least 15% PCR content, and all other rigid plastic containers must contain at least 10% PCR. The amount of PCR content increases by 5% every three years (i.e., 20% in 2027, 25% in 2030, and so on) for beverage bottles and 10% every three years (i.e., 20% in 2027, 30% in 2030, and so on) for all other rigid plastic containers until reaching a 50% PCR threshold. Hot-fill applications are capped at 30% PCR.

[Washington](#): Most plastic beverage bottles must contain 15% PCR content, which increases to 25% by 2026 and 50% by 2031. For personal care and household cleaner products, the plastic packaging must contain 15% PCR by 2025, 25% by 2028, and 50% by 2031.

States with the Minimum Post-Consumer Recycled (PCR) Content Requirements



Source: Berlin Packaging

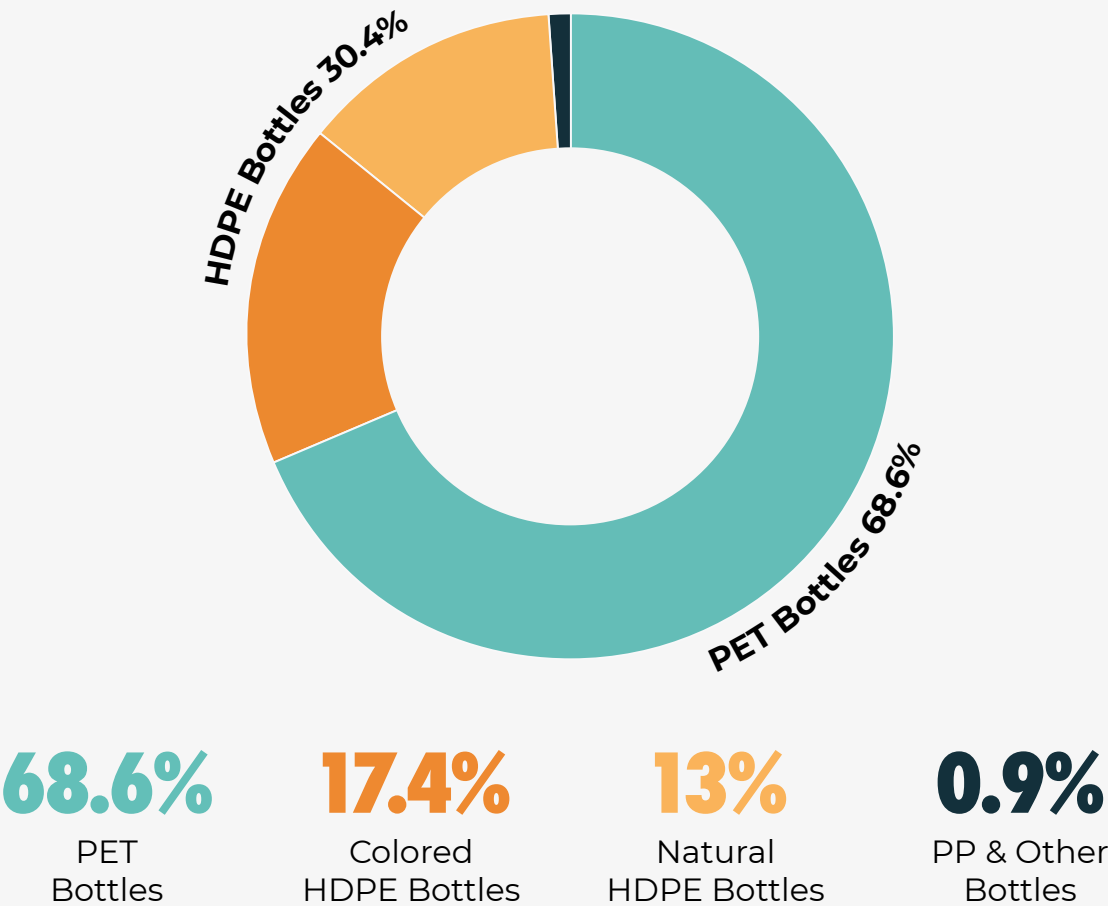
PCR PLASTIC SUPPLY

In 2022, about 5 billion lbs. of post-consumer plastic material sourced in the U.S. was recovered for recycling, according to the [2022 U.S. Post-consumer Plastics Recycling Data Study](#) (released in March 2024) conducted by Stina Inc. NAPCOR, Association of Plastic Recyclers, U.S. Plastics Pact, and ISRI contributed to the study.

More than 55% of the post-consumer plastic recovered for recycling was in the form of bottles, categorized as PET bottles (38%), HDPE bottles (17%), and PP and other bottles (<1%). Other post-consumer plastic recovered for recycling included non-bottle rigids at 22%, film at 22%, and other plastics (excluding foam) at <1%.

With 6.6 billion lbs. of resin used for PET bottle production and 1.9 billion lbs. of PET bottles recovered for recycling, the PET bottle recycling rate was 29% in 2022, notes the study. The HDPE bottle recycling rate was 27% in 2022, with 3.1 billion lbs. of HDPE resin for bottle production and 847 million lbs. recovered for recycling.

Percentage of Pounds of Bottles Recovered for Recycling by Plastic Type



Source: Stina Inc.

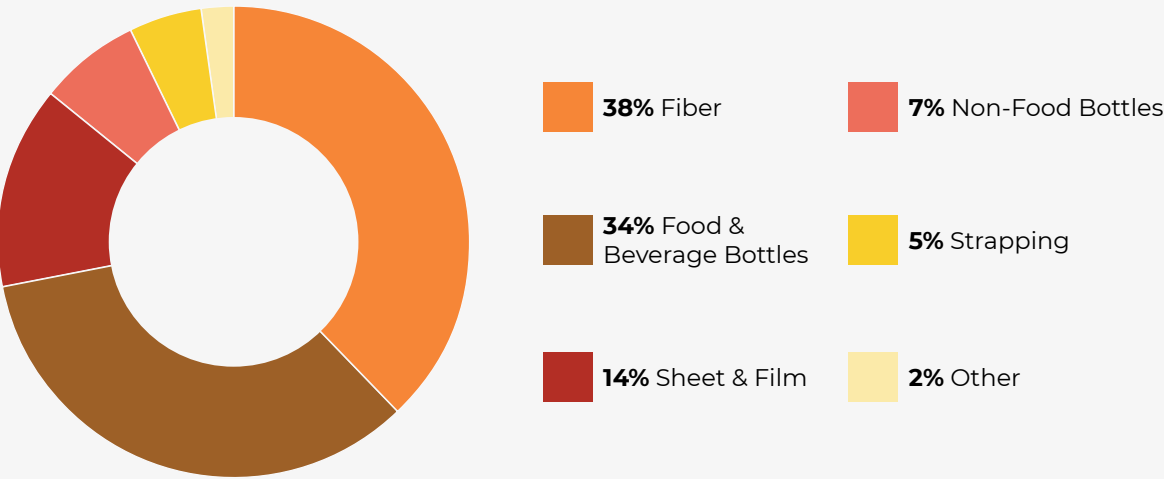
The packaging industry uses less than 50% of the market for PCR plastic resins. End-use markets for recycled PET bottles include bottles (food, beverage, and non-food), fiber, and other non-bottle end uses (e.g., sheet & film, strapping, etc.).

Most of the natural-color recycled HDPE bottles go into producing new bottles. Other uses include pipe, plastic lumber/decking, and lawn/garden products. The leading end use for recycled colored HDPE bottles is pipe, followed by lawn/garden products. Other notable end uses include automotive applications, bottles, construction products, plastic lumber/decking, and film/sheet.

End uses for recycled non-bottle rigid plastic are diverse: automotive products, pallets, crates, buckets, pipe, injection molded containers, plastic lumber/decking, lawn/garden products, other construction items, and railroad ties.

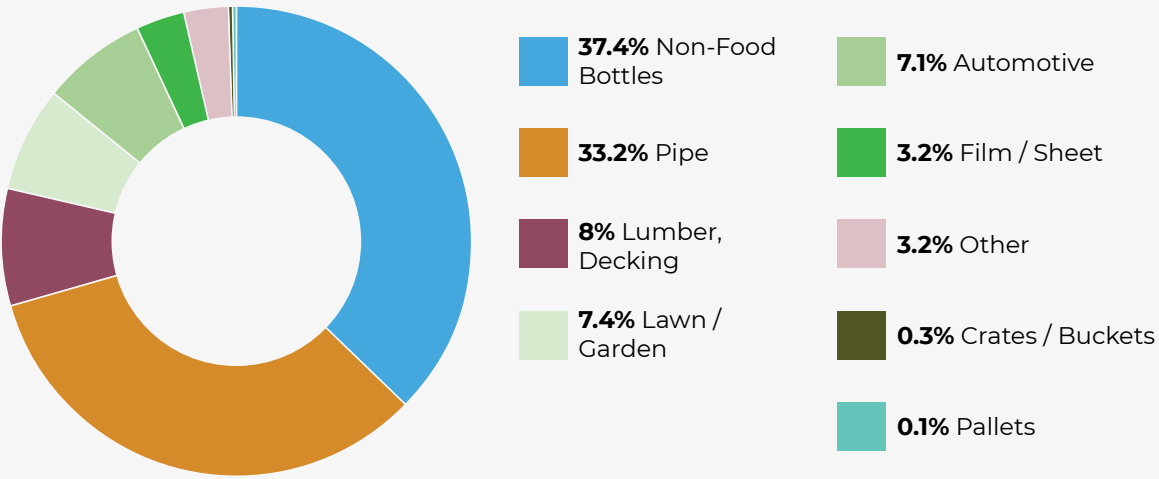
The primary end uses for recycled plastic film are plastic lumber/decking and new films (e.g., bags), followed by sheet and pipe, reports the study.

U.S. Recycled PET End Use Markets



Source: Napcor

U.S. Recycled HDPE End Use Markets



Source: ACC / APR

PCR PLASTIC PRICING

Several factors influence the pricing of PCR plastic. These market dynamics include supply, demand, collection rates of plastic, type of plastic, quality of the recycled content, imports, exports, seasonality (e.g., summer beverage peak demand for PET bottles), purchase volumes of PCR plastic, lengths of purchase contracts, regional differences (i.e., East Coast vs. West Coast), transportation costs, the price of virgin resins, and different pricing models.

In 2023, prices for non-food-grade PCR HDPE were generally higher than virgin HDPE, while prices for food-grade PCR PET were lower than virgin PET. This market condition has continued through the first quarter of 2024, according to data from ICIS.

Berlin Packaging subscribes to a leading market intelligence service for monthly reports on the supply, demand, inventory, and price of PCR plastics. This subscription builds upon our deep knowledge of the PCR resins market, provides a timely, accurate, and objective price index of PCR resins, and strengthens Berlin's capabilities to source and negotiate cost-competitive PCR plastic resins for our customers.



SPECIFYING PCR PLASTIC

Not all PCR plastic is identical. Closed-loop recycling, such as bottle deposit-redemption programs, typically delivers the cleanest materials with the highest grades. Examples include clear PET water bottles and natural HDPE milk jugs. Single-stream recycling combines all the plastic packaging, mixing different types and colors and increasing the likelihood of contaminants. These materials require sorting and cleaning.

Several variables like contaminants, impurities, heat, and oxidation can impact the quality, functionality, performance, batch-to-batch consistency, appearance, and odor of PCR plastic.

Using higher percentages of PCR plastic may result in the darkening or yellowing of transparent PET bottles.

This discoloration may result from contaminants or thermal degradation. Adding a light blue or gray tint to the material can mitigate this visual issue and provide color consistency. With opaque HDPE containers, choosing a muted colorant versus a brighter colorant can downplay the pigment variation from batch to batch.

Oxidation and repeated reprocessing (e.g., shredding, heating, extruding, injection molding, blow molding) of plastic can lead to brittleness, reduced strength, and less impact resistance. However, incorporating special additives during recycling can nullify these undesirable material properties.



100% Virgin



100% PCR

Contaminants such as paper labels and organic residues may create an odor in PCR plastic. Improved washing and deodorizing technologies of the plastic PCR flakes can remove the organic contaminants and minimize odor. In addition, paper labels and organic contaminants may create charred particles during the extrusion process that show up as black specks in the finished container.

Using PCR plastic as the core layer in a multi-layer structure with virgin materials on the exterior and interior layers can avoid most of the aesthetic issues.

Some brand owners require food-grade PCR plastic for their products, such as food, beverages, and pharmaceuticals. To ensure quality raw materials for food-grade PCR, many producers of recycled plastic for food-grade applications restrict their feedstock to post-consumer or post-industrial plastic previously designated as food-grade.

The FDA does not certify or approve food-grade PCR. Instead, food-grade PCR plastic producers petition the FDA for a “letter of no objection” (LNO). This request requires submitting a description of the complete recycling process (e.g., sourcing, quality assurance to prevent contamination), any tests performed on the food-grade PCR material, and a description of the proposed conditions of use.

While not a formal approval, the FDA LNO signifies that the recycling process likely will produce PCR plastic of suitable purity for food-contact applications.

PCR plastic has come a long way in recent years. Better sensors and manufacturing controls, increasing supplies of food-grade PET and HDPE PCR, advanced sorting and recycling technologies, and additives have produced higher grades of PCR with more uniform properties. These improvements have allowed up to 100% PCR in plastic packaging applications.

For Kenra’s Sugar Beach shampoo and conditioner packaging, Berlin Packaging’s Studio One Eleven® team created a sleek bottle made from 100% ocean-bound plastic with soft curves and an elongated neck, resembling the silhouette of a wine bottle.





We Believe Anything Is Possible[®]

With over 100 years in the packaging industry, more than 2,000 packaging professionals and a global network of suppliers and warehouses, we offer 50,000+ SKUs of plastic, glass, and metal containers, closures, and dispensing systems across all markets for customers just like you.

Our Business Model

Berlin Packaging combines the best elements of manufacturing, distribution and logistics, and value-added service providers to deliver cost-effective packaging solutions to our customers. Our mission is to improve our customers' net income through packaging products and services. We are the world's largest Hybrid Packaging Supplier[®].



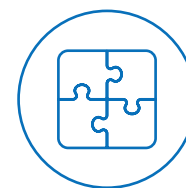
Best Elements of
a Manufacturer

+



Distribution
& Logistics

+



Value-Added
Specialty Services

Value-Added Specialty Services

Our compelling suite of solutions addresses your needs and unlocks profit.

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- Quality Service Management
- Global Sourcing & Services
- Inventory Management Services
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