RECOMMENDATIONS FOR

RECYCLED CONTENT

REQUIREMENTS FOR PLASTIC GOODS AND PACKAGING

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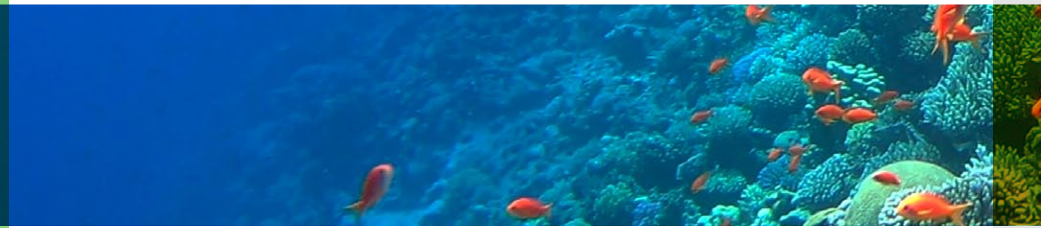

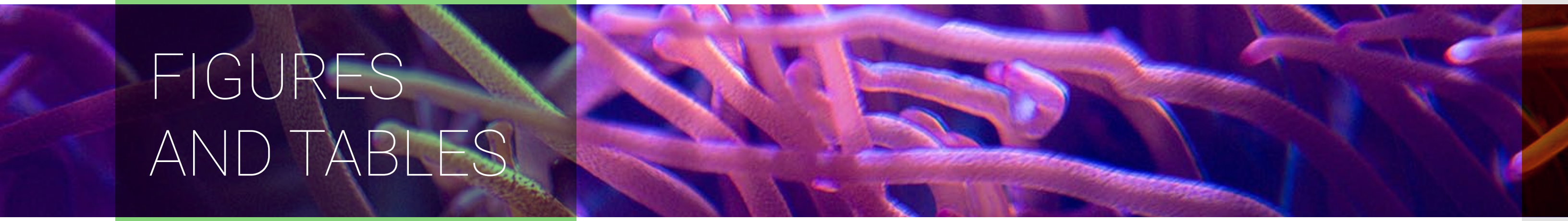

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FOREWORD

The United States has a plastics problem. Americans generated 35.6 million tons of plastic waste in 2018 (the most recent U.S. EPA data available) [1]. To put that in ocean terms, that is more than 215,000 blue whales! Only 8.7% of that plastic is recycled [1]. The remainder goes to landfill – where it remains indefinitely – or is incinerated – where it creates greenhouse gas emissions and harmful pollution.

Packaging and containers were the largest category of plastic waste, with 14.5 million tons generated in 2018 [1]. This reliance on single-use plastics has enormous impacts on the environment. Plastic pollution has become one of the most visible environmental threats of our time, with an estimated 11 million metric tons – equivalent to over a garbage truck every minute – leaking into the ocean [2]. Once there, plastics harm and kill marine life through entanglement and ingestion. Ocean plastic transports invasive species and disease. And for millions of people around the world, it can ruin a simple day at the beach.

For the sake of the planet, the U.S. cannot continue this way. Fortunately, there is a growing consensus among the public, government and the private sector that we can and must change. However, this is a complex problem and there is no single solution. We need a suite of actions to reduce our use of plastics, to better manage the plastics we do need, and to clean up plastics already in the environment. Ocean Conservancy's own research indicates that recycled content standards can make a major contribution to building a more circular economy [3].

This report focuses on the current landscape of recycled content for plastic packaging in the U.S. as well as how to grow end markets for these materials given their prevalence in the waste stream and in the environment. Our goal with this report is to demonstrate that minimum recycled content mandates are technically and economically feasible in the U.S. today and can be scaled up over time to reduce our dependence on virgin plastics.

As the report indicates, there is a lot of room for improvement, but there is a path forward and the impacts are significant. If we were to achieve the rates of postconsumer recycled content (PCR) for the packaging applications presented in Scenario 1 of this report, we would more than quadruple the amount of PCR used for those applications and avoid four million metric tons of carbon dioxide emissions compared to using virgin plastic — that's three million metric tons more than we save today under current PCR rates[1], not including the benefits of using the recommended rates of PCR in durable and plastic film products [4].

It will take time and significant effort to scale up recycled content in a variety of applications in the U.S. and while starting with what is currently technically and economically feasible is important, it's also important to continuously up the ambition. This report identifies what is within reach currently, as well as an alternate scenario that demonstrates how progress could be accelerated with additional supply-side policy measures, such as extended producer responsibility. Even in this more ambitious scenario a fully circular economy is not achieved. For that a broad suite of actions is needed, including reducing the amount of plastic and packaging in use, expanding reuse models, and investing in innovation to redesign materials and formats for recyclability. It is our hope that the U.S. can lean into the growing momentum for action to significantly reduce the use of single-use plastics and build a domestic plastic recycling environment that creates new jobs, reduces environmental degradation, and builds a truly circular economy. The health of the ocean and coastal communities depends on it.

Kacky Andrews
Chief of Strategy
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[1] Calculations based on today's market size.

ACKNOWLEDGMENTS

Ocean Conservancy is a non-profit environmental advocacy group, based in Washington, D.C., United States. The organization works towards science-based solutions to protect the ocean and the wildlife and communities that depend on it. From the Arctic to the Gulf of Mexico, from ocean acidification to ocean plastic, Ocean Conservancy brings people, science, and policy together to champion innovative solutions to today's greatest global challenges. Ocean Conservancy is host to the Trash Free Seas Alliance® which brings together private sector and conservation entities to discuss and collaborate on upstream solutions to ocean plastic pollution.

Ocean Conservancy commissioned Resource Recycling Systems (RRS) to develop this report. RRS is a mission-driven recycling and sustainability consulting firm providing business and technical expertise to help build the circular economy of the future. RRS is committed to making a positive business, environmental, and social impact by helping clients to achieve their climate, waste, and resource recovery goals. The firm has engineers, economists, technical specialists, and a dedicated communication team that have core strengths in materials and recovery, life cycle management, applied sustainable design, and collaborative action development.

Ocean Conservancy and RRS would like to recognize the valuable insights of the contributors to this report.

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EXECUTIVE SUMMARY

To address plastic pollution, we ultimately need to make less plastic and reuse more. Mandatory minimum recycled content standards, requiring a minimum amount of postconsumer recycled (PCR) material in certain products and/or packaging, are a crucial step in the transition to a circular economy. They can play an important role in growing and ensuring stable demand for postconsumer material and reducing demand for (and associated emissions from) virgin plastic resin. Many voluntary (and ambitious) public commitments to use PCR content have been made, particularly in the packaging arena – efforts which are to be applauded and supported. However, mandatory minimum recycled content requirements set a level playing field across all companies – and are just that – the minimum required to be permitted to sell the specified product or packaging in the marketplace. This report evaluates the current plastics recycling landscape and outlines the benefits of, and recommendations for, minimum PCR content requirements for plastic products and packaging on a national level within the United States.

CURRENT PLASTIC RECYCLING LANDSCAPE

We are using more plastic, and generating more plastic waste, than ever before. Plastic packaging makes up about 40% of the plastic in the municipal solid waste stream [1]. Despite decades of effort to collect, sort, and recycle plastic packaging, most is destined for disposal in a landfill or waste-to-energy facility (e.g., incineration). Polyethylene terephthalate (PET) and High-density Polyethylene (HDPE) bottles make up the majority of the plastic packaging recycled today. Recycling of other plastic packaging remains low due to lack of collection, limited end markets, sorting challenges, and packaging design, which leads to both confusion about recyclability and difficulties in the recycling process.

Currently, recycled plastic packaging is largely used to make new durable goods (e.g., carpet, apparel, pallets, lumber, pipe, etc.) with small amounts going to other end uses, including new packaging. However, few plastic products consistently contain PCR content, and those that do often contain a low percentage compared to virgin plastic content. Achieving significant levels of PCR content in new packaging, particularly food-grade packaging, will require policy changes, recycling system supply chain improvements, and technological innovation.

BENEFITS OF MANDATORY RECYCLED CONTENT LEGISLATION

Minimum recycled content standards are an effective tool to advance markets for recycled plastics and to protect the environment. When implemented thoughtfully, they can increase the value of recycled materials, improving the economics of recycling and reducing the economic risk for investments in capital-intensive recycling infrastructure. Mandatory standards increase regional and national demand for PCR, which incentivizes action to increase supply. Importantly, these requirements reduce demand for virgin materials in new products, significantly reducing emissions associated with material production and resource extraction. If we achieve the rates of PCR for the packaging applications presented in Table 2 ("Scenario 1"), we would quadruple the amount of PCR used in those packaging applications and avoid three million metric tons (MT) of CO_2 emissions compared to today [4].[2] Under the second more ambitious scenario (Table 3 "Scenario 2"), we would increase the amount of PCR used in the covered packaging applications 600% and avoid four and a half million metric tons of CO_2 emissions compared to today [4].[3]

[2] Calculations based on today's market size.

[3] Ibid

BENEFITS OF PAIRING SUPPLY WITH DEMAND

Mandatory recycled content legislation is a demand-side policy, meaning it creates demand for materials collected and processed through the recycling system by requiring producers to include recycled materials in their products. Demand-side policies will only be successful when coupled with strong supply-side policies that increase the collection and processing of recyclables. Examples of effective supply-side strategies include extended producer responsibility (EPR) and beverage container deposits (bottle bills). When implemented together, supply- and demand-side policies are effective at improving the entirety of the recycling system, enabling an expedited transition to a circular economy. Momentum is growing for supply-side polices, as demonstrated through recent legislative activity and industry commitments, making it an opportune time to advance strong demand-side policies like recycled content standards. The combined impact would provide a comprehensive boost to the U.S. recycling system to jump-start the transition to a circular economy.

MANDATORY RECYCLED CONTENT POLICY RECOMMENDATIONS

Mandatory minimum recycled content requirements should be established through a legal framework that drives technology and markets to achieve the economic, environmental, and community benefits of using recycled content, and that fosters continual improvement through increasing requirements over time. The most salient considerations for mandatory minimum recycled content legislation include:

- **Covered and exempt items:** Requirements should be applied to a suite of products that can accept recycled content from across the quality spectrum: the quality spectrum including high quality and food-grade packaging, durable goods with less stringent requirements, and non-food packaging applications that can accept mid-quality PCR. Increasing PCR content in packaging is critical to reducing virgin plastic production, while applying PCR content standards to durable goods that currently absorb the majority of the PCR content would provide needed scale and certainty to the reclamation industry by ensuring a market for the range of quality produced.
- **Recycled content types:** Mandatory recycled content legislation should stipulate the use of PCR content, as opposed to post-industrial (a by-product of manufacturing) or pre-consumer recycled content (a product that never reaches the consumer).
- **Rates and dates:** Mandatory recycled content levels should be increased incrementally over time to allow for the growth of supply. Rates in durable goods should level off over time, allowing for the expansion of PCR content usage in packaging applications.
- **Portfolio standards:** Recycled content legislation should allow for portfolio-level standards or averaged recycled content across a company's product portfolio, allowing flexibility with regard to geographies and product formats. To ensure that portfolio standards do not undermine the minimum content requirement, standards must be crafted carefully and specifically to ensure a market for all resins. Consideration should be given to the inclusion of a penalty (fee) in the short-term and/or a sunset for portfolio standards to ensure all products eventually contain PCR.
- **Verification:** New policy requirements should take advantage of existing systems to appropriately document claims and certify recycled content. A federal certification program for recycled content that benchmarks average content within a category of products or packaging, or federal recognition of current certification programs, would provide verifiability.
- **Waivers:** Waivers should be available when supply is inadequate to fulfill requirements or other technical issues arise; however, they must be time limited and require robust justification.
- **Reporting and enforcement:** Annual reporting at the federal level of the weights, percentages, and flows of PCR and virgin resin should be required. Enforcement and penalties must be vigorously implemented to incentivize compliance. In addition to fees, which can be seen as a cost of doing business, a recommended penalty is to prohibit the sale of products that are not in compliance with requirements.

MANDATORY MINIMUM RECYCLED CONTENT RATE RECOMMENDATIONS

Three recommendations for mandatory minimum recycled content levels are presented (Tables 1, 2, and 3). As noted above, plastic film and durable goods (Table 1) are critical in supporting a healthy plastics recycling infrastructure by absorbing a baseline amount of the lower quality PCR generated. To drive circularity, Table 1 should be coupled with standards for packaging applications (Tables 2 and 3), with the percentage of recycled content required in packaging increasing substantially over time. Two scenarios for minimum recycled content standards for packaging are presented: Table 2 assumes growth in recycling collection, driven by the current increase in supply-side policy at the state level, while Table 3 assumes increased supply driven by momentum for national best-in-class collection policy, along with technological improvements and design for recyclability standards.[4] The recommendations in Table 3 acknowledge the time needed for national policy to increase the supply of recyclables, thus rates do not increase above Table 2 recommendations until 2030. The incremental increase of percentages is designed to ensure robust support for materials currently moving through the system and to serve as a driver for technological and market innovation. Table 3 moves us far closer to a circular economy with significantly lower associated greenhouse gas emissions and less plastic pollution flowing into our ocean.

Table 1: Plastic Film and Durable Products

EXAMPLE PRODUCTS	RESIN	2019/2020 EST. % PCR (US & CANADA)*	2025 % PCR	2030 % PCR	2035 % PCR	2040 - 2050 % PCR
Carryout Bags and Polybags	PE Film	unavailable	10%	20%	30%	35 - 40%
Trash Bags	PE Film	unavailable	10%	15%	20%	20%
Garden Pots	PP, HDPE	<10%	20%	30%	30%	30%
Storage Bins	PP, HDPE	unavailable	20%	30%	30%	30%
Garbage & Recycling Carts	PP, HDPE	<3%	5%	15%	15%	15%
Pipe	HDPE	unavailable	20%	30%	30%	30%

* Estimates for 2019/2020 % PCR for film and durable products are limited due to lack of data availability and reporting. PCR use is reported for both the US and Canada because the two countries operate effectively as one marketplace.

Table 2: Packaging Applications Scenario 1 – Assumes Significant Growth in Recycling Collection and Modest Technological Innovation

EXAMPLE PRODUCTS	2019/2020 EST. % PCR (US & CANADA)	2025 % PCR	2030 % PCR	2035 % PCR	2040 - 2050 % PCR
PET Bottles	11%	15%	20%	25%	30 - 40%
PET Thermoforms	16%	16%	20%	25%	30 - 35%
HDPE Bottles	17%	17%	20%	25%	30 - 40%
PP Packaging	0%	5%	10%	15%	25 - 30%

Table 3: Packaging Applications Scenario 2 – Assumes National Supply-Side Policy (EPR and Bottle Bill), Technical Innovation, and Design for Recycling Improvements

EXAMPLE PRODUCTS	2019/2020 EST. % PCR (US & CANADA)	2025 % PCR	2030 % PCR	2035 % PCR	2040 - 2050 % PCR
PET Bottles	11%	15%	30%	45%	55 - 60%
PET Thermoforms	16%	16%	22%	30%	35 - 45%
HDPE Bottles	17%	17%	25%	25%	40 - 50%
PP Packaging	0%	5%	15%	25%	30 - 35%

[4] Capture rates from best-in-class recycling practices are based on analysis conducted by The Recycling Partnership in its "Paying It Forward" report [29].

INTRODUCTION AND BACKGROUND

INTRODUCTION

Two critical pieces of work guided the decision to create this report. The first was Ocean Conservancy's Plastics Policy Playbook, published in 2019 in collaboration with its Trash Free Seas Alliance® – while the report was not focused on the U.S., the findings could be applicable in any geographic context. It found that for systemic impact, there was an urgent need for "circularity to be adopted at-scale, with high recycled content standards (and reuse) across all industries"[3]. The Playbook also highlighted the need to combine policy measures – a theme in this report, as well – because while recycled content mandates alone will not solve the plastics problem, they are an important part of the overall solution.

The second piece of work that led to this report was Ocean Conservancy's support for the Save Our Seas 2.0 Act (SOS 2.0), which was signed into law in December 2020 after 18 months of advocacy by numerous conservation and private sector actors. Many members of the Trash Free Seas Alliance® joined Ocean Conservancy to write letters of support for SOS 2.0. This report is aimed squarely at SOS 2.0 Sections 306 and 307. These sections require the Environmental Protection Agency (EPA) to create two reports by December 2022 on recycled content end markets for plastic packaging and goods and an assessment of the technological and economic feasibility of postconsumer recycled content standards for plastic.

Following the passage of the SOS 2.0 Act, Ocean Conservancy commissioned this report, which is intended to inform the EPA and other stakeholders through a data-driven analysis of the role of mandatory minimum recycled content requirements to grow demand for recovered plastics and build a more circular economy for plastic packaging and products. This report presents analyses to understand the role and impact of minimum recycled content policies and to inform federal mandatory recycled content requirements for packaging and products, as well as spur ambition for holistic action to tackle the problem of plastic pollution.

The report is focused on the U.S. market, but recognizes the important role of the Canadian market as the two markets are reliant on one another, serving as both purchasers and suppliers of recycled content.[5]

BACKGROUND

Municipal curbside recycling is a complex system characterized by a supply chain involving many actors with diverse reasons for participating. A healthy recycling system requires all actors to play a part, and policy is critical to motivate and engage every actor. Policy that supports recycling can be grouped into supply-side and demand-side policies. Mandatory minimum recycled content requirements are an example of a demand-side policy that plays an important role in ensuring that the materials collected through the recycling system make their way to a productive end use.

Increasing minimum content requirements creates an environment where the economic, environmental, and community benefits of using recycled content are valued and there is competition to drive continuous improvement. Well-crafted minimum content requirements support strong prices for recycled commodities, adding financial resources to the recycling system, and reducing the risk of investing in recycling-related infrastructure. Recycled content requirements ultimately reduce demand for virgin materials, which in turn reduces negative environmental and social impacts associated with extraction and production of virgin materials. Manufacturing with recycled instead of virgin materials significantly reduces energy consumption and greenhouse gas emissions [5].

[5] In some cases (e.g., recycled resin end markets) the data presented in this report represents both the U.S. and Canadian markets, as the data is consolidated prior to reporting.

Currently, one of the barriers to increased use of recycled plastics is the lack of available supply – there is not enough postconsumer plastic being collected in the recycling system to meet voluntary corporate commitments and industry demand. The benefits of mandatory recycled content policies would be greatly expanded if they were paired with policies that drive the supply of material by providing Americans with universal access to recycling collection programs, motivating the public to participate in those programs, improving recycling infrastructure, and requiring producers to design products and packaging that are truly recyclable or are otherwise circular. Presently, there is unprecedented momentum towards enacting supply-side policies, as well as increasing interest in circular design and recyclability, making this is an opportune time to develop demand-side policies like recycled content standards to accelerate the development of a truly circular market.

The research team for this report has performed a detailed review of the state of the plastic recycling industry, its stakeholders, and its market dynamics, and has identified the most salient considerations for mandatory minimum recycled content legislation including defining the products and packages to target, the standards they should meet, and dependable mechanisms for verifying and enforcing compliance.

THE PLASTIC RECYCLING LANDSCAPE

Key Points

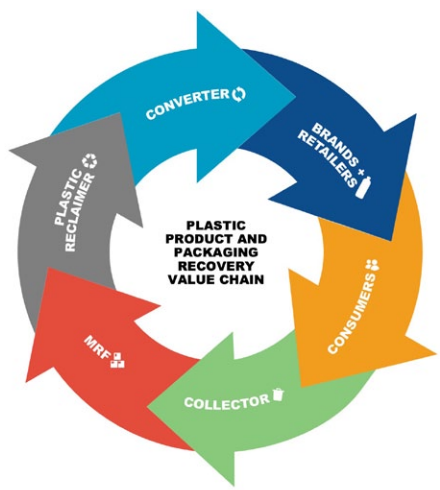
- Recycling rates for most types of plastic packaging are low and stagnant.
- The most mature and robust recycling infrastructure in place today is for PET (#1) and HDPE (#2) bottles, which make up most rigid plastic packaging and that dominated the market as the recycling system developed. Despite being the most mature recycling market, PET and HDPE bottle recycling rates nationally hover around a mere 30%.
- Other plastic resins and packaging formats have struggled to reach the recycling rates achieved by PET and HDPE bottles due to challenges like underdeveloped end markets, lack of critical volume for recycling, lack of sufficient funding mechanisms, confusion about what is recyclable, sorting challenges, and packaging design properties that make the recycling process difficult.
- Reclamation capacity is not a barrier to increasing recycled content. There is excess reclamation capacity for most resins and historically reclamation capacity has developed where supply and demand align (driven by private markets).

THE PLASTIC RECYCLING SUPPLY CHAIN

The plastic recycling supply chain includes several steps and many participants (Figure 1). First, a company sells a product (that may or may not be designed to be recycled), then the consumer or end user decides whether or not to recycle it. That end user's decision may be a simple one if they are in one of the roughly half of U.S. households [6] that have automatic access to a curbside recycling program and have clear information on whether the item is accepted or not. Or that decision may be more complex if they have to subscribe and pay for recycling collection service, take their materials to a drop-off site, or do not have ready access to information on whether the material is accepted in their recycling program.

If placed into a recycling bin, the plastic item is collected and transported by waste haulers to a material recovery facility (MRF) for sorting. The MRF sorts items by material and form to create different commodity bales for sale to material reclaimers. Reclaimers recycle the sorted plastic into plastic flakes or pellets that are then sold to converters or product manufacturers to make new products or packaging. Since most of the plastic that moves through the municipal recycling system is packaging [1], this section focuses on plastic packaging flows.

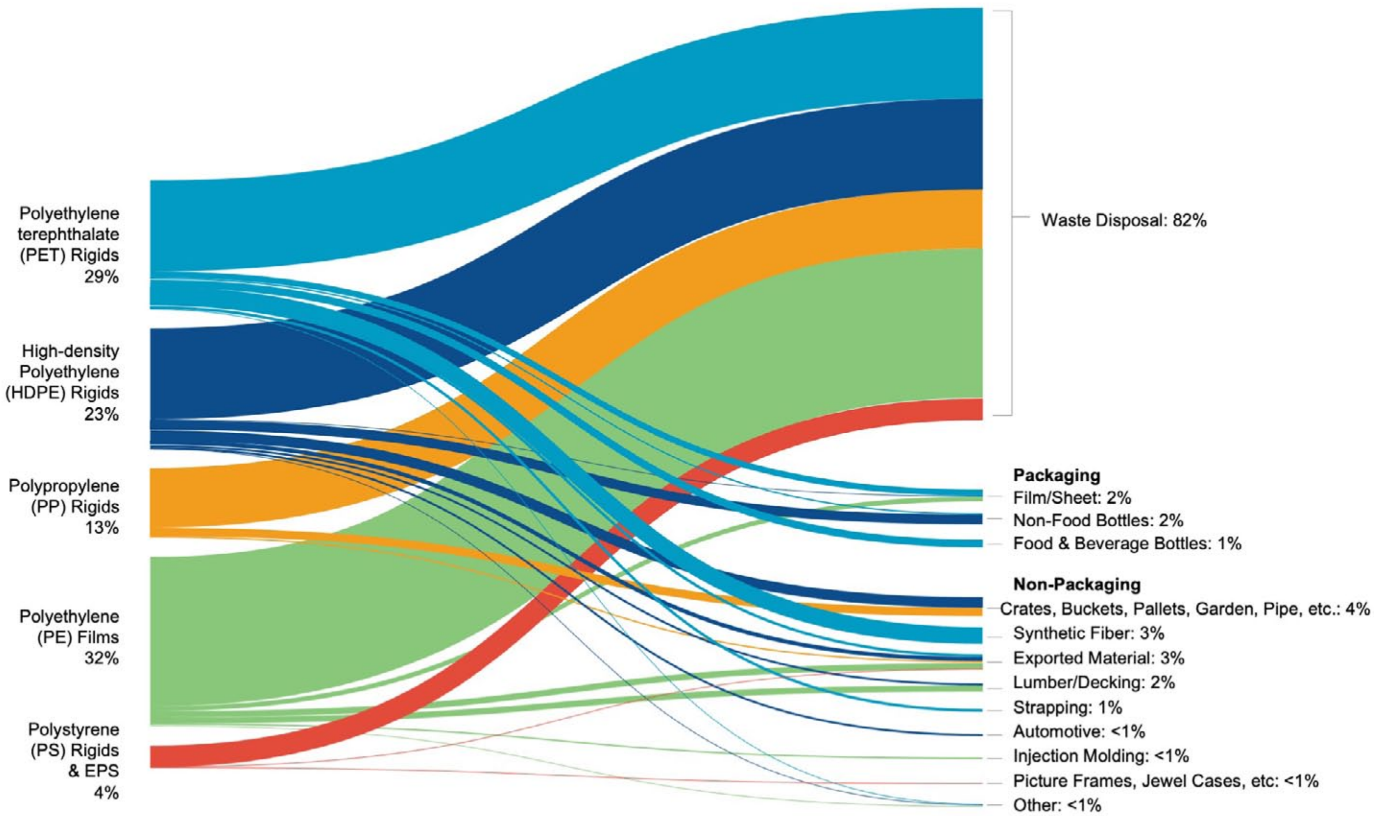
Figure 1: Plastic Product and Packaging Recovery Value Chain



PLASTIC RECYCLING TODAY: THE DYNAMICS OF CURRENT SUPPLY

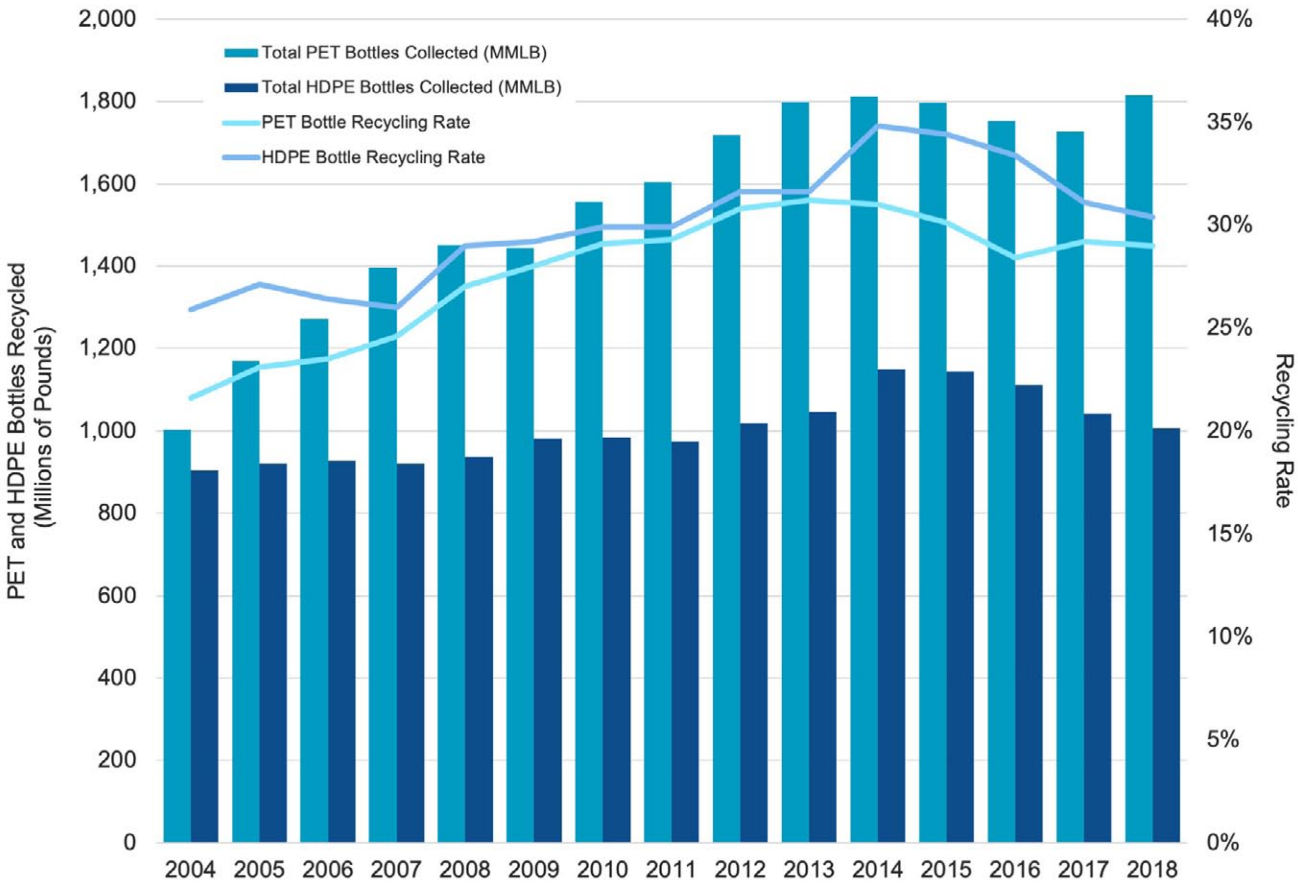
Despite decades of effort to collect and process it for recycling, most plastic packaging produced today is destined for disposal in a landfill or waste-to-energy facility. The plastic packaging that is recycled is used for a variety of end uses, including packaging and durable goods (Figure 2) [7].

Figure 2: Residential and Commercial Plastic Packaging Waste Material Flows (By Weight)



Today the most mature and robust recycling infrastructure is for PET and HDPE bottles, which are the plastic resins and packaging formats that make up the majority of rigid plastic packaging and that have dominated the packaging market as the recycling system has developed over the past 40 years. Not surprisingly, PET and HDPE bottles are also the plastic resins and packaging formats most commonly recycled back into packaging applications, with approximately 50% of recycled PET bottles (rPET) and 40% of recycled HDPE bottles (rHDPE) being used in packaging applications [8]. While PET and HDPE bottles experienced a steady increase in recycling rates and tons recovered in the 1990s and early 2000s, recycling rates have remained flat or dropped over the past decade (Figure 3) [9] [10].

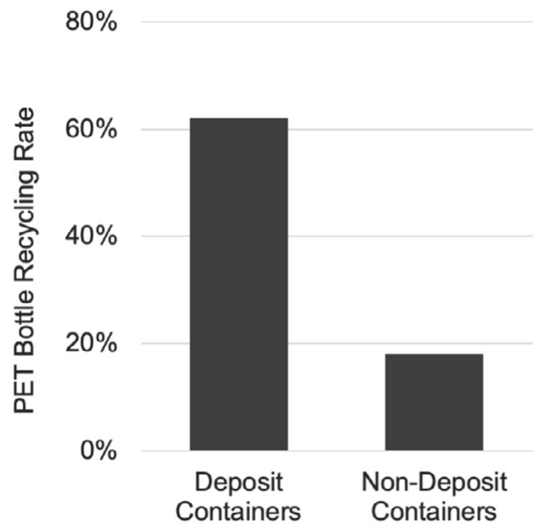
Figure 3: PET and HDPE Bottle Recycling Rate and Tons Recycled, 2004-2018



The lack of improvement in recycling rates for PET and HDPE bottles is due to a variety of factors including minimal expansion of access to recycling programs, the inexpensive cost of disposal across most of the country compared to the cost of recycling, insufficiently funded outreach and education for encouraging consumers to recycle, lack of direct incentives for consumers to recycle, and lack of scaled recycling programs. In the case of PET bottles specifically, the limited expansion of beverage container deposits (i.e., bottle bills, which are the most effective incentive for recycling collection in place today) have inhibited recycling rates.

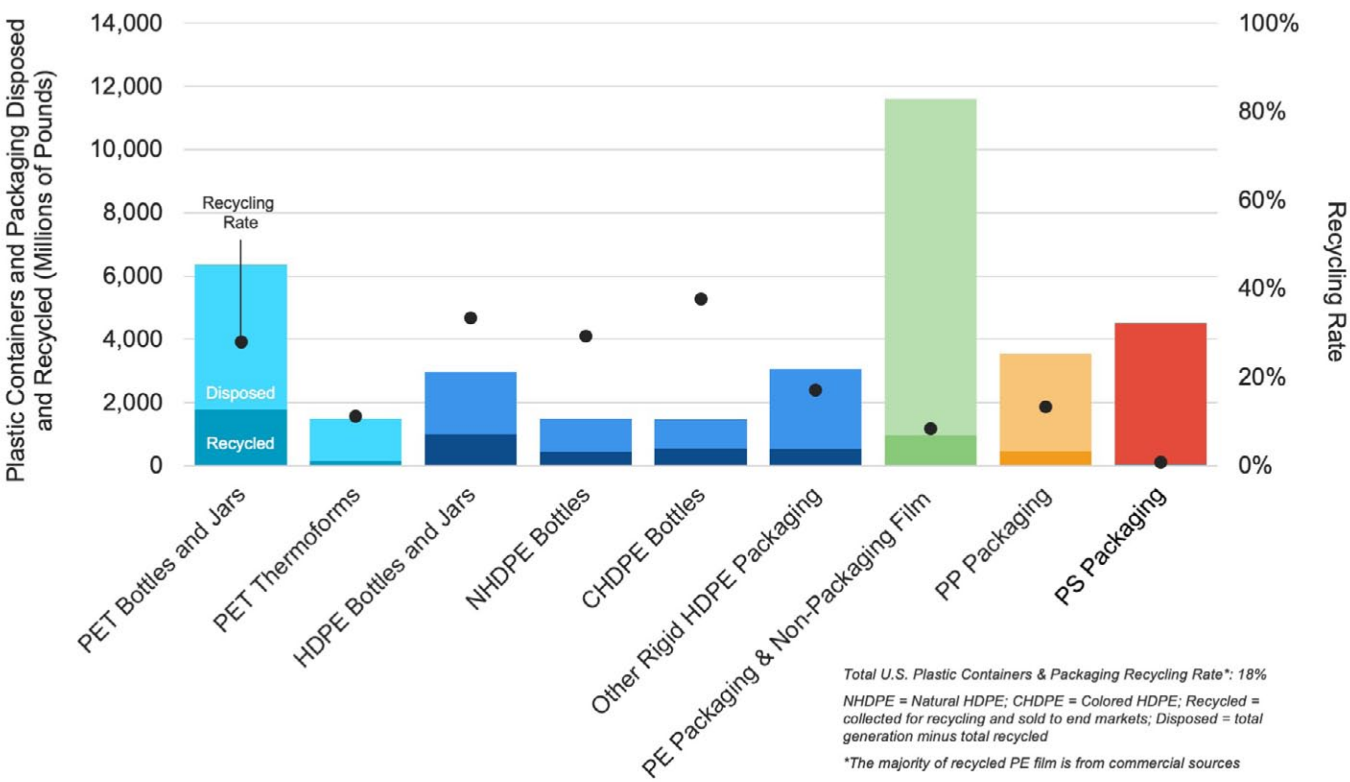
Exacerbating this problem for PET bottles is the fact that most of the growth in PET packaging is in the formats and types of bottles that are not covered by bottle bills (e.g., juices, teas and other non-carbonated beverages, which are only covered in a few bottle bill programs, and cleaning and personal care products that are not included in any), while traditional formats included in all bottle bills, such as carbonated drinks, have a declining market share. As a result, less material is flowing into the packaging types captured by high recovery rate deposit programs and more is flowing into packaging types that are part of lower-recovery rate curbside programs (Figure 4) [11]). This shift results in a decrease in the overall PET bottle recovery rate.

Figure 4: U.S. Average Recycling Rates for PET Bottles by Deposit Status, 2017



Another factor contributing to declining amounts of materials collected for recycling is package lightweighting – meaning a bottle today weighs less than a bottle a decade ago. In addition, lightweighting has contributed towards a shift from rigid plastic packaging to flexible packaging (e.g., drink pouches), which requires less material but is not recyclable in today's system. While lightweighting results in the use of less material, it can also make maximizing use of PCR content more difficult as it can be more challenging to incorporate recycled content into thin food-grade films and other light-weight products and packages. While lightweighting is most noticeable in packaging like single-use water bottles, it has occurred across almost all food and beverage formats as packaging manufacturing technologies have adapted to address the pressure to reduce plastic usage to benefit the environment and decrease costs.

Figure 5: Containers and Packaging Recovery by Resin Type (U.S. 2019)



Packaging resins and formats other than PET and HDPE bottles have struggled to reach the recycling rates achieved by PET and HDPE bottles (Figure 5) [4], [9], [10], [1].

Poor recycling rates for non-bottle packaging can be attributed to a number of factors:

- **Lack of supply-side policy:** Most states and communities do not have strong policies supporting recycling collection and processing (e.g., supply-side policies). Only 54% of the U.S. population has automatic access to curbside collection for recyclables while the remainder of Americans do not have convenient access to recycling [6]. This impacts the level of consumer participation and, therefore, the supply of recyclables. Thoughtful supply-side policy interventions (e.g., EPR or mandatory recycling) have a proven ability to drive the supply of feedstock needed to support recycled content.
- **Underdeveloped end markets:** Until recently, few end markets existed for plastic resins other than PET and HDPE. Any recycling system requires the existence of markets that value and consume the collected and sorted materials. End markets must have sufficient capacity and be within reasonable geographic distance of recovered commodity supply. Without domestic end markets, export becomes the default. In the past decade, markets for PP have grown substantially, and markets for film packaging are emerging. Mandatory recycled content requirements would encourage and accelerate this domestic market growth.
- **Lack of critical volume:** To be economically recyclable, materials need to be present in sufficient quantities and forms to be collected, sorted, and shipped in full truckloads within a reasonable amount of time. MRFs typically do not have space to store materials for more than a month. Plastics constitute a relatively small proportion (17% by weight) of the packaging waste stream today and represent an even smaller proportion (6%) of the typical mix of recyclables received by a MRF [4][12]. While most rigid plastic packaging is PET or HDPE, the remainder includes a variety of plastic resins and packaging formats. As a result of this and given storage constraints, for most MRFs, amassing enough of a single-resin package type to ship to markets within a reasonable time interval is a business concern. The wide variety of plastics and packaging formats has driven the development of a market for “mixed plastic” or “#3-7 bales” where MRFs sort several plastic resins into a single bale and sell it to reclaimers who extract the plastic resins of value. As the use of polypropylene (PP) grows in packaging applications, more MRFs are reaching the critical volumes needed to sort PP as an individual commodity and moving away from producing mixed plastic bales.

POST-INDUSTRIAL, PRE-CONSUMER AND POSTCONSUMER RECYCLED CONTENT

Post-industrial recycled (PIR) content is a by-product of manufacturing that was never used for its intended purpose, such as scrap generated in the manufacturing process. Post-industrial material is often homogenous and can be used as a direct input back into manufacturing. Markets for postindustrial plastics are strong, typically business-to-business transactions, and can be driven through conventional supply-demand economic signals.

Pre-consumer recycled content is from finished packaging or products that are recovered before fulfilling their intended use and are never sold to a consumer. Examples include packaging associated with returns, expired or defective product.

Postconsumer recycled (PCR) content is from plastic that was used for its intended purpose. PCR is typically derived from materials that are collected in residential and commercial recycling programs.

- **Confusion over what is recyclable:** Despite increasing consumer awareness about packaging waste and its environmental impact, recovery rates have not increased in part because of confusion over what to recycle. The growth in the variety of plastic resins and packaging formats, unclear labeling, and the lack of standardization of recycling programs across municipalities have created challenges for consumers (and MRFs) to identify what is and is not recyclable (or marketable) in a given locale. It is relatively simple to identify PET bottles (e.g., soda bottles, peanut butter jars, clear cleaning product bottles, etc.) or HDPE bottles (e.g., milk jugs, detergent bottles, household cleaners in colored bottles, etc.) by appearance. Other resins and formats are far more complex and frequently feature the "chasing arrows" symbol as part of the resin code, which can mislead consumers on how to sort them.

- **Packaging design:** Certain packaging design elements can interfere with sorting at the MRF or in the plastic reclamation process. For example, full-wrap shrink labels that cover the entire bottle can block the near infrared (NIR) signals used to identify and sort different plastics in a MRF, and these labels are sometimes made of plastics that are not compatible with the plastic reclamation process. Most black resins cannot be identified or sorted with currently deployed NIR systems (see below). Furthermore, using colored resins and/or other additives impacts the potential end markets and applications for PCR as multiple colors mixed together can only be used for grey or black products and many additives are not approved for use in food-contact packaging.

- **Sorting challenges:** Recyclables are sorted into commodities at the MRF according to their physical characteristics including shape, size, color, and material (e.g., resin type for plastic). Shape is important because plastic containers are separated from paper using screens that sort two-dimensional objects (paper) from three-dimensional objects (containers). If plastic packaging is two dimensional (e.g., lids, films, pouches), or if it becomes flattened during collection, it is likely to be misdirected to the paper stream and never make it to a plastics market (unless the MRF has invested in additional cleanup of the paper line). Similarly, items that are smaller than 2-3 inches in size in any two dimensions (such as bottle caps, straws, etc.) often fall through screening equipment and end up as residue, which is typically landfilled. Plastic films can wrap around screens and clog equipment, increasing downtime and maintenance costs, and plastics that wind up in the paper stream must be removed through quality control measures (often manual sorting). As noted above, color also impacts sortability. Black plastics absorb rather than reflect the NIR light used to identify and sort resins, consequently, most MRFs cannot successfully sort black plastics. New pigments and markers are being developed that allow for NIR sortation to address this issue.

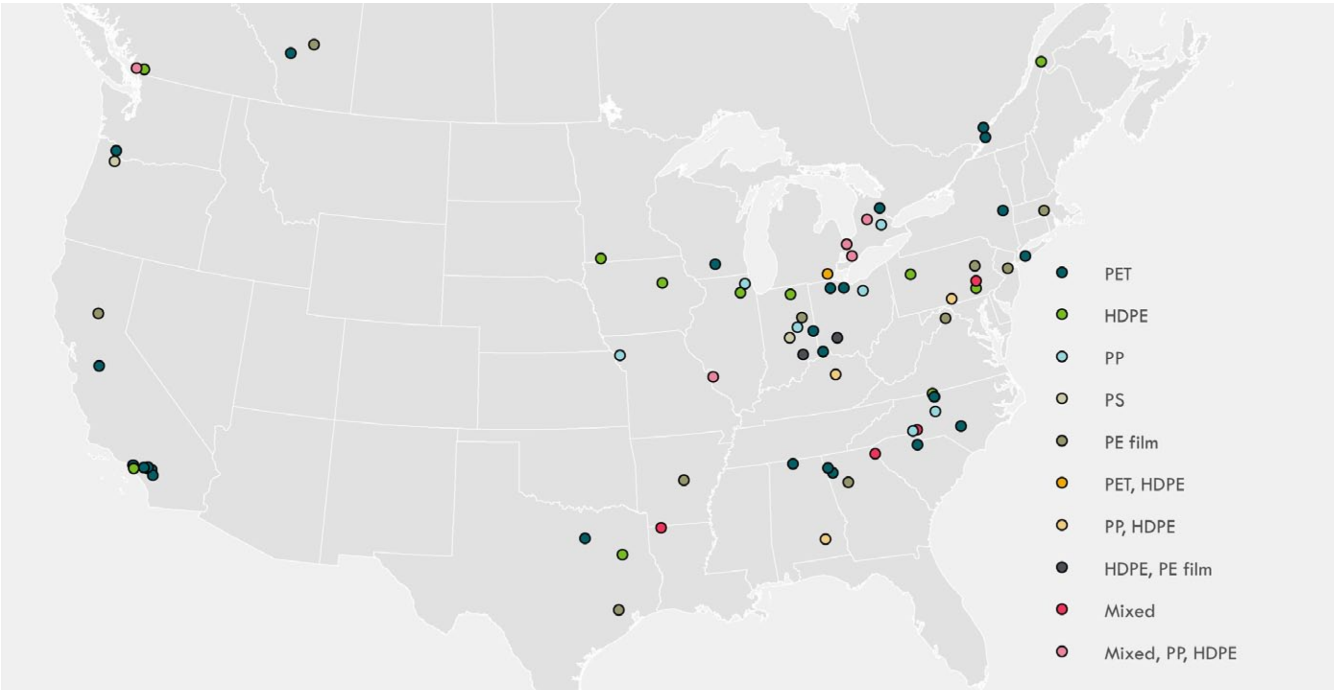
- **Technical challenges:** Technical characteristics, such as the chemical or physical properties of a plastic package, impact recycling. For example, thermoformed PET packages (e.g., plastic cups and berry clamshells) tend to be more brittle than PET bottles because of their physical properties; the differences between thermoforms and bottles (e.g., bulk density, viscosity, etc.) make recycling them more challenging. Similarly, the properties of HDPE tubs differ from those of HDPE bottles as a result of how they are manufactured (injection vs. extrusion blow molded). Most HDPE reclamation systems can handle a small proportion of tubs, but if the level gets too high the quality of the recycled content produced is negatively impacted. Furthermore, not all plastic resins can be used to produce food-grade recycled content. Reclaimers sort specific plastic resins and packaging formats for use in end markets that require food-grade materials from those plastic resins and formats not destined for food grade. The ease with which this can be done varies from resin to resin (PET is the easiest) and generally requires sorting technology to differentiate the two types.

Today, the challenges to sorting and recycling posed by non-bottle plastics increase MRF processing costs and have added economic stress to the recycling system. With a lack of supportive policy and market-driven recycled content supply chains, recycled plastics have struggled to take hold as a competitive alternative to virgin materials. However, thoughtfully developed recycled content requirements, in conjunction with other policy changes, can be pivotal in addressing many of these challenges.

PLASTIC RECLAMATION CAPACITY

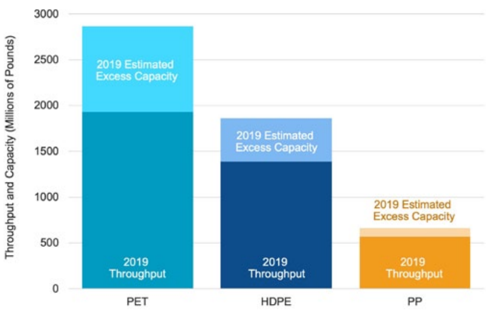
Plastic reclaimers purchase bales of sorted plastics from MRFs and other generators and process them into flake or pellet that is then sold to packaging converters and product manufacturers. A map of plastic reclaimers in the U.S. and Canada is shown in Figure 6.

Figure 6: Plastic Reclaimers in the U.S. & Canada



Currently, there is excess reclamation capacity for the major plastic resins used in packaging. Figure 7 compares total current reclamation throughput against total estimated capacity for PET and HDPE across the U.S. and Canada as of 2019 [4].

Figure 7: Estimated Throughput vs. Reclamation Capacity for Major Packaging Resins in the U.S. and Canada



In response to corporate commitments and the impact of China's National Sword policy that banned the import of most scrap plastics, there has been substantial investment to develop and expand plastics reclamation infrastructure, particularly for PET, HDPE, and PP – all resins with strong end market demand. Typically, where supply and demand are aligned, there is a business case, and investments to build reclamation capacity follow. As a result, the lack of reclamation capacity has rarely been the barrier to growth in the production of PCR resin. More commonly, a lack of supply or weak demand by end markets has held back the growth in the plastics reclamation industry.

TOOLS TO INCREASE RECYCLED CONTENT FOR PLASTICS

Key Points

- Mandatory minimum recycled content laws are a proven tool for increasing use of recycled content. Other approaches that support uptake of recycled content include government procurement policies, voluntary commitments by industry, product standards, and green building standards.
- Mandatory minimum recycled content requirements for plastics are effective because they:
  - Positively impact the economics of recycling, thereby supporting long-term continuity of supply and de-risking investments in recycling.
  - Bolster regional and national end market development and ensure end market outlets for recovered materials.
  - Reduce demand for virgin materials and offer related environmental and climate benefits.
  - Level the competitive playing field for brands and manufacturers.
  - Stabilize the market for reclaimers and investors.
- California's Rigid Plastic Packaging Container law, Trash Bag Recycled Content law, and Reusable Grocery Bag law are examples of mandatory minimum recycled content laws that are direct and impactful.
- While state-level laws have been successful at driving markets for postconsumer recycled content, the patchwork regulatory landscape adds complexity and makes it difficult for covered entities to comply; harmonized national standards would create a more efficient system and a more level playing field.
- Minimum content standards cannot be achieved without a strong and consistent supply of recyclable materials, and are therefore best pursued in concert with supply-side recycling policies (e.g., EPR, bottle bills, mandatory recycling)

MANDATORY MINIMUM RECYCLED CONTENT REQUIREMENTS

Set in statute, mandatory minimum recycled content requirements obligate companies to use a minimum amount of recycled material in the production of certain new products or packaging. The requirements effectively guarantee a market for the specified recycled materials if they can be produced in the necessary quantities and to the appropriate quality standards. Mandatory minimum recycled content requirements have been effectively applied to paper products (e.g., newsprint and paper bags) and glass containers, as well as plastic bottles, carryout bags, and trash bags.

Table 4 provides an overview of the mandatory minimum recycled content laws for plastic products and packaging currently in place in the U.S. Some of these laws were enacted recently and it is too soon to evaluate their impacts. Of the laws that have been fully implemented, the California Rigid Plastic Packaging Container (RPPC) law and the California Trash Bag Recycled Content law have the most longstanding, direct, and impactful PCR content requirements. (See page 24 for a case study on the RPPC law.) California's PCR requirement for reusable grocery bags has also been successful at driving demand for LDPE in California. In contrast, legislation enacted in Oregon in the 1990s did not drive demand for recycled materials since it allowed packaging manufactures to comply through source reduction, recycled content, or recycling collection rates, the latter of which was used by most manufacturers to meet these requirements.

Table 4: Recycled Content Mandates in Place in the U.S.

JURISDICTION	LEGISLATION TITLE	EFFECTIVE DATE	PLASTIC MATERIALS COVERED	SUMMARY OF REQUIREMENTS
CA	Rigid Plastic Packaging Container Law (California Public Resources Code Section 42330)	1/1/1991	Rigid plastic packaging containers	Mandates certain rigid plastic packaging (defined as plastic package that has a relatively inflexible finite shape or form) sold in the state to meet one of the following standards by 1995: • Contain 25% PCR content, • Achieve source reduction milestones (based on weight or concentration), • Be reusable or refillable, or • Attain a 45% recycling rate.
CA	Article 5. Recycled Content Trash Bag Program	3/1/1999	Plastic trash bags	Plastic trash bag manufacturers must annually certify compliance with the requirement of PCR content being equal to at least 10% by weight of the annual aggregate of regulated trash bags produced by manufacturer or 30% of the weight of the material used in all plastic products intended for sale in California.
CA	Plastic Minimum Content Standards (AB 793)	1/1/2022	Plastic beverage containers subject to the California Refund Value (CRV)	Requires that plastic beverage containers include at least 15% PCR by January 1, 2022, increasing to 25% in 2025 and 50% in 2030.
CA	Single-Use Carryout Bag Ban (SB 270)	7/1/2015	Single-use carryout bags	Requires reusable plastic grocery bags to contain 40% PCR content.
CT	CT SB928 An Act Concerning Recycled Content for Products Sold in Connecticut	Requirement developed 12/1/2022	TBD	Requires the Connecticut Commissioner of Energy and Environmental Protection to develop recycled content requirements for "products sold in the state" by December 1, 2022.
NJ	Postconsumer Recycled Content in Certain Containers and Packaging Products (S2515)	TBD	Rigid plastic containers, plastic carryout bags, and plastic trash bags	Requires that by 2024 rigid plastic non-beverage containers include at least 10% PCR and plastic beverage containers include 15% PCR. Percentage requirements increase incrementally until 50% by 2036 and 2045, respectively. Requires plastic carryout bags to include 20% PCR. Requires plastic trash bags to meet PCR rates based on thickness. Bans polystyrene packing peanuts in 2024.
OR	ORS 459A.655 Minimum reuse or recycled content for rigid plastic containers	1/1/1995	Rigid plastic containers	Rigid plastic containers must meet one of three criteria: 25% recycling rate, 25% PCR content or be reused or refilled at least 5 times.
WA	SB 5022: Recycling and waste and litter reduction	7/25/2021	Plastic beverage containers, household cleaning & personal care products, trash bags	Plastic beverage containers must have 15% PCR by 2023, 25% by 2026, 50% by 2031. Plastic containers for household cleaning and personal care must have 15% PCR by 2025, 25% by 2028, 50% by 2031. Plastic trash bags must contain 10% PCR by 2023, 15% by 2025, 20% by 2027. Content levels can be adjusted through rulemaking.

While some state-level laws have been successful at driving markets for PCR, the patchwork regulatory landscape adds complexity and makes it difficult for covered entities to comply. Harmonizing legislation through federal policy could eliminate some of this complexity and create a more efficient system and level playing field. It could also provide more robust market support by consistently targeting a range of end products that can absorb PCR. When fashioning a federal standard, it is important to keep in mind the scale of the requirement and the supply of PCR needed to reach that scale. For this reason, it would not be appropriate to simply adopt the standards or content rate mandates developed on the state level at the federal level. For example, California's very robust recycling infrastructure, including an effective beverage container deposit program and broad access to recycling, generates a significant supply of recyclable materials that can be used to meet the state's content requirements. Applying California content levels to parts of the country that don't have robust recycling collection will ultimately be ineffective because there will be insufficient supply of recyclable material to meet the minimum content requirements.

Looking abroad, as a part of the EU's recently adopted Single-Use Plastics Directive, PET beverage bottles will be required to use 25% recycled plastic beginning in 2025 and all plastic beverage bottles will be required to use 30% recycled content in 2030 [13]. The United Kingdom has taken a slightly different approach for incentivizing the use of recycled plastic by applying a tax to plastic packaging that does not contain 30% PCR by April 1, 2022 [14]. These ambitious standards are enabled by rigorous policies that disincentivize landfilling and drive collection and the circular use of materials through both mechanical and chemical recycling technologies.

From a structural perspective, mandatory minimum recycled content laws typically include the following elements:

- **Covered and exempt items:** Defines the products or packages obligated to use recycled content and any exemptions; exemptions generally include packaging where the use of PCR content may pose safety concerns (e.g., packaging for medical devices, tamper-evident seals, etc.).
- **Recycled content types:** Defines whether recycled content mandates can be met with post-industrial or pre-consumer material, or whether recycled content must be sourced from PCR material.
- **Rates and dates:** Establishes the percentage of recycled content required for certain products or packages by dates specified in statute.
- **Product-level versus portfolio-level standards:** Product-level standards require each product or item to contain a minimum rate of PCR content. Portfolio-level standards place the recycled content requirement on all products within or across product portfolios. For example, if there were a standard of 25% PCR content in PET bottles, a manufacturer could meet it with some PET bottles at 75% PCR content and others with little or no recycled content as long as the overall the use of PCR content is 25% of the total PET bottle consumption.
- **Verification:** Documentation that validates or certifies postconsumer content.
- **Waivers:** Some laws allow for waivers or exemptions where a manufacturer demonstrates that it is not technically feasible for them to achieve the requirements, or there is not sufficient supply of recycled materials available to meet the requirements based on robust justification.
- **Reporting and enforcement:** The most impactful laws provide transparency and accountability through specific reporting requirements and strong enforcement provisions, including substantial fines or sales prohibitions.

Impact of Minimum Recycled Content Requirements

Minimum recycled content requirements and other policies that require the use of recycled materials play an important role in establishing and supporting demand for the materials collected in recycling programs. The guaranteed demand for recycled outputs reduces the economic risk for plastic reclaimers and enables them to scale in relation to that demand.

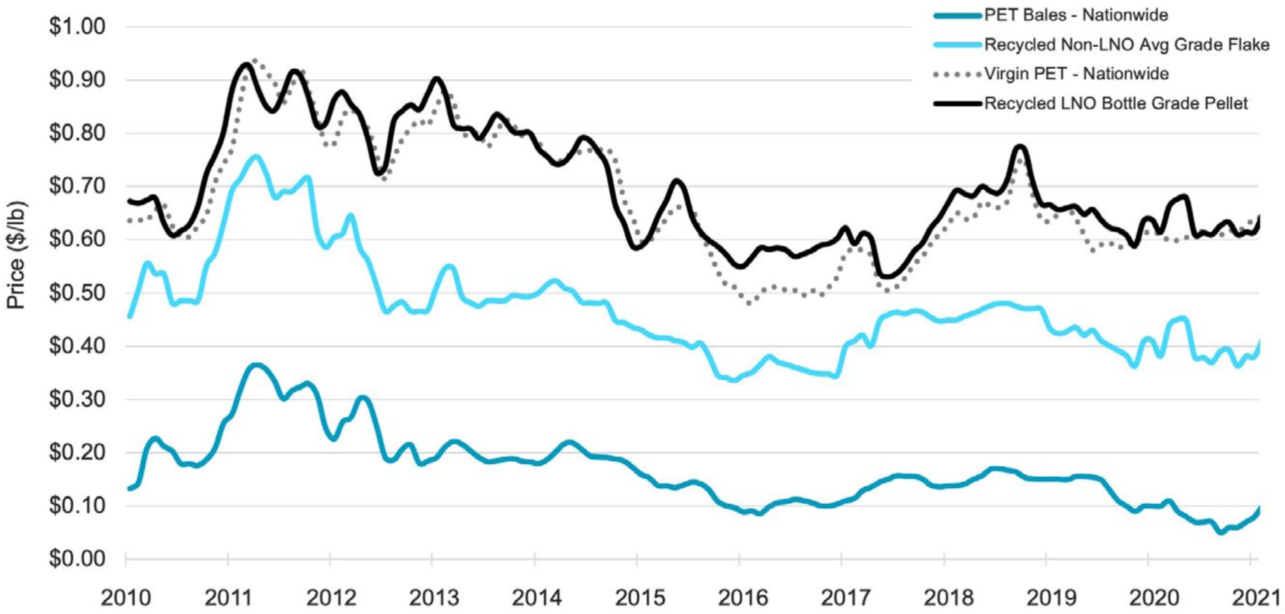
Recycled content requirements can stabilize or increase the market price for recycled commodities, either in the form of bales sold by MRFs to reclaimers, or the resulting products sold by reclaimers to packaging and product manufacturers or brands. This higher price improves the economics of recycling and in turn supports a healthy and vibrant MRF and reclamation industry and drives an environment for reinvestment.

Historically, the price of most grades of PCR resin has been effectively capped by the price of the competing virgin resin (Figures 8 and 9). If PCR costs are higher than virgin, buyers tend to switch back to virgin, unless required to use PCR to meet government mandates. Most PCR is sold into markets for durable goods like pipe and plastic lumber because it can readily meet the standards and performance specifications of these applications. Customer demand for PCR is typically not a driving factor for its use in most durable goods, so virgin resin pricing continues to effectively set the price ceiling.

KEY BENEFITS OF MINIMUM RECYCLED CONTENT STANDARDS

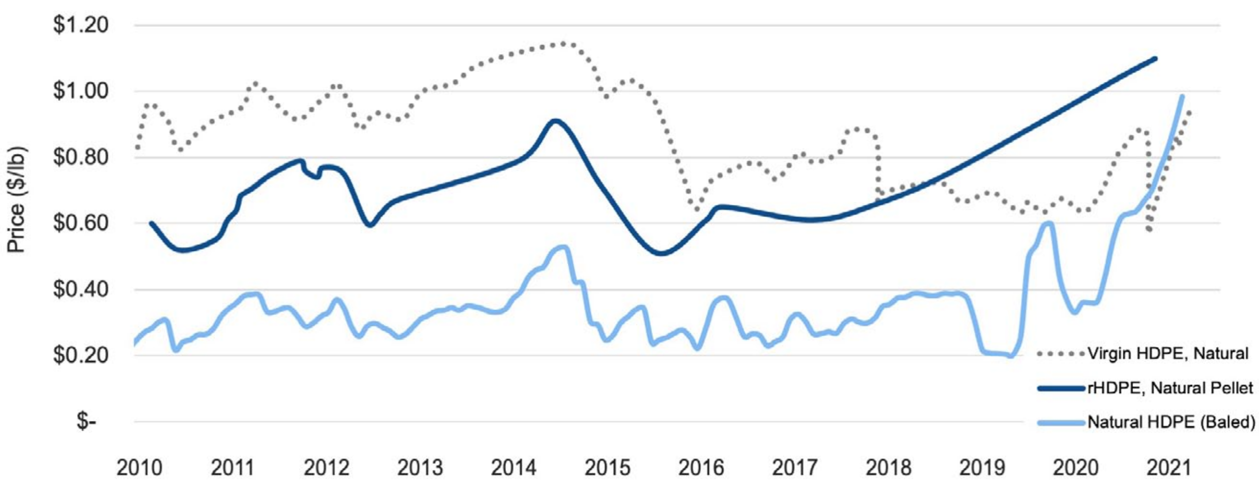
- **Feeds a circular economy for plastics to keep materials in use longer**
- **Supports capital investments in recycling markets and infrastructure through increased demand**
- **Displaces the use of virgin resin**
- **Lowers greenhouse gas emissions**
- **Reduces waste to landfills or incinerators**
- **Reduces waste management costs**
- **Reduces energy consumption**
- **Creates jobs and economic opportunity**

Figure 8: PET Virgin and Recycled Pricing



LNO = Letter of no objection from FDA. Indicates that a process has been approved to produce recycled plastic that can be used for specified food-contact applications. Non-LNO grade is not suitable for food-contact products.

Figure 9: NHDPE Virgin and Recycled Pricing



Competition with virgin resin can be challenging for plastic reclaimers because their cost structures are completely different from producers of virgin resin. While virgin resin prices fluctuate with the oil and gas market, the cost for reclaimers to purchase, clean, and process bales of sorted plastic and dispose of residue remains relatively unchanged. As such, the reclaimer's operating margin has effectively been the difference between the bale price paid to MRFs and the sale price of PCR resin to manufacturers. Reclaimers cannot drop the bale price paid to MRFs too low, or they risk losing that supply either to another reclaimer or because it is no longer economical for the MRF to sort that plastic. The sale price for PCR has historically been capped by virgin pricing for most resins and grades. As a result, if the virgin resin price drops substantially, as it has for most resins in the last few years (prior to 2021), there may not be sufficient margin between bale price and PCR sale price for reclaimers to make a profit or to justify producing high-grade recycled materials.

The cost dynamic for PCR resins is exacerbated by the artificially low prices for virgin plastic resin, which result from economic policies that incentivize oil and gas production and, by extension, virgin resin production. Direct federal subsidies to the fossil fuel industry have been estimated at approximately $15 billion per year [15]. If subsidies for the externalities (societal, environmental, and health costs) are included, the International Monetary Fund estimates that U.S. subsidies related to fossil fuel production add up to $649 billion per year [15]. The recent oil and gas boom driven by these subsidies has also resulted in a significant expansion of virgin plastic resin capacity and historically low resin prices, creating a marketplace where recycled plastics cannot fairly compete [16].

On the positive side, in recent years, a comparison of PCR and virgin resin pricing indicates that the high demand for certain grades of recycled plastic may be driving a decoupling of virgin and PCR prices. Corporate commitments for PCR content and compliance with California's RPPC law are driving demand for recycled natural HDPE (NHDPE) resin (e.g., the unpigmented HDPE often used in milk and water jugs) and for food-grade rPET bottles. For the first time, data indicates that manufacturers are paying a premium for these high grades of PCR as compared to virgin, illustrating the importance of strong demand and minimum content standards for stabilizing the business environment for recyclers and for the plastic recycling value chain as a whole.

CASE STUDY: CALIFORNIA'S RIGID PLASTIC PACKAGING CONTAINER LAW

In 1991, California enacted the Rigid Plastic Packaging Container (RPPC) law, which required certain rigid plastic packaging (defined as plastic package that has a relatively inflexible finite shape or form) manufactured in the state to meet one of the following standards by 1995:

- Contain 25% PCR content,
- Achieve source reduction milestones (based on weight or concentration),
- Be reusable or refillable, or
- Attain a 45% recycling rate.

Due to technical challenges in achieving food-grade PCR resin standards, the law exempts food-contact packaging. It applies primarily to fabric care, household cleaning products, and other non-food bottles. Given that recycling rates for plastic packaging have not hit 45% and the challenges of meeting the source reduction and reusable/refillable standard, many brands comply by using PCR. HDPE is the dominant resin used in these applications with PET used to a lesser extent. The law has had a significant impact on rHDPE markets and a marginal impact on rPET markets.

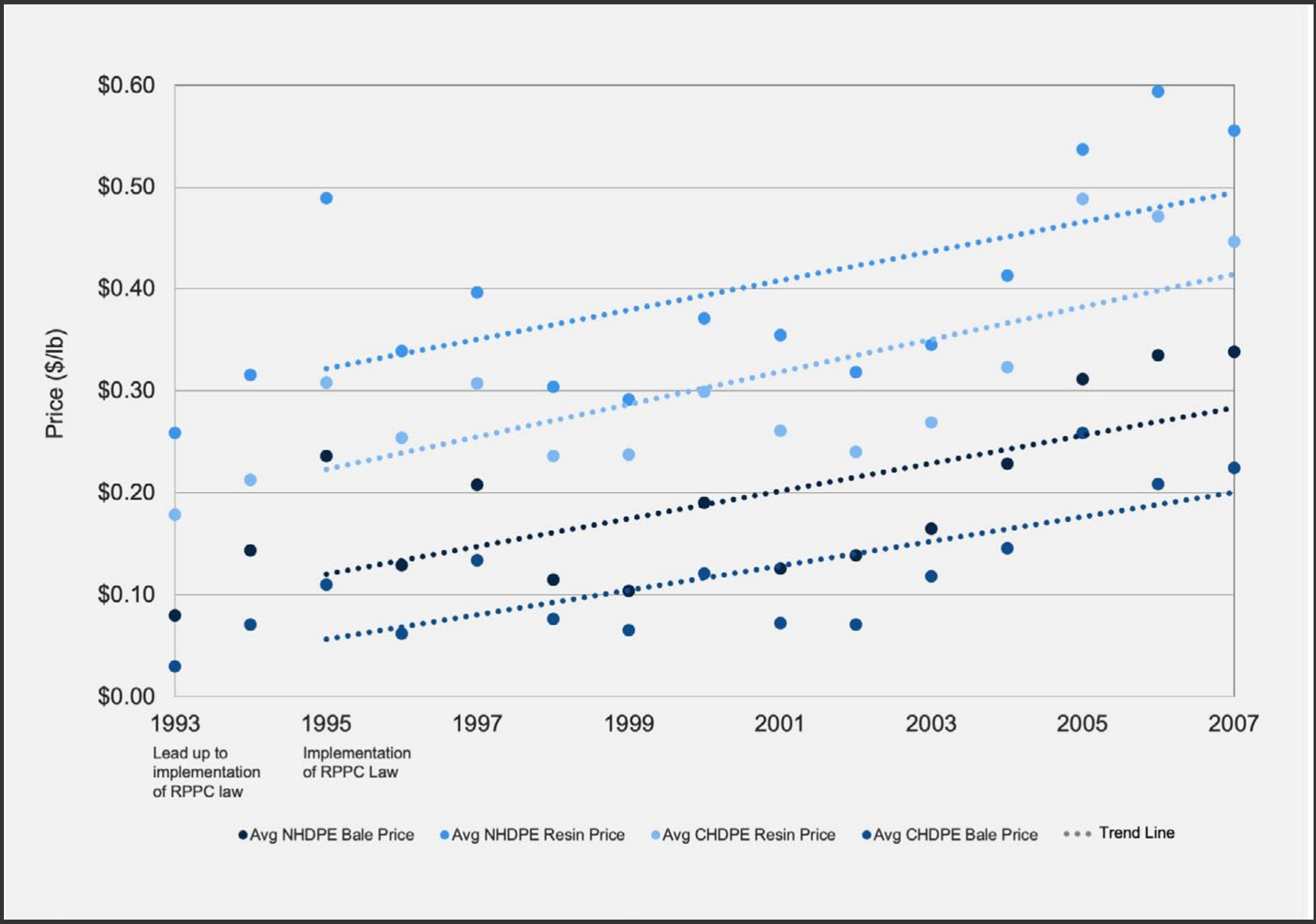
Because NHDPE is unpigmented, it is more easily incorporated into a variety of recycled content products without compromising color or performance; therefore, it commands a high price value on the market. It has been the recycled resin of choice to meet the obligations under the RPPC law. Despite implementation and enforcement challenges, many in the plastics recycling industry credit the RPPC law with fostering the development and maturing of the bottle-to-bottle markets that now represent nearly 40% of rHDPE end uses [8]. The consistent demand created by the RPPC law has sustained recycled NHDPE markets through volatile pricing swings, including historic lows in virgin resin pricing.

Industry experts estimate that demand created by the RPPC law is responsible for about two-thirds of the NHDPE recycled each year – more than 250 million pounds [17]. Due to California's significant market size, demand related to RPPC requirements has impacts beyond the borders of the state and supports at least a dozen HDPE reclaimers nationally who are able to sell recycled resin at a higher price due to this demand. Figure 10 shows that prices for rHDPE resin and bales rose in anticipation of the RPPC law and remained consistently higher after implementation [4]. The additional value of that HDPE was passed along to the MRFs that supply them through an increased bale price. Through that price signal, the RPPC law reduced risk, drove entrepreneurship, and fostered an environment for investment to develop systems and technology to bring PCR resin to higher-value end uses and provided a market for companies that invested in producing a higher-grade end product.

In the PET market, the RPPC law has supported a steady demand for rPET in non-food bottles, accounting for most of the 50 to 60 million pounds per year used in non-food bottles for the two decades from the late-90s to the late-2010s [18].

Building on lessons learned from laws like RPPC, future laws should forgo enforcement mechanisms that rely on on fees, as these can be treated as a cost of doing business, and instead structure enforcement mechanisms to incentivize compliance. One way of doing this is to prohibit the sale of products that do not meet the minimum recycled content standards.

Figure 10: Historical Average Price of Natural and Pigmented HDPE Bales



Social and Environmental Benefits of Recycled Content

The production and consumption of plastics have environmental, human, and social consequences. Oil extraction and petrochemical production are highly polluting, exposing those working in the industry to toxic chemicals and causing those living in nearby areas (often vulnerable communities) to have higher levels of severe health conditions than the general population. Improperly disposed plastics pollute the air if burned, contaminate the human food chain as microplastics, and increase the risk of flooding by clogging stormwater systems [32]. Ocean Conservancy has documented millions of pounds of plastics collected from the environment and conducted research on the impact of plastics on marine life [33]. Evidence of the impact of plastics (particularly micro-plastics) on human health is continuing to grow.

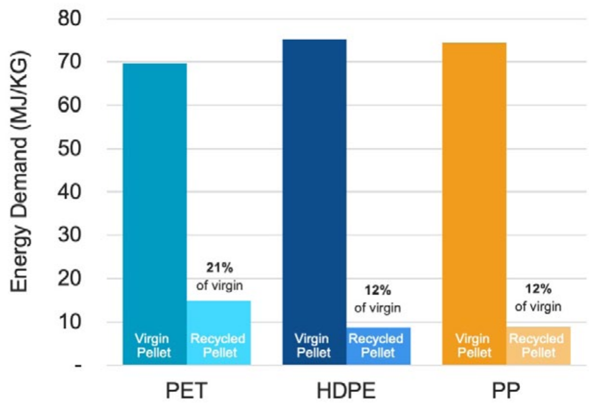
Requiring the use of recycled content reduces reliance on virgin plastic resin and the associated environmental impacts of extraction, processing, and manufacturing plastic. Addressing the environmental and public health impacts of plastic production requires significantly reducing demand for plastics overall and using recycled plastic in place of virgin wherever possible.

The projected growth in plastic production is substantial, and the environmental and social impacts of that growth are sobering. The emissions associated with global plastic production and consumption are projected to double by 2050 to 2.8 gigatons of carbon dioxide [19]. Meanwhile, plastic waste entering the marine environment is projected to triple by 2040 [20].

Research done by the Association of Plastic Recyclers (APR) demonstrates that using PCR in place of virgin plastic reduces total energy use and greenhouse gas emissions. Figures 11 and 12 show a comparison of total energy consumption and global warming potential, respectively, of PCR plastic pellets versus virgin plastic pellets from petrochemical sources. The total energy required to manufacture 100% rPET pellet is 21% of the energy required to manufacture virgin PET pellet, while the global warming potential is 33% that of manufacturing virgin PET resin [21]. The total energy required to manufacture 100% rHDPE or rPP pellets is 12% of the energy required to manufacture virgin, while the global warming potential is approximately 29% that of virgin for each of those resins.

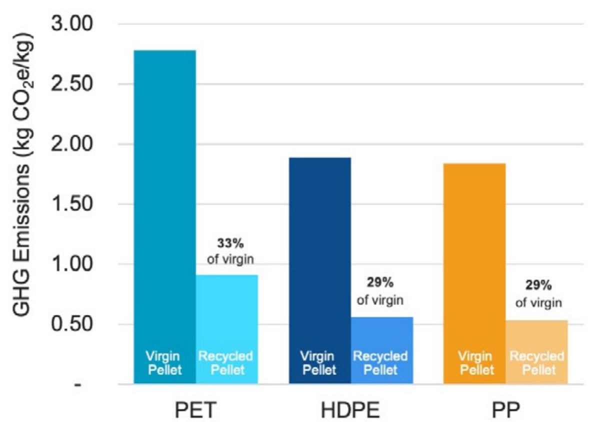
Displacing usage of virgin resin by doubling the amount of postconsumer PET, HDPE, and PP resin used in the U.S. in 2019, for example, would result in a savings of 4.9 million MT CO_2e [4].

Figure 11: Energy Required to Produce Virgin vs. Recycled Resin (excludes embedded feedstock energy of material)



Feedstock energy is the energy content of the resources removed from nature and used as material feedstocks (e.g., the inherent energy of oil and gas resources used as material feedstocks to produce virgin resins).

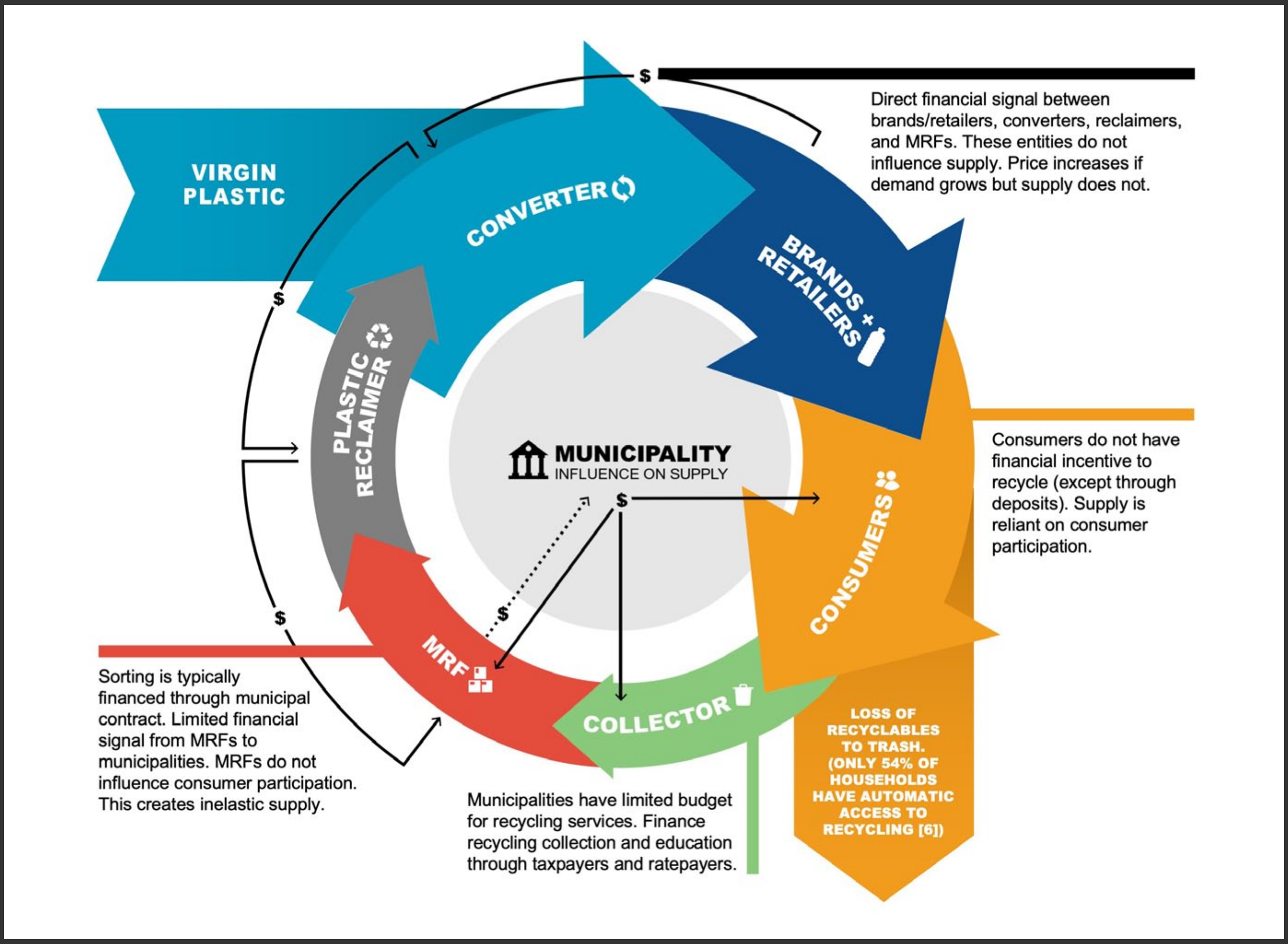
Figure 12: Global Warming Potential of Virgin vs. Recycled Resin



Meeting the demand created by minimum recycled content laws requires increasing the supply of plastics collected and sorted for recycling. However, high demand does not automatically translate to an increase in collection and recycling (or recycling rates) because recycling collection programs – the supply side of the equation – are driven by a different set of policies, including access to recycling or mandatory recycling, EPR, and beverage container deposits (bottle bills). As such, policies that drive supply and demand are best pursued in tandem.

Minimum recycled content requirements support end markets and processing infrastructure. The increased demand for recycled plastics created by content requirements will likely yield an increase in the price paid by the end market to the plastic reclaimer, and by the plastic reclaimer paid to the MRF. However, that price signal is not likely to reach the parties that are critical to generating the supply of recyclables – the municipality that manages the recycling program and the resident who chooses whether or not to place the recyclable material in the bin (Figure 13). Even with record high prices for NHDPE experienced in 2021, there is no indication of increased collection volumes. Although high prices increase revenue to the system overall, higher revenues do not always trickle down to the local level, nor would those revenues be adequate to cover the substantial costs of collection.

Figure 13: Supply of Recovered Plastics is Financially Delinked from Demand

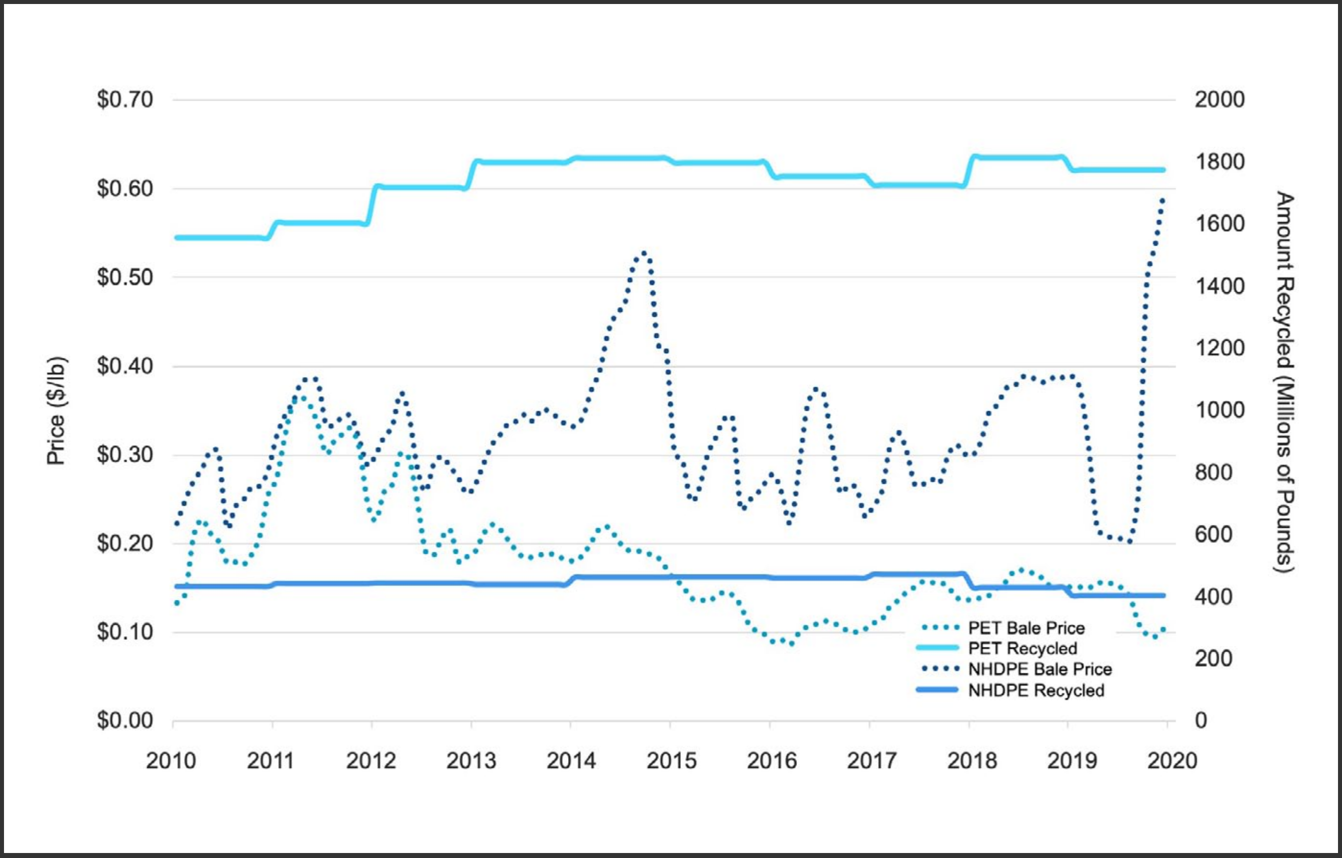


Depending on how recycling programs and contracts are structured, the municipality may or may not share in the revenue from the sale of recycled commodities by the MRF, though it is likely responsible for paying for transportation and MRF processing costs. In the past few years, recycled material markets have become even more volatile due to the COVID-19 pandemic and the implementation of the Chinese National Sword policy, which has led to the abrupt closure of Asian markets to American recyclables and resulted in a swift drop in commodity revenues. Consequently, recycling program managers must budget for processing cost expenses, but cannot budget for material revenues, and therefore cannot make investments based on assuming a return. Furthermore, if municipalities do share in recycled material revenues, it is commonly returned to the municipal general fund and not the recycling program specifically.

It is also important to understand that the economics of municipal recycling are not driven by plastic, they are driven by paper. Plastics are a small part of the overall stream of recyclables that MRFs process: ~8% by weight, compared to ~60% for paper, 19% for glass, and 3% for metals (the remainder is residue) [22]. So, even if recycled plastic values reach record highs, as they have at the time of this report, it is not enough to change the underlying economics of recycling programs. Combining policies that drive both supply and demand is crucial to ensuring that progress on recycling does not rely solely on what can be driven by market forces.

Figure 14 illustrates that the price paid to MRFs for sorted and baled PET and NHDPE has not led to an increase in the volume of PCR supply of those resins; this is why complementary policies that also support broader collection (supply) are important to optimize the performance of the entire system [4]

Figure 14: PET and NHDPE Bale Pricing and Recycled Volumes Over Time



ADDITIONAL DEMAND-SIDE POLICY DRIVERS FOR RECYCLED CONTENT

As described above, recycled content requirements for plastics are an important tool for creating and stabilizing recycling markets and for supporting the economics of recycling. Other policies play a supportive role in advancing the use of recycled content, as well. These include the following:

- Government procurement policies favoring recycled content products
- Voluntary corporate commitments for use of recycled content
- Product standards
- Green building standards

Complimentary supply-side policies and other economic incentives are discussed below (pg. 36).

Government Procurement Policy Favoring Recycled Content Products

Many government entities at the local, state, and federal levels have environmentally preferable purchasing programs in place to harness their buying power to drive the market for products that reduce their environmental footprint. These programs can be targeted towards the purchase of plastic products with recycled content to increase demand for recycled materials, and in some cases, incorporating long-term purchasing arrangements that can provide a stable baseline of demand. However, in the decades that these programs have been in place, progress has been limited.

The lack of progress can be linked to a number of factors, especially the complexity of selling to the government – a process that not all companies are equipped to manage.

Most government purchasing is done through the development of specifications for specific target products – an agency sets a specification, the purchasing agent uses that to make a purchase, and the company selling the product demonstrates that their product meets the specification. To facilitate purchases of recycled products, specifications must allow for, incentivize, or require the use of recycled content. The staff developing those specifications need to be aware that recycled content can be used in the product and that all of the performance requirements for that product can still be met. Then, the government purchasing agent must seek out the product that meets that specification, and the vendor must come forward to offer the product while also competing on price and performance.

Improving the effectiveness of government purchasing as a tool to build end markets requires effort both on the part of the purchasing agent to adjust bid specifications and by the vendor to make government purchasers aware of their products and how well they compete on price and performance. The government may need to allow for higher prices for products with recycled content to ensure purchasing is not decided on price alone. Government purchasing standards can drive the market by setting more aggressive standards than the more broadly applied minimum recycled content standards, increasing demand and driving innovation to achieve these levels of PCR. Policymakers should seek to harmonize approaches to ensure a robust and effective impact on the marketplace.

To help harness public sector purchasing power to support markets for recycled plastics, the Northeast Recycling Council (NERC) and APR have created the Government Recycling Demand Champions program to offer tools and resources to help governments maximize their demand for PCR [23]. Additionally, the Sustainable Purchasing Leadership Council, which includes representatives at all levels of government as well as corporate procurement professionals, has developed best practices for procurement of preferred products, including items made with recycled content.

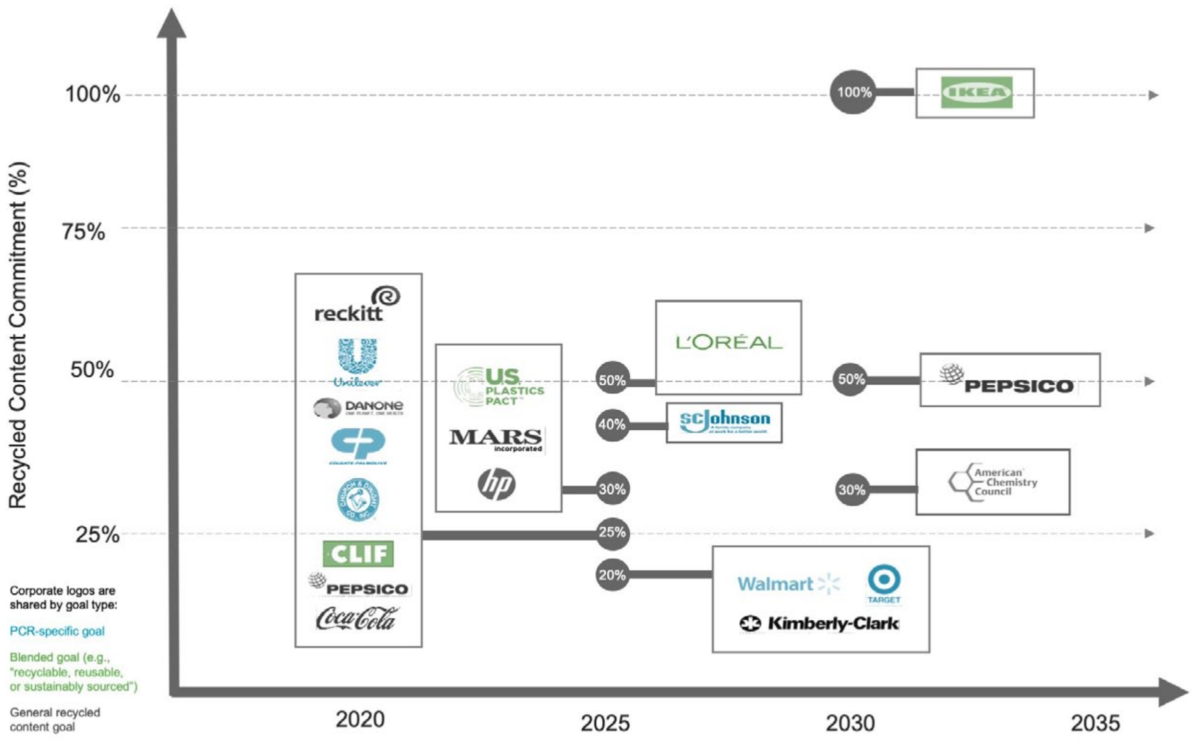
Voluntary Commitments for Use of Recycled Content

Corporate commitments to use recycled content can be powerful drivers in the recycling marketplace. In the early 1990s, newsprint producers signed agreements with state officials, committing the companies to using recycled content. These commitments, along with those made mandatory by legislation, helped to stabilize the paper recycling market and normalize production of recycled newsprint.

Today, corporate commitments, often made in response to public pressure, are driving strong demand for high-grade PCR resins for use in packaging. Most of the major corporations in the U.S. have committed to increasing their use of PCR in packaging (Figure 15). In addition, more than 100 activators (including Ocean Conservancy) spanning the plastics value chain have signed onto the U.S. Plastics Pact, committing them to use PCR content or bio-based resins for 30% of their packaging by 2025. Some corporations are also driving policy changes, such as endorsing minimum recycled mandates at the state level.

Recognizing that there is a significant supply of lower-grade, mixed-color material and that most demand is for high-grade, unpigmented PCR resin, the APR's Recycling Demand Champions initiative harnesses corporate purchasing power to support markets for durable goods that can absorb the current supply of PCR plastics. Under the program, companies volunteer to increase their use of PCR in any application, including their own products and packaging, as well as in items like pallets, slip sheets, roof coverboard, and trash bags. The program has been highly successful, with corporate use of PCR growing from 6.8 million pounds in 2018 to 175 million pounds in 2020 [24].

Figure 15: Corporate Commitments to Use Recycled Content



The corporate commitments to using recycled content in packaging and the Recycling Demand Champions program's commitments to PCR in durable goods complement each other and have the potential to provide robust market support for nearly all grades of PCR moving through the system. It is critical that a balance is maintained in the demand for high-grade and low-grade end uses so that the appropriate materials are directed to each end use and strong demand for durable goods does not undermine the supply chain and technological improvements needed to drive greater levels of circularity (e.g., packaging-to-packaging applications).

While voluntary corporate commitments are valuable, historically they have rarely been achieved and have had an unreliable influence on recycling markets. When PCR content is more expensive than virgin or if quality supply is constrained, companies have tended to shift back to virgin resin. For example, commitments to PCR made by the major beverage companies in the 1990s and 2000s were never achieved and decades passed with little corporate demand for recycled content beyond a few industry leaders, with companies citing supply and pricing challenges. Today, through organizations and programs like the U.S. Plastics Pact and Recycling Demand Champions, the combined volume and diversity of commitments for PCR plastics has grown substantially and scaled demand for recycled content across the consumer product goods industry. In fact, some buyers are entering into long-term purchasing agreements to secure PCR. These agreements help to stabilize the reclamation industry by providing reliable market outlets at a predictable price over the contract period, which should also reduce risk for investors in new capacity. However, these voluntary commitments remain voluntary, and without supportive policies, the markets for PCR content could shift again.

Green Building Standards and Recycled Content

Use of PCR in durable goods is also driven by strategies like green building specifications, such as the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) points and procurement policies. The USGBC LEED system provides incentives through LEED points for the use of recycled content that contributes to a building's green rating. Products like plastic lumber made with recycled PE and carpet containing rPET are examples of building products that can be used to achieve LEED points.

Product Standards Driving Recycled Content

Product standards ensure performance and technical specifications are met through standardized testing and protocols established by a standards-setting organization (e.g., ASTM International; American Association of State Highway and Transportation Officials (AASHTO)). These standards, like AASHTO-M298-16 and ASTM Intl F 2306-Pipe for corrugated HDPE pipe, can establish allowable rates for recycled content (40-60% for HDPE pipes). Paired with government purchasing requirements or organizations that purchase products based on product standards, these can be powerful drivers to develop end markets for recovered plastics.

PCR IN PLASTIC PACKAGING AND OTHER APPLICATIONS

Key Points

- Durable goods are well suited for high percentages of PCR content as recycled content is easier to incorporate into those products than into packaging, especially food-grade packaging.
- PCR usage in packaging applications is limited predominantly to PET and HDPE, the resins with the most developed recycling system infrastructure.
- Broad application of PCR in packaging will require technical innovation and greater supply of clean material.
- Chemical recycling has the potential to remove several of the technical challenges that limit mechanical recycling, but has yet to be proven at scale, raises human and environmental health concerns, and faces the same supply-side challenges as our existing recycling system, thus it cannot be seen as a quick-fix to our recycling system.

END USES BY RESIN TYPE – HIGH-GRADE PET AND HDPE

The end uses for the plastic packaging recycled today vary by resin, packaging format, and relative maturity of the recycling infrastructure for the specific format. Recycling systems for PET (#1) and HDPE (#2) bottles are well established nationally, as these packages have been widely used and widely recycled for decades.

Over half of all rPET in the U.S. and Canada is used in packaging applications (including bottles and thermoforms like clamshells and berry baskets) [18]. The success of PET bottle-to-bottle recycling can be attributed to the maturity of the market, initially developed by state-level beverage container deposit systems that were collecting large volumes of PET in the 1970s and expanded in the 1980s and 1990s to incorporate materials collected through curbside recycling programs. Another factor in its success is the relative uniformity of the rPET stream – most PET bottles and jars are clear with similar characteristics and all virgin PET is food grade at the point of production.

Recycled HDPE is also used in new packaging applications in the U.S. and Canada, but to a lesser degree than rPET (37%) and generally not in food-grade applications [8]. The rHDPE market is slightly less mature than rPET because it developed with curbside recycling. HDPE is not used in many beverage containers targeted by deposit programs, so it has not been significantly impacted by bottle bills. Most of the rHDPE used in new packaging applications is derived from NHDPE streams (e.g., milk jugs) for two reasons. First, the lack of pigments in NHDPE and the relative uniformity of the stream make it readily useful and highly desirable for a variety of recycled applications. Second, most NHDPE is food grade at the point of production, which enables its use in food packaging as well as other applications where buyers specify food-grade resin (e.g., personal care products).

END USES BY RESIN TYPE – EVERYTHING ELSE

There is currently very little use of other recycled resins (colored HDPE, PP, or LDPE) in new packaging applications. Instead, most of the PCR derived from these resins is used in durable goods, such as pipe, lumber and decking, buckets, lawn and garden products, and more (Figure 16) [9][10][25]. The following factors contribute to the challenges of using more PCR in packaging applications:

- **Quality:** Plastics collected for recycling in residential recycling programs are often diverse in size, form, and technical properties, and include packaging that is not designed for recycling systems, leading to contamination in the recycling stream and a lower quality output.

- **Color:** High volumes of colored packaging (e.g., colored HDPE and PP) create a recycled resin that is grey or black, limiting the applications to those that can tolerate black. Currently, few packaging applications fit that description.

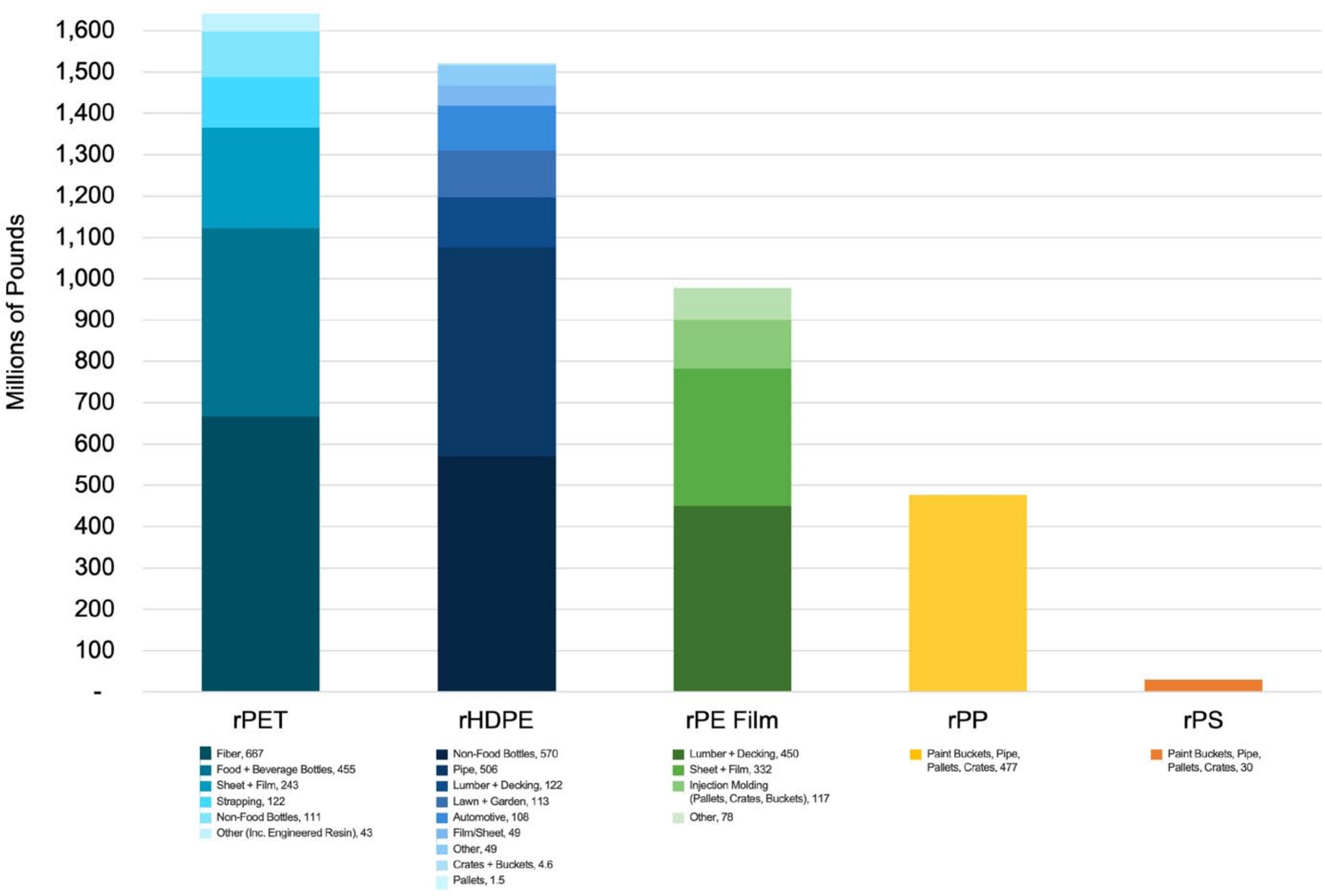
- **Food-grade sources:** For certain resins, Food Drug Administration (FDA) approval of food-grade PCR requires verification that the source materials were food grade at the point of production and only include food-contact-approved additives, which adds another step in the reclamation process to sort food-grade packaging from other packaging feedstocks. The production of food-grade recycled plastic requires a letter of no objection (LNO) from the FDA, and qualification from brands that may have more stringent and often lengthy internal qualification procedures.

- **Additives:** Non-food-contact plastic packaging applications may use additives that are not safe for food-contact use and are therefore limited to non-food-contact end uses.

- **Aesthetics and odor:** Postconsumer plastics can carry contaminants, and in some cases odors, which impact their potential applications; for example, rHDPE can carry the odor of detergent or spoiled milk if not processed sufficiently.

Minimum recycled content requirements for products that can absorb lower-grade, mixed-color (black or grey) recycled resin (e.g., storage bins, trash bags, flowerpots, etc.) would provide important support to plastic recycling markets. At the same time, investments should be made in research and innovation to overcome technical hurdles and enable more PCR to be utilized in higher-grade circular applications.

Figure 16: End Uses by Recycled Resin, 2018-2019



Food-Grade Applications

Food-grade PCR is in high demand for food-contact, health, beauty, and some personal care applications. Some packaging converters may also avoid regulatory and facility management challenges from cross contamination by using only food-grade PCR. Under an LNO issued by the FDA, a substantial proportion of the reclamation capacity for each resin has approval to produce food-grade quality PCR resin [4]. However, while there is capacity to produce food-grade material, actual production (beyond PET) is limited because of a lack of supply that meets quantity, color, and food-quality requirements. In general, the chemistry of polyolefin plastics (HDPE, LDPE, LLDPE, and PP) and additives used in them may limit the ability to recycle these plastics into food-grade plastic. Mechanical reclamation of food-grade recyclate from polyolefins requires material inputs to be source controlled, which means restricted to food-contact applications. The processes that can convert lower-quality recycled materials to the food-grade recycled content in demand by the packaging industry are currently cost prohibitive for most applications and lead to substantial manufacturing yield loss. In addition, certain brands have quality standards that exceed FDA mandated minimum food-grade requirements and require suppliers to engage in lengthy qualification or certification processes that can make the market demand even more challenging to meet.

Minimum recycled content standards can drive the innovation and investment needed to overcome the challenges of incorporating PCR in food-grade and other higher-value applications by ensuring a market for the resulting recycled product. This is especially true if PCR requirements are thoughtfully constructed to allow for that innovation and growth in higher-value markets over time. In effect, minimum content standards can help de-risk investment and drive technology improvements to achieve circularity in packaging.

THE ROLE OF CHEMICAL RECYCLING TECHNOLOGIES

The term “chemical recycling” is used to refer to a suite of technologies that use a variety of non-mechanical processes to convert plastic waste back into a like-virgin recycled resin, resin precursors (e.g., monomers like DMT and EG), or petrochemical intermediates and fuels (e.g., naphtha, waxes, or diesel).

To date, most of these technologies have not been demonstrated at commercial scale, nor have their full human health and environmental impacts been studied. Furthermore, they will face the same challenges associated with obtaining sufficient supply that mechanical recycling operators do, if not more, as these facilities require very large volumes of recovered feedstock that meet their quality specifications to operate efficiently.

If chemical recycling technologies that turn plastics back into plastics can achieve commercial scale and meet strict human health and environmental parameters with stringent regulations, they could play an important role in balancing the supply-demand equation of PCR resins. Technologies that turn plastics into fuel are not contributing to a circular system since materials are cascaded into fuel products instead of being sent back into plastics; therefore, they are not considered a sustainable pathway for plastics.

Plastic-to-plastics chemical recycling could have a role in processing the currently available supply of low-grade, mixed-color recycled material and produce a high-quality, food-grade, unpigmented recycled resin. These technologies could open a pathway and create an economic incentive to upcycle plastics that are otherwise destined for the landfill or waste-to-energy. However, as these technologies remain unproven economically and environmentally, it is important not to rely on these technologies when establishing minimum recycled content standards.

SUPPLY AND DEMAND FOR RECYCLED CONTENT

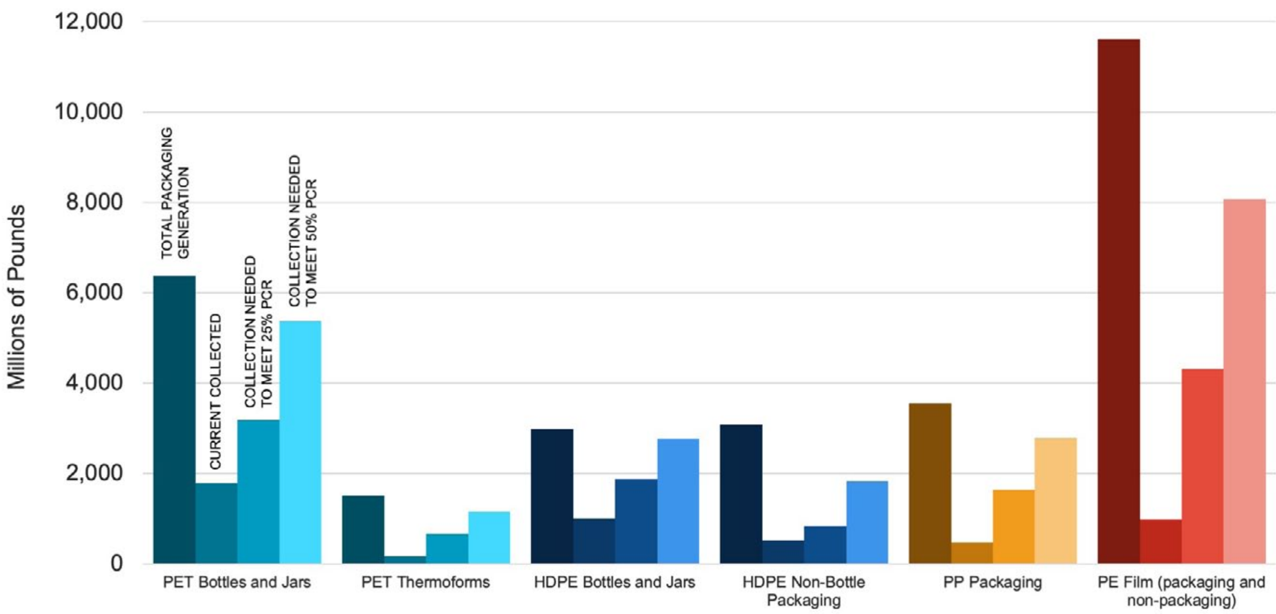
Key Points

- There is currently not enough plastic collected for recycling to meet corporate commitments and mandates for the use of PCR. Most of what is currently recycled is not of a quality suitable for use in packaging applications.
- The most effective driver to increase the supply of postconsumer plastics is policy. Beverage container deposit systems (i.e., “bottle bills”) and extended producer responsibility (EPR) are two effective supply-side policies.
- To avoid market distortion (e.g., PCR shortages, unreasonably high prices, stress on regional and international markets) and meet market demands, minimum content standards should be pursued in concert with supply side policies.
- Additional plastics policies, such as a tax on virgin plastic resin or design for recyclability requirements, can support the use of PCR by leveling the economic playing field and/or reducing contamination in the recycling stream.

RECOGNIZING THE MISMATCH BETWEEN SUPPLY AND DEMAND

The supply of recyclable materials (mostly low quality, mixed source, and mixed color) is not well matched with the demand for high-quality, food-grade, unpigmented materials. Achieving higher levels of PCR in packaging applications will require actions to improve both the quality and the quantity of the supply available for recycling. Technological innovation in packaging design and recycling systems is also needed to increase the available supply to bridge the supply-demand mismatch. Figure 17 compares the quantity of material that would need to be collected to satisfy a 25% and 50% resin-wide PCR content requirement for several packaging formats to the amount of material collected today [4]. The analysis presented adjusts collected volumes for yield loss and assumes that demand from non-packaging end uses (e.g., PET bottles used to make carpet) remain constant. These results demonstrate the need for strong supply to match growing demand; for example, to achieve 50% PCR for PET bottles we need to recover 84% of bottles. This level of collection is currently only achieved in efficiently operating deposit return systems, highlighting the need for effective supply-side policies to enable higher levels of PCR.

Figure 17: PCR Content Supply to Demand Gap



GROWING SUPPLY TO MEET PCR MANDATES & COMMITMENTS

Achieving substantial increases in the supply of plastics to grow the use of PCR requires investments in recycling collection. Many corporations are making investments in organizations like Closed Loop Partners and The Recycling Partnership to address the supply of recyclable materials by improving recycling collection, consumer education, and MRF processing.

As of the end of 2021, legislation establishing EPR for packaging has been enacted in Maine and Oregon and has been introduced in at least six other states as well as at the federal level. As more EPR for packaging legislation is enacted and implemented, PCR content requirements will ensure that collected material is recycled into new products or packaging. Moreover, instituting a timeline for increasing levels of PCR in the future may help incentivize support for supply-side policies such as EPR or container deposit legislation and give companies a clear indication of how to source feedstock in the future.

A key method for improving the quality of postconsumer plastics is to eliminate known problematic plastics or features and promote design for recyclability, including using tools provided by the APR. Plastic packaging that meets design for recyclability guidelines is more likely to be recycled into a high-grade application, while packaging that does not meet such standards may not make it through the recycling process at all.

Policy has proven to be an effective mechanism for driving recycling collection programs, as states and local governments with strong policy frameworks have consistently outperformed those without, as measured by recycling collection volumes [26]. There are a host of policy tools available to the government at the local, state, and federal levels to improve and increase recycling. Table 5 presents the major policy options and their impacts on the recycling system.

Table 5: Policies to Increase the Supply of Plastic for Recycling

POLICY TYPE	DESCRIPTION	IMPACT
DISPOSAL BANS	Prohibits disposal of designated items (e.g., beverage containers) with trash.	Can keep material out of disposal systems and drive consumer recycling participation when coupled with education, infrastructure, and enforcement.
UNIVERSAL ACCESS TO RECYCLING	Requires service providers (public or private sector) to offer recycling everywhere waste collection is provided.	Expands access to recycling, particularly in rural, multi-family, and away-from-home settings; requires processing infrastructure and end markets.
MANDATORY RECYCLING	Requires generators to recycle; requires haulers to provide recycling services; or requires local governments to implement recycling.	Can drive consumer recycling participation when coupled with education, infrastructure, and enforcement.
EXTENDED PRODUCER RESPONSIBILITY (EPR)	Requires producers/brands/retailers to cover some or all of the costs of recycling packaging.	Provides financial support and central coordination/management to recycling system; re-aligns incentives for product and packaging design to ease waste management challenges.
BEVERAGE CONTAINER DEPOSITS	Places a deposit on certain beverage containers that can be redeemed when returned for recycling.	Generates significant quantities of clean, high-quality aluminum, PET and glass that facilitates high-grade end use.

OTHER SUPPORTIVE POLICIES

One of the challenges to the growth of PCR use is competition with low-priced virgin resin. To level the playing field, a tax on virgin resin used to produce single-use products and packaging was recently proposed at the federal level (S.2645). The tax would make PCR resins more economically competitive in the marketplace. The funding created through that legislation would be used for various plastic waste prevention and recycling activities.

Additionally, policies that incentivize design for recyclability and appropriate educational labeling to support recycling behaviors can support a healthy recycling system. Among other provisions, California's SB 343 codifies the Federal Trade Commission's (FTC) Green Guide for recycling-related claims and requires that any plastic packaging labeled as "recyclable" or features the "chasing arrows" symbol must be consistent with APR's Recycling Design Guide. This will encourage those putting packaging into the market to provide accurate information to consumers and follow design for recycling guidelines while also enabling consumers to recycle more thoughtfully.

Furthermore, there is a need for funding, innovation, and/or economic subsidies to support the development of technologies and systems to replace or recycle plastic packaging for which recycling collection and sorting infrastructure is currently immature or non-existent (e.g., pouches and other flexible films).

QUALIFYING PCR AND LABELING

TRACEABILITY OF SOURCES

Validating the source of recycled material in a package or product requires certification. Minimum recycled content requirements need to define which sources of recycled content are valid and reference accepted standards for postconsumer, pre-consumer, and postindustrial sources of recovered material. By validating the source of recycled content, certification provides accountability within the plastic recovery value chain and builds trust and credibility within the plastic recycling system. Traceability or chain of custody processes for pre-consumer and postindustrial streams is uncommon for plastics today.

Traceability of the source of recycled content has become increasingly important and is being demanded by customers seeking to use PCR and to comply with regulatory requirements. APR has taken steps to establish third-party certification of postconsumer plastics through auditing. GreenBlue's Recycled Material Standard, launched in 2021, also provides third-party certification of recycled content.

Claims related to recycled content from chemically recycled plastic can be verified through certifications like ISCC PLUS. Mass Balance Accounting standards are in development through ISO and will provide additional avenues for recycled content claims for chemically recovered content.

CLAIMS AND STANDARDS

One of the driving influences for the use of PCR in consumer-facing products and packaging is the ability to make a marketing claim. In the U.S., the FTC oversees marketing claims related to recycled content and provides guidance in its Green Guide [30]. The FTC distinguishes between postconsumer and pre-consumer recycled content. In all cases, substantiation is required to show material has been recovered or diverted from the waste stream either during manufacture (pre-consumer) or after consumer use (postconsumer). Recycled content claims may distinguish between postconsumer and pre-consumer content but do not have to. When a distinction is made between postconsumer and pre-consumer, it requires substantiation for any claim about the percentage of content. A recycled content claim cannot be made for materials that are normally reused by industry within the original manufacturing process and would not normally have entered the waste stream.

RECOMMENDATIONS

MANDATORY MINIMUM RECYCLED CONTENT POLICY CONSIDERATIONS

Minimum recycled content requirements should be established through a legal framework that drives technology and markets to achieve the economic, environmental, and community benefits of using recycled content, and that fosters continual improvement through increasing requirements over time. Based on the detailed review of the plastics recycling industry, its stakeholders, and its market dynamics presented in this report, the most salient considerations for mandatory minimum recycled content legislation are summarized below.

MANDATORY RECYCLED CONTENT POLICY RECOMMENDATIONS

Covered and exempt items: Clear delineation of which resin types and packaging formats are subject to minimum content requirements is crucial to ensuring successful implementation. Mandatory minimum recycled content standards should focus on both high-grade circular packaging and container applications (e.g., beverage bottles and foodservice packaging), plastic film applications (e.g., trash bags), and durable goods (e.g., storage bins, drainage pipe, curbside carts). Given the supply constraints in the market today, both in terms of quality and quantity, focusing mandatory minimum PCR content standards only on high-grade packaging (i.e., bottles) could lead to higher prices for PCR resins and bales of recycled plastics, while resulting in little real improvement to the recycling market.

Plastic film products and durable goods, while often overlooked, are an important foundation to a robust plastics recycling system. Plastic film and durable goods provide large capacity end markets for materials that are difficult for MRFs and reclaimers to market (e.g., colored and byproduct streams). Expanding mandatory minimum PCR content standards to include plastic film and durable goods that absorb most of the recycled plastics currently moving through the recycling system would provide needed certainty to the reclamation industry, ensuring a market for both the higher- and lower-grade PCR resins they produce. However, it will be important to consider the balance of PCR content requirements for packaging versus durable goods so as not to stifle innovation in producing packaging grade material.

Initially, requirements should be applied to a specific suite of consumer-facing products across the quality spectrum:

- **Food-grade packaging.** Closed-loop applications that can be achieved using the high-grade supply generated by beverage container deposit systems.
- **Plastic film and durable goods.** Applications that have less stringent requirements and can use the range of materials in the curbside recycling stream.
- **Non-food packaging.** Applications in the middle-grade range require investment in systems to appropriately process and prepare for market. Ramp-up of the middle range is critical to reducing virgin plastic production.

Recycled content types: Minimum content requirements need to define which sources of recycled content are valid and reference accepted standards for postconsumer, pre-consumer, and postindustrial sources of recovered material, regardless of the technology used to process those materials. To drive market development, it is critical to focus on the use of content derived from postconsumer materials. Markets for postindustrial materials are strong and not in need of policy support. Allowing for the inclusion of postindustrial material would weaken a policy's impact in supporting residential recycling systems.

Rates and dates: Mandatory recycled content levels should be increased incrementally over time to allow for the growth of supply. Legislation should include provisions that require periodic review and adjustment of targets based on available data and market information. PCR content standards for higher-grade applications should be increased periodically to drive the technological innovation needed to reclaim higher volumes of plastic to higher-grade closed-loop packaging applications. Rates in durable goods should increase initially and level off over time, allowing for the expansion of PCR content usage in packaging applications. Concurrently, efforts must be made to increase plastic recycling by enacting supply-side policy and strengthening community recycling programs.

Portfolio-level standards: Recycled content legislation should allow for portfolio-level standards or averaged recycled content across a covered entity's product or packaging portfolio to provide flexibility with regard to geographies and product formats. Portfolio standards also limit the need for waivers. To ensure that portfolio standards do not undermine the minimum content requirement, they must be crafted carefully and specifically to ensure a market for all resins. Consideration should be given to penalties (fees, prohibition of sales, or other remedies) and/or a sunset for portfolio standards to ensure all products eventually contain PCR.

Verification: New policy requirements should take advantage of existing systems to appropriately document claims and certify recycled content. Chain of custody or other forms of traceability of supply should be required for all sources of recovered plastic and standardized in order to reduce confusion and duplicative standards and systems. A federally recognized certification program for recycled content that benchmarks average content within a category of products or packaging and recognizes performance above the average, much like the EPA/U.S. DOE Energy Star program, would increase consumer understanding and confidence in recycled content purchasing, provide a platform for continuous improvement, and potentially provide a platform for harmonized content reporting.

Waivers: Waivers should be available when supply is inadequate to fulfill requirements or other technical issues arise. However, a supply-based waiver must require robust justification and exploration of barriers between existing and potential supply.

Reporting and enforcement: Annual reporting should be required at the federal level of the weights, percentages, formats, and flows of PCR resin and virgin resin. Enforcement of minimum content requirements must be strenuous enough to incentivize compliance. In addition to fees for non-compliance, which may be seen as a cost of doing business, a recommended enforcement tactic is to prohibit the sale of products that are not in compliance with minimum content requirements.

MANDATORY MINIMUM RECYCLED CONTENT RATE RECOMMENDATIONS

Achieving meaningful recycled content rates across plastic products and packaging will require increased collection and innovation across the plastics value chain. This report presents three rate tables for consideration; one table presents durables and non-packaging items, while the others present two scenarios for packaging applications.

Durables and non-packaging items (Table 6): Durable goods and non-packaging applications are the underpinnings of a robust and healthy recycled content market. These goods provide a consistent baseline demand for lower-grade recycled resin while technologies and supply grow to support use of recycled resins in high-grade applications like bottles and packaging. For this reason, rates for the durable goods and non-packaging applications increase initially and then level off.

Packaging Scenario 1 (Table 7): The first scenario is predicated on the assumption that supply grows substantially over time from the adoption of supply-side policies like expanded bottle bills and EPR in key states. This scenario begins with goals that are realistically achievable given current collection rates in the first year and increases rates over time based on target application as supply-side strategies are activated to match demand.

Packaging Scenario 2 (Table 8): The second scenario presents rates based on the assumption that best-in-class recycling programs will be available nationwide, supported by the adoption of a national bottle bill for all beverage containers and a national EPR policy for other packaging. This scenario assumes these policies are adopted in the near term (2022-2023) and that supply of recycled goods grows quickly thereafter (2025-2035).[6] Typical policy development timeline for a substantial supply-side policy, such as EPR or beverage container deposit, is between two and five years from the date of passage to full implementation; therefore, increased PCR rates to reflect the increase availability of supply are not recommended until 2030. Scenario 2 also assumes the optimization of solutions to address technical, quality, and color issues, the adoption of design for recyclability standards by brands, and innovation in plastic-to-plastic recycling.

The assumptions behind the analysis supporting the rates in these scenarios are provided in Appendix B.

Table 6: Plastic Film and Durable Products

EXAMPLE PRODUCTS	RESIN	2019/2020 EST. % PCR (US & CANADA)*	2025 % PCR	2030 % PCR	2035 % PCR	2040 - 2050 % PCR
Carryout Bags and Polybags	PE Film	unavailable	10%	20%	30%	35 - 40%
Trash Bags	PE Film	unavailable	10%	15%	20%	20%
Garden Pots	PP, HDPE	<10%	20%	30%	30%	30%
Storage Bins	PP, HDPE	unavailable	20%	30%	30%	30%
Garbage & Recycling Carts	PP, HDPE	<3%	5%	15%	15%	15%
Pipe	HDPE	unavailable	20%	30%	30%	30%

* Estimates for 2019/2020 % PCR for film and durable products are limited due to lack of data availability and reporting. PCR use is reported for both the US and Canada because the two countries operate effectively as one marketplace.

Table 7: Packaging Applications Scenario 1 – Assumes Significant Growth in Recycling Collection and Modest Technological Innovation

EXAMPLE PRODUCTS	2019/2020 EST. % PCR (US & CANADA)*	2025 % PCR	2030 % PCR	2035 % PCR	2040 - 2050 % PCR
PET Bottles	11%	15%	20%	25%	30 - 40%
PET Thermoforms	16%	16%	20%	25%	30 - 35%
HDPE Bottles	17%	17%	20%	25%	30 - 40%
PP Packaging	0%	5%	10%	15%	25 - 30%

* Estimates for 2019/2020 % PCR for film and durable products are limited due to lack of data availability and reporting.

Table 8: Packaging Applications Scenario 2 – Assumes National Supply-Side Policy (EPR and Bottle Bill), Technical Innovation, and Design for Recycling Improvements

EXAMPLE PRODUCTS	2019/2020 EST. % PCR (US & CANADA)*	2025 % PCR	2030 % PCR	2035 % PCR	2040 - 2050 % PCR
PET Bottles	11%	15%	30%	45%	55 - 60%
PET Thermoforms	16%	16%	22%	30%	35 - 45%
HDPE Bottles	17%	17%	25%	25%	40 - 50%
PP Packaging	0%	5%	15%	25%	30 - 35%

* Estimates for 2019/2020 % PCR for film and durable products are limited due to lack of data availability and reporting.

[6] Capture rates from best-in-class curbside recycling programs are based on analysis conducted by The Recycling Partnership "Paying It Forward" report.

IMPACTS OF MANDATORY RECYCLED CONTENT RECOMMENDATIONS

The PCR rates recommended above would reduce demand for virgin materials in new products, reduce emissions associated with material production, and reduce demand for resource extraction. Achieving the recommended PCR rates for packaging in Scenario 1 would result in a 400% increase in the amount of PCR used in those packaging applications and the avoidance of three million metric tons of CO_2 equivalent emissions compared to today [4].[7] Achieving the rates of PCR under the more ambitious Scenario 2 would result in a 600% increase in the amount of PCR used in those packaging applications and the avoidance of four and a half million metric tons of CO_2 equivalent emissions compared to today [4].[8]

THE ROADMAP FOR MINIMUM RECYCLED CONTENT STANDARDS

Minimum recycled content standards are a critical step in achieving a circular economy for plastics. The steps on the roadmap below (Figure 18) show the process for establishing effective and impactful PCR standards.

Figure 18: Roadmap for Minimum Recycled Content Standards

ELIMINATE problematic materials, encourage reusable packaging where possible to reduce single-use formats, incentivize design for recyclability, and develop other supportive policies to continue leveling the economic playing field.

ENSURE sufficient funding and incentives for innovation for technologies that recycle plastics.

2022

1 — **INCREASE** the supply of plastics collected for recycling through policy and investment.

2022-2023

2 — **IMPLEMENT** government purchasing programs focused on PCR content to significantly increase demand and drive innovation.

2025

3 — **ESTABLISH** mandatory minimum recycled content requirements across a range of products including packaging, plastic film, and durable goods.

2027 →

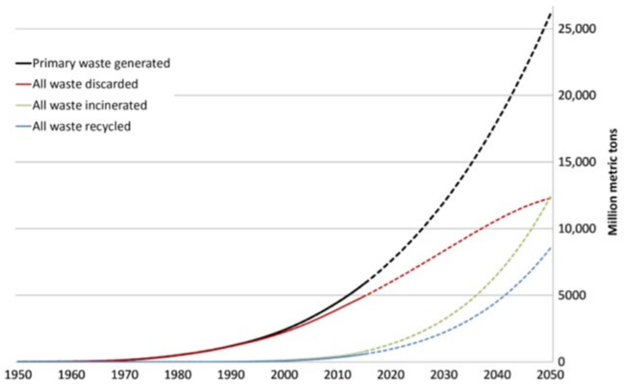
4 — **ADJUST** mandatory minimum recycled content requirements periodically to increase rates for the closed-loop applications.

[7] Calculations based on today's market size.
[8] Ibid

CONCLUSION

ACTION IS URGENTLY NEEDED TO ADDRESS PLASTIC POLLUTION AND THE ESCALATING ENVIRONMENTAL IMPACTS OF A RAPIDLY GROWING FOSSIL FUEL-BASED PLASTICS INDUSTRY.

Figure 19: Cumulative plastic waste generation and disposal (in million metric tons)



Source: Geyer, et al., 2017

The global plastics industry has experienced an average growth rate of 9% per year since 1950 and, as of 2015, produced an estimated 388 million tons of primarily fossil fuel-based plastic annually [27]. At this rate of growth, using 2015 as a baseline, the global production of plastic could more than double by 2025 as shown in Figure 19 [28]. The U.S. represents about 19% of global production and is a cost-advantaged producer of plastics due to abundant and heavily subsidized low-cost fossil feedstocks [27]. Plastics are one of the fastest growing segments of the U.S. municipal waste stream and represent about 12.2% of all MSW [1].

A large portion of industry and environmental organizations have reached the consensus that developing a circular economy for plastics to reduce dependence on virgin plastic resin is a necessary action. Implementing mandatory minimum recycled content requirements and growing the demand for PCR plastics is a key step in that transition. At the same time, momentum continues to build for supply-side policies that drive recycling collection programs at the state and national level. Now is a critical moment to advance strong demand-side policies that ensure a strong end market for recovered plastic packaging and products. The combined impact of implementing minimum recycled content standards and supply-side policies will provide a much needed and comprehensive boost to the U.S. recycling system, creating jobs and providing numerous benefits for the environment and our communities. In short, it is essential that we create the policy environment to increase the sustainable use of plastic packaging and products while simultaneously addressing some of the most challenging and acute environmental issues facing the U.S. today.

Ocean Conservancy looks forward to working with the EPA, legislatures, and other interested stakeholders in the coming months and years to advance policies laid out in this report. The health of our communities and our ocean depend on it.

APPENDIX A: GLOSSARY

- **Colored HDPE (CHDPE)** – Colored HDPE is pigmented HDPE. Colored HDPE bottles are used to contain fabric care (e.g., detergent and softeners), personal care (e.g., shampoo and conditioner), and household products (e.g., cleaners, motor oil, etc.).

- **Containers and packaging** – According to the EPA, packaging is the product used to wrap or protect goods, including food, beverages, medications, and cosmetic products. Containers and packaging are used in the shipping storage and protection of products. The EPA defines containers and packaging as products that are assumed to be discarded the same year the products they contain are purchased.

- **Durable goods** – EPA defines durable goods as products with a lifetime of three years or more.

- **End market** – Purchaser of a material, good, product, or commodity.

- **HDPE** – High-density polyethylene (HDPE) is defined by its exceptional toughness and strength, as well as its ease of processing. It is designated by resin identification code #2. HDPE is frequently used in rigid plastic packaging and film applications, such as trash bags and agricultural film.

- **LDPE** – Low-density polyethylene (LDPE) is distinguished by its flexibility, relative transparency, low melting point, and strength. It is designated by resin identification code #4. It is often used in plastic retail bags, flexible lids and bottles, and cable applications.

- **LLDPE** – Linear low-density polyethylene is characterized by high impact resistance, low shearing, and exceptional flexibility. It is designated by resin identification code #4. These qualities allow LLDPE to be used in thinner film applications, such as stretch wrap. LLDPE is also used in flexible tubing and cable applications.

- **Natural HDPE (NHDPE)** – Natural high-density polyethylene (NHDPE) is distinguished from colored HDPE because it is unpigmented. It is designated by resin identification code #2. It otherwise retains the same properties as HDPE. NHDPE bottles are used as milk jugs and gallon size water bottles.

- **PET** – Polyethylene terephthalate (PET) is a lightweight and impact-resistant plastic with good moisture barrier properties. It is designated by resin identification code #1. It is commonly used in soft drink bottles and thermoformed containers (e.g., cups, clamshells).

- **Plastic reclaimers** – Recyclers that purchase bales of sorted plastics from MRFs and other generators and process them into flake or pellet that is sold to packaging and product manufacturers.

- **PP** – Polypropylene (PP) is a thermoplastic resin characterized by its high melting point, low density, and easy processing. It is designated by resin identification code #5. It is most often used in flexible and rigid packaging, as well as larger molded parts for consumer goods and automotive products.

- **Postconsumer Resin (PCR)** – Recycled resin produced from material that was used for its intended purpose. PCR is typically derived from materials that are collected in residential and commercial recycling programs.

- **Postindustrial Resin (PIR)** – Recycled resin produced from a by-product of manufacturing that was never used for its intended purpose, such as scrap in the manufacturing process.

- **Pre-consumer recycled content** – Defined as materials that are recovered before reaching the consumer. Examples include reject packaging and destruction material (e.g., filled but not sold) post-production but before being sold to the end consumer. Sometimes used interchangeably with postindustrial recycled content.

- **PS** – Polystyrene (PS) is a versatile plastic with a relatively low melting point and low-impact resistance. It is designated by resin identification code #6. Polystyrene is frequently used in protective packaging, cups, lids, and containers.

- **Rigid Plastic Container** – Any plastic package having a relatively inflexible finite shape or form that is capable of maintaining its shape while holding other products, including, but not limited to, bottles, cartons, and other receptacles.

- **rPET** – Recycled PET
- **rHDPE** – Recycled HDPE
- **rPP** – Recycling PP
- **rPET** – Recycled PET
- **rPS** – Recycled PS
- **rLLDPE** – Recycled LLDPE

- **Thermoform packaging** – Packaging that is produced by heating thermoplastic sheets until they reach a formable state where they are then shaped to the contours of a mold using air and mechanical assists.

APPENDIX B: RATE + ASSUMPTIONS

The following assumptions apply to the rates in Table 1 and Table 6: Plastic Film and Durable Products.

- Sales growth of the products listed in the table was not factored into any calculations.
- PCR that is currently being used in other applications (e.g., carpet, lumber) is assumed to remain constant.
- All analyses are based on best available data, including APR and American Chemistry Council (ACC) annual report on postconsumer plastic recycling [8], NAPCOR PET recovery data [18], ACC Annual Resin Review [31], U.S. EPA facts and figures reports [1], RRS data, and interviews with industry experts.
- Little to no data are available on current PCR content in these applications.
- 2025 targets are either achievable or almost achievable given today's supply of postconsumer resin; targets beyond 2025 require supply increases.
- rHDPE and rPP used in durable applications (i.e., garden pots, storage bins, garbage and recycling carts, drainage pipes) derives predominantly from HDPE bottles and rigid PP packaging.
- Postconsumer resin derived from PCR polybags and PE carryout bags is used to produce retail bags, trash bags.
- Long-term targets take into account supply, recycling, and technical product performance limits.
- Reclamation yield loss is factored into calculations.

The following assumptions apply to the rates in Table 2 and Table 7: Packaging Applications Scenario 1 – Assumes Significant Growth in Recycling Collection and Modest Technological Innovation.

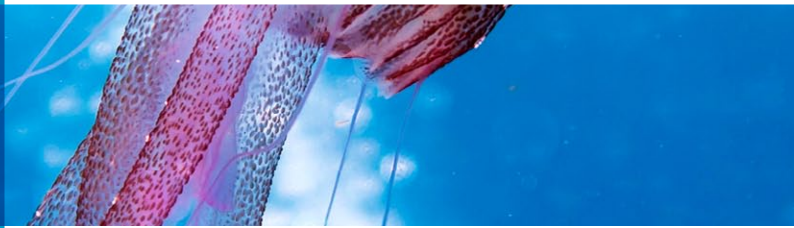
- Sales growth was not factored into any calculations.
- PCR that is currently being used in other applications (e.g., carpet, lumber) is assumed to remain constant.
- All analyses are based on best available data, including data from the following sources: APR and ACC annual report on postconsumer plastic recycling [8], NAPCOR PET recovery data [9][18], ACC Annual Resin Review [31], U.S. EPA facts and figures reports [1], RRS data, and interviews with industry experts.
- Current PCR content percentages are based on reported industry-level uses of PCR (by weight) in the designated packaging applications divided by reported total resin used (by weight) for the packaging applications.
- 2025 targets are either achievable or almost achievable given today's supply of postconsumer resin; targets beyond 2025 require commensurate supply increases.
- rPET used in production of thermoforms comes predominantly from recycled postconsumer PET bottles.
- Postconsumer resin derived from HDPE bottles is used for several end uses, including new HDPE bottles, garden and nursery pots, storage bins, garbage and recycling carts, drainage pipe.

- Postconsumer resin derived from PP packaging is used for several end uses, including packaging, garden and nursery pots, storage bins, and garbage and recycling carts.
- The production of black packaging (and technology to sort it at MRFs) is expanded to enable the increase in use of rHDPE and rPP (derived from mixed-color streams) in packaging applications.
- Reclamation yield loss is factored into calculations.

The following assumptions apply to the rates in Table 3 and Table 8: Packaging Applications Scenario 2 – Assumes National Supply-Side Policy (EPR and Bottle Bill), Technical Innovation, and Design for Recycling Improvements

- Sales growth was not factored into any calculations.
- PCR that is currently being used in other applications (e.g., carpet, lumber) is assumed to remain constant.
- All analyses are based on best available data, including data from the following sources: APR and ACC annual report on postconsumer plastic recycling [8], NAPCOR PET recovery data [9][18], ACC Annual Resin Review [31], U.S. EPA facts and figures reports [1], RRS data, and interviews with industry experts.
- Supply is generated through the enactment of a national EPR for Packaging policy and a national deposit on all beverage containers in the near-term (2022-2023).
- Capture rates from best-in-class curbside recycling programs are based on analysis conducted by The Recycling Partnership "Paying It Forward" report [29].
- Technical innovation in materials and design, recycling sortation, and plastic-to-plastic recycling enable higher use of PCR content in packaging applications.
- All brands universally adopt design for recycling practices, such as using only non-colored resins and recycling friendly caps, labels and closures on all packaging, either through corporate responsibility or regulatory policies [29].
- PET bottle supply is circular, meaning that resin for new PET bottles comes only from rPET bottles, and the bottles are collected predominantly through deposit-systems.
- Postconsumer PET used in production of thermoforms comes predominantly from rPET bottles, and later transitions into PCR content from rPET thermoforms.
- The increase in use of rHDPE for bottles does not draw postconsumer resin away from existing end uses; it relies solely on collection of new HDPE bottles and jars.
- PP packaging supply is circular, meaning that resin for new PP packaging comes only from rPP packaging.

APPENDIX C: BIBLIOGRAPHY



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