

Addressing the Challenge of Film and Flexible Packaging Data

for The Recycling Partnership's Film
and Flexibles Coalition

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About:

This report has been prepared for the members of The Recycling Partnership's Film & Flexibles Coalition.

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ADDRESSING THE CHALLENGE OF FILM AND FLEXIBLE PACKAGING DATA

INTRODUCTION

The Recycling Partnership's Film and Flexibles Coalition (the Coalition) is an independently funded group of industry stakeholders working collaboratively to identify and scale methods to collect and recover film and flexible packaging¹ from households across the U.S. These packaging formats face significant challenges to be collected, sorted and processed for recycling, and as a result we estimate, based in part on data provided by an American Chemistry Council (ACC) report, that the residential recycling rate for film and flexible packaging is just 1.8%.² The Coalition aims to improve this. The Coalition's long-term goals are to:

1. Bring residential curbside recycling of film and flexible packaging to more Americans and make it a mainstream recyclable material;
2. Increase demand for products manufactured from recycled film and flexibles to support end markets; and
3. Achieve a 30% recovery rate in line with the Ellen MacArthur Foundation's definition of recyclable.

Members of the Coalition as of February 2021 are:



One of the first challenges faced by the Coalition in meeting its goals is to gather data that shows how much of this packaging is generated and recycled in U.S. households. Reliable data and consistent metrics are necessary to track performance against these goals as well as the various initiatives that will help advance progress.

The Recycling Partnership staff evaluated several existing data sources, including those from the U.S. Environmental Protection Agency (EPA), American Chemistry Council (ACC), FPA, and Closed Loop Partners (CLP), to provide insights on current data. This report summarizes the available estimates. **Even taking these sources into account, there is currently very little comprehensive data available related to household generation and capture of film and flexible packaging. In order to reach ambitious targets like 30% recovery of film and flexible packaging, this data gap must be addressed.**

¹ Film and flexible packaging are both defined in Appendix A.

² American Chemistry Council. *2018 National Post-Consumer Plastic Bag and Film Recycling Report*. Retrieved November 10, 2021 from <https://www.americanchemistry.com/better-policy-regulation/plastics/resources/2018-national-post-consumer-plastic-bag-and-film-recycling-reports>.

To complement the information from these studies, The Recycling Partnership staff also reviewed publicly available waste characterization and capture rate studies. Based on the limited data available, we estimate **generation of film and flexibles is likely within a range of 75 to 88 pounds per household per year.**³ Using this as a starting point, The Partnership estimates that U.S. households generate 10.4 billion pounds of film and flexible packaging each year. To achieve a 30% residential recycling rate of film and flexible packaging in the U.S. roughly 3.1 billion pounds of film and flexible packaging would have to be recycled.⁴

FINDINGS

BASED ON OUR ANALYSIS OF THE DATA GATHERED, THE RECYCLING PARTNERSHIP MADE THE FOLLOWING FINDINGS AND RECOMMENDED THE FOLLOWING ACTIONS FOR THE COALITION AS IT WORKS TOWARD ITS GOALS.

<p>Challenge 1: There is insufficient data to measure progress on recycling film and flexible material.</p>	<p>Challenge 2: Only 1% of households can recycle film at home today.</p>	<p>Challenge 3: There are a limited number of end markets available to process recovered material.</p>
<p>Action 1: The Coalition will work with the U.S. Plastics Pact and other industry groups to set the standard for data establishing the foundation for progress.</p>	<p>Action 2: The Coalition will pilot and prove scalable curbside collection for film.</p>	<p>Action 3: The Coalition will map existing end markets and identify solutions to fill gaps.</p>

1. **Challenge: There is insufficient data to measure progress on recycling film and flexible material.**

There is an excruciating lack of data on the generation and recovery of film and flexible packaging in the U.S. Basic data that is available for other materials, like polyethylene terephthalate (PET) bottles and high-density polyethylene (HDPE) bottles, does not exist for film and flexible packaging. Reliable data and consistent metrics are necessary to track performance against recovery goals established by individual companies as well as by collaborative initiatives like the U.S. Plastics Pact. To increase recycling of film and flexible packaging, we must establish basic metrics and identify ways to gather the information to report on those metrics. If we are to include store drop-off materials in metrics, we will need to establish a way to measure how much material stores are collecting.

In addition to a lack of data, there is also a lack of consistency in the data. Waste characterization and capture rate studies that include film and flexible packaging use dissimilar sorting categories. Even in studies with multiple sort categories, large volumes of materials are falling into undefined “other” categories. Consistent categorization will be critical to understanding how generation and recovery rates change over time.

³ The Coalition & The Recycling Partnership intend to keep working to find more data & refine this number further.

⁴ To think about these numbers from an individual household’s perspective, we can review The Recycling Partnership’s *The State of Curbside Recycling in 2020* report. In this report, The Recycling Partnership showed the average single-family household generates 768 pounds of commonly recyclable household materials each year, of which about 32% is captured through curbside recycling. Film and flexible packaging is not included in this estimate, as these packaging types are not commonly accepted for recycling.

Action: The Coalition will work with various industry groups involved in film and flexible packaging and with the U.S. Plastics Pact to set the standard for data, establishing a foundation for progress.

- A. This will include conducting capture rate studies to collect more information on the generation of film and flexibles, as well as recovery of film and flexible packaging when that is available to consumers. The results of these studies will be shared with the public. This will provide baseline data on the amount and type of film and flexibles packaging residents are generating annually.
- B. The Coalition will establish a standard for addressing film and flexible packaging in capture rate studies, including how to account for flexible film bags used to dispose of trash. This will help create standardized ways to assess generation and composition of film and flexible packaging, allowing for more consistent comparisons from one study to another.

2. Challenge: Only 1% of households can recycle film at home today.

As mentioned above, to reach a 30% recycling rate for film and flexible packaging, the U.S. would need to recycle roughly 3.1 billion pounds of film and flexible packaging annually. However, for most Americans, curbside recycling of film and flexible packaging is not available. At present, approximately 50 U.S. local governments report monolayer PE as an acceptable recyclable material for curbside recycling. This is approximately 1% of all U.S. households.

While many Americans have access to return monolayer polyethylene (PE) film to retail stores, commonly called “store drop-off,” this option is less convenient than curbside recycling. Consumers must remember to bring their film packaging back to stores, and they must find stores with drop-off boxes. Moreover, the scope of accepted materials at store drop-off does not include all formats of film and flexibles. Consequently, this collection method cannot be solely used to reach a 30% recycling rate for film and flexible packaging.

Action: The Coalition will pilot and prove scalable curbside collection for film.

A better understanding of the costs, effectiveness and applicability of different collection models is needed to scale curbside collection. The Coalition will initiate and manage pilots that work with communities and MRFs interested in expanding curbside collection of film or flexibles, with a goal of applying the lessons learned to more communities in the future and activating additional curbside collection programs.

3. Challenge: There are a limited number of end markets available to process recovered material.

There are a limited number of end markets that can process film. The low number of end markets is exacerbated by the low price of oil, which makes purchasing virgin plastics for new products cheaper than purchasing recycled plastics. Additionally, recycled film bales often sell at a price lower than other plastic commodities. Accordingly, recycled film end markets may need a variety of supports to expand production, such as access to audit data on bales of materials, purchasing contracts from their customers for the recycled product, or grants for new equipment.

Action: The Coalition is mapping existing end markets and identifying solutions to fill gaps.

The Coalition will continue its efforts to learn more about the current status and the needs of end markets. In addition, the Coalition will need to stay current on data related to end markets, such as technologies in use and their impact on material acceptability.

ANALYSIS OF EXISTING DATA SOURCES OF FILM AND FLEXIBLE PACKAGING

Unlike some traditionally recyclable commodities, such as PET bottles or HDPE bottles, there is not very much publicly available information on the generation and composition of film and flexible packaging. For the purposes of this report, the Partnership reviewed research by the EPA, ACC, CLP, and the FPA. Further details about these data sources are available in Appendix B.

AVAILABLE DATA ON GENERATION OF FILM AND FLEXIBLES

What is clear from these data sources is that film and flexible packaging is a growing packaging format. FPA reports⁵ that **2019 sales figures for flexible packaging are \$33.6 billion, making it the second largest valued packaging segment in the U.S. behind only corrugated containers and ahead of bottles and other rigid plastic packaging.**

To further understand generation of film and flexibles, we reviewed six capture studies in addition to the published reports described above. The results of these six studies are shown in Table 1, and further details on each are available in Appendix B. It should be noted that none of these studies attempted to assemble drop-off data or materials recycled through other means.

Table 1: Summary of Household Generation For Film And Flexibles In Capture Rate Studies

Study Location	Household Generation (pounds per household per year)
Bellevue, NE (prior to Energy Bag implementation)	96
Bellevue, NE (after Energy Bag implementation)	122
Portland Metro, OR	74.5
Red Wing, MN	42.1
SWACO, OH	68.3
Cary, NC	111.4
California Statewide	98.2
Average	87.5

Looking across these seven studies, we find that household generation ranges from 42 pounds per household to 122 pounds per household. The straight average based on the capture rate studies listed above is 87.5 pounds per household per year of film and flexibles. However, when interpolation of generation resources is included and the weight of trash bags is deducted since they are not considered a package, the estimate is 75 pounds per household of per year of film and flexibles. Based on the limited data available, we believe generation of film and flexibles is likely within a range of 75 to 88 pounds per household per year.

⁵ FPA prepares an annual state of the industry report based on an annual member survey as well as a non-member "Industry-Wide Converter Survey." The report is further supported by U.S. Census Bureau data. These reports are available for purchase and were provided to The Recycling Partnership by FPA for use in this summary.

AVAILABLE DATA ON RECOVERY OF FILM AND FLEXIBLES

While there is some information available on generation of film and flexibles, it is even more challenging to identify how much of this growing packaging stream is recovered. The EPA routinely tracks recycling rates expressed as a percentage of generation. **However, because the EPA accounts for materials from households as well as from schools, hospitals and commercial sources, there is no way to tell how much of this material households generate.** It is also not clear how the EPA data accounts for flexible packaging formats.⁶

Despite the lack of clear information on recovery, we do know film recycling lags behind other packaging materials. Research by CLP⁷ is one of the few known sources to publish details behind an estimate of the recovery rate of residential PE film. They report 4% recovery of residential polyethylene film. ACC provides a data point on pounds of film recovered, reporting 187 million pounds of residential film was recovered in 2018. If that amount is divided by 119,730,128 households,⁸ **we estimate that the national average rate of return-to-retail is roughly 1.6 pounds per household per year.** Both estimates are much lower than recovery estimates for traditional curbside recyclable commodities, like PET bottles and corrugated cardboard. Put more plainly, even if households are returning 1.6 pounds to retail as estimated above, there remain 73.4 to 86.4 pounds of film and flexible packaging per household per year that is not returned to store drop-off, and that households must either reuse or discard.

FIRST ESTIMATES OF THE GAP TO ACHIEVING RECYCLABILITY AT SCALE

Although the data on generation and recovery of film and flexibles is limited, we can use it to assess the current state of recovery. If the average of the estimate of 75 to 88 pounds per household, or 81.5, represents the broad category of film and flexibles, a recycling rate of 30% would be equivalent to 24.5 pounds per household. However, it is clear that due to a lack of access to curbside recycling of film and flexibles and comparatively low participation in store drop-off, we cannot rely on every household to contribute at this rate.

Extrapolating the 81.5 pounds per household to a national generation load (multiplying by 128 million households) indicates a generation burden of 10.4 billion pounds of household materials per year. Using the 186.9 million pounds of film recovered as reported by the most recent ACC Film report, we can estimate that the current recycling rate is 1.8%. Based on this estimate, achieving a 30% recovery of this level of material would require capturing 3.13 billion pounds of material.

However, more and better data is needed to check these numbers and to ensure we are tracking progress with accurate information.

⁶ EPA. *Advancing Sustainable Materials Management: Facts and Figures Report*. Retrieved January 21, 2021 from <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management>

⁷ CLP. *Investment Opportunities in Film Plastic Recycling*. Retrieved January 21, 2021 from <https://www.closedlooppartners.com/foundation-articles/investment-opportunities-in-film-plastic-recycling/>

⁸ According to the U.S. Census Bureau QuickFacts, available at <https://www.census.gov/quickfacts/fact/table/US#>

CURBSIDE ACCESS TO PE FILM COLLECTION

Because curbside recycling is more convenient for consumers to use, and they are therefore more likely to take advantage of it, curbside access to recycling of film and flexibles will be critical to achieving a 30% recovery rate. Currently, there is limited access to curbside recycling of film and flexibles, however, a small percentage of communities do report on their websites that they collect monolayer PE film via curbside recycling. A handful of communities served by the [Materials Recovery for the Future \(MRFF\)](#) project in Pennsylvania have access to recycling monolayer PE and other film and flexibles. Those communities served by Energy Bag may also recycle certain film and flexibles.

Despite changes in overseas markets brought on by National Sword and related customs enforcement actions and China's scrap ban, there are a number of local governments in the U.S. that collect polyethylene film packaging in curbside recycling programs. Typically, these programs ask households to put their monolayer PE film packaging inside of a single retail carry-out bag, tie it off, and place the bundle in their recycling cart. At the MRF, workers hand pick these bags off of the line. In years past, these materials could have been sold to overseas markets, but as with other forms of curbside recycling of film, it is more challenging today to identify buyers for film collected at the curb.

One Canadian and five U.S. local governments participate in Energy Bag, which allows households to place PE film in a bag with other hard-to-recycle plastics. These programs are included in this section so as to describe how many households have access to include PE film in their curbside collections.

The Recycling Partnership documents local governments that list film and bags as acceptable recyclable materials on their websites. We vetted this list by checking local government websites and eliminating any programs that no longer report collecting this material. We estimate that 50 local governments report they accept monolayer film at the curb (excluding Energy Bag and MRFF communities). Communities participating in the MRFF project were added to the total number of households using the estimate available in MRFF's report, [Flexible Packaging Recycling Material Recovery Facilities Pilot](#). Communities participating in Energy Bag were added based on the number of households provided by the program. The total number of households with some type of access to recycle PE film at the curb is estimated to be 2,349,767. This equates to roughly 1% of all U.S. households, or 3% of households with access to curbside recycling.⁹

While some of these products may be recycled into new products, it is important to note that just because these materials are collected at the curb does not guarantee they are recycled into new products. Some of these local governments may have energy recovery end markets, as is the case for certain Energy Bag participants. It is also possible that some MRFs receiving the film may have trouble marketing the material and end up sending it to a landfill or incineration.

While we have collected data on communities' acceptance of film and flexible packaging, it is important to maintain and improve that data over time. Communities change acceptable materials lists regularly, and this data does not yet address what MRFs accept film and flexibles. Maintaining data both on community and MRF acceptance of these materials will be critical to tracking the progress of film and flexible packaging towards mainstream recyclability.

⁹ The Recycling Partnership used data from the U.S. Census' American Community Survey 2017 to calculate the number of households with access to film recycling and the percent of households with access to film recycling.

CONCLUSION

There is currently limited data on the generation and composition of household films and flexibles, and the Coalition can play a role in filling that void. Cultivating additional data will be beneficial not just for the Coalition and others to use in measuring progress towards goals, but also for end markets to use in building a business case for recycling more film and flexible packaging. End markets rely on data to understand how to expand their services and whether to accept more materials.

From what data is available, it is clear that there is much more work to be done to achieve a 30% recycling rate of this packaging category. To track progress on improving the recycling rate, the Coalition will start by gathering more data in the form of capture studies, evaluating and piloting collection systems to process more film and flexibles, and supporting the end markets we will need to turn these raw materials into new products. Developing a fuller picture of the size and extent of the challenge of film and flexible packaging, as well as the details of communities and MRFs currently accepting these materials, paves the way for addressing those challenges.

The economics of this challenge, with pricing for virgin resin consistently lower than recycled resin, means that progress toward recycling film and flexible packaging cannot be made without financial investment. Without new investments, end markets cannot expand operations. Without new investments, MRFs cannot expand their lists of acceptable recyclables to include new packaging types. Depending on the collection solution used, investments may be needed at the local level as well. To advance the recyclability of film and flexible packaging and make progress towards recyclability targets, producers will need to fund these investments. While some are voluntarily supporting efforts, such as those funding this Coalition, it is likely policy will be necessary to bring everyone to the table and fund the level of investment that is needed to address the challenge of film and flexible materials. The work of this Coalition will be critical to prove what works so that when packaging legislation does go into effect, we will have proven solutions that can be quickly scaled.

APPENDIX A: DEFINITIONS

For the purposes of this report and for the work of the Coalition, we have defined certain terms related to film and flexibles as shown below.

Film: Plastic film is typically defined as any plastic less than 10 millimeters thick. The majority of plastic film are made from polyethylene (PE) resins, including both low-density and high-density materials. Examples include retail grocery bags, bread bags, produce bags, newspaper sleeves, bubble wrap, PE based film mailers, air pillows and case wrap. Polypropylene (PP) is also used for packaging in similar applications. These film categories are often referred to as “mono-material” or “monolayer” film.

Flexible packaging: In contrast to monolayer film, flexible packaging is often comprised of multiple materials or multiple layers of plastic film. The different properties in each layer contribute different performance characteristics to the package. The layers within a flexible package can be aluminum foil or paper in addition to plastic. Flexible packaging often includes pouches, sleeves, sachets, and bags.

Recycling: We rely on definition of recycling as laid out in the Ellen MacArthur Foundation’s New Plastics Economy initiative. Full details can be found here:

https://www.newplasticseconomy.org/assets/doc/Global-Commitment_Definitions_2020-1.pdf

Below is an excerpt from this document which defines recycling as follows:

“Definition: Material Recycling

Reprocessing, by means of a manufacturing process, of a used packaging material into a product, a component incorporated into a product, or a secondary (recycled) raw material; excluding energy recovery and the use of the product as a fuel.

Source: ISO 18604:2013 – *Packaging and the environment – Material recycling*, modified (note to entry not applicable).”

Recycling Rate: In its simplest form, a recycling rate is that portion of recyclable materials that are diverted from the waste stream. To determine the recycling rate for consumer packaging, one must understand both the volume generated as well as the volume collected for recycling:

$$\frac{\text{Volume Collected}}{\text{Volume Generated}} \times 100$$

While simple in expression, it has been challenging to acquire data to measure the recycling rate for film and flexible packaging.

APPENDIX B: DETAILS ON DATA SOURCES

DATA SOURCES

The data sources used in this report are described in further detail below.

ENVIRONMENTAL PROTECTION AGENCY

The EPA is one of the few sources that routinely tracks recycling rates expressed as a percentage of generation. Each year, the EPA releases a report called *Advancing Sustainable Materials Management: Facts and Figures Fact Sheet*. According to the EPA data, plastics generation as a percentage of total generation has grown slightly over the past five years.

The EPA estimates film generation and recycling rates under the heading, “bags, sacks and wraps.” The EPA data for “Bags, sacks and wraps” for the years 2016, 2017 and 2018 is shown in Tables 2, 3, and 4. Based on this data, 4,200,000 tons of bags, sacks and wraps were generated in 2018, and 10% of those were recycled.

**Table 2: EPA Data for Post-Consumer Plastic Subcategory
“Bags, Sacks & Wraps” From 2016**

Resin	Generation	Recycled	
	(Thousand Tons)	(Thousand Tons)	(% of generation)
HDPE	680	40	5.9%
PVC	70		
LDPE/LLDPE	2,660	480	18.0%
PP	540		
PS	140		
Total	4,090	520	12.7%

**Table 3: EPA Data for Post-Consumer Plastic Subcategory
“Bags, Sacks & Wraps” From 2017**

Resin	Generation	Recycled	
	(Thousand Tons)	(Thousand Tons)	(% of generation)
HDPE	660	50	7.6%
PVC	70		
LDPE/LLDPE	2,730	340	12.5%
PP	540		
PS	140		
Total	4,140	390	9.4%

**Table 4: EPA Data for Post-Consumer Plastic Subcategory
“Bags, Sacks & Wraps” From 2018**

Resin	Generation	Recycled	
	(Thousand Tons)	(Thousand Tons)	(% of generation)
HDPE	640	50	7.8%
PVC	70		
LDPE/LLDPE	2,780	370	13.3%
PP	570		
PS	140		
Total	4,200	420	10.0%

Reference: Tables 8A and 8B, EPA SMM Facts and Figures [for 2016 and 2017 and 2018](#).

There are a few challenges to relying on the EPA data, however. For one, the EPA data accounts for materials from households as well as institutions such as schools and hospitals and commercial sources. In other words, there is no way to tell from the EPA data how much of this material is derived from households.

It is also not clear how the EPA data accounts for flexible packaging formats. The 4,200,000 tons reported in 2018 is equivalent to 8.4 billion pounds. A study conducted by CLP (discussed further below) estimated the total film and flexibles category to be 11.8 billion pounds in 2012 along with a growth forecast estimating 14.3 billion pounds of film and flexible packaging for 2022. Thus in 2018 we would expect the total to have been over 13 billion pounds and growing based on the research by CLP.

According to the EPA’s [methodology documentation](#), the primary sources of data are ACC and the National Association for PET Container Resources (NAPCOR). While they indicate that their import adjustments do not account for all products, they do not identify which products are missing. In the EPA data are other categories of plastics generation that correlate with film and flexible packaging. For example, 1.8 billion pounds of LDPE/LLDPE is listed under “other plastics packaging” – it is likely that some of this material takes the form of film or flexible packaging. In addition, it should be noted that the EPA estimates generation of approximately 2.7 billion pounds of LDPE and HDPE trash bags.

AMERICAN CHEMISTRY COUNCIL

ACC has published the *National Post-Consumer Plastic Bag & Film Recycling Report* annually since 2005.¹⁰ The report is based on survey data conducted by MORE Recycling. Throughout the rest of this section, these reports are simply referred to as the “ACC Film Reports.” These annual reports describe film as “thin flexible sheets of plastic” made primarily from polyethylene resins. Dividing the 2018 residential film recovered (187 million pounds) by 119,730,128 households¹¹, we estimate that the national average rate of return-to-retail is roughly 1.6 pounds per household per year.

Data from the most recent three years of the *National Post-Consumer Plastic Bag & Film Recycling Report* is summarized in Table 5.

Table 5: ACC Data for Film Recovered from 2016, 2017 and 2018

Film Category	Millions of Pounds Recovered ¹²		
	2016	2017	2018
PE Clear Film	535.7	392.9	472.5
PE Colored Film	289.8	149.2	116.3
PE Agricultural Film	193.7	164.2	133.7
PE Retail Bags and Film	195.7	225.0	242.3
MRF Curbside Film	20.9	18.3	3.7
Other Film	86.4	57.1	33.5
Total	1,322.1	1,006.7	1,002.0

The PE Retail Film category includes both residential film collected by retailers using store drop-off points and commercial film generated by retailers themselves. The methodology explains that retailers routinely bale their own commercial and residential sources together. In 2016 and 2017, the ACC Film Reports conveyed that 57% of the retail bales were estimated to be from residential sources. In 2018, this figure was adjusted to 76% based on a more recent ACC bale audit study. By combining the residential portion of PE Retail Bags of film with the MRF curbside film we are able to estimate the total amount of residential film recovered in Table 6.

Table 6: Estimated Amount of Residential Film Recovered

Category	Millions of Pounds Recovered		
	2016	2017	2018
MRF Film	20.9	18.3	3.7
Residential/Retail	111.6	128.2	183.3
Total Residential	132.5	146.5	187.0

The data shows a significant drop in MRF film being recycled while the amount of residential film recovered by retailers grew, resulting in year-over-year growth of the total residential film category. The ACC Film Reports do not attempt to calculate recovery rates on a percentage basis.

Dividing the 2018 residential film recovered (187 million pounds) by 119,730,128 households¹³, we estimate that the national average rate of return-to-retail is roughly 1.6 pounds per household per year.

¹⁰ Unlike the annual *National Postconsumer Plastic Bottle Recycling* report written by the Association of Plastic Recyclers and ACC and the annual *PET Recycling Report* written by NAPCOR, ACC’s plastic bag and film report includes only the recovery estimate but provides no estimate of material generation.

¹¹ According to the U.S. Census Bureau QuickFacts, available at <https://www.census.gov/quickfacts/fact/table/US#>.

¹² This table compiles data from the 2018, 2017 and 2016 ACC reports available here: <https://plastics.americanchemistry.com/Reports-and-Publications/>

¹³ According to the U.S. Census Bureau QuickFacts, available at <https://www.census.gov/quickfacts/fact/table/US#>.

CLOSED LOOP PARTNERS

CLP commissioned RSE USA to prepare a [Film Recycling Investment Report](#), which was issued in 2017. This study is a comprehensive overview of the U.S. film recycling landscape, including in depth descriptions of film packaging types, market size and growth estimates and an in-depth analysis of the U.S. film recycling value chain. The authors started with 2012 estimates of film generation provided by FPA and combined them with 2014 data from ACC's annual film recycling report. The result is one of the few known sources to publish details behind an estimate of the recovery rate of residential PE film. They find an estimate of 4% recovery of residential PE film.

Table 7 shows CLP's estimates for recovery of residential and commercial film.

Table 7: CLP's 2017 Estimate of Pe Film Recycling Rates

	Generated	Recovered	% Recovered
Residential	3.34 Billion lbs.	136 Million lbs.	4%
Commercial	4.15 Billion lbs.	859 Million lbs.	21%
Total	7.5 Billion lbs.	995 million lbs.	13%

Note: The authors refer to this category of film as single PE resins or blends of compatible PE resins which includes retail carry bags, heavy duty shipping sack, shrink wrap, cut and glue wrap and stretch film.

RSE USA noted that they used sources in addition to the FPA data but do not clearly cite them. They also noted making an adjustment for retail bags used for pet waste and can liners as these materials are not available for recycling. It is not clear what volume of retail bags was omitted.

FLEXIBLE PACKAGING ASSOCIATION

FPA prepares an annual state of the industry report based on an annual member survey as well as a non-member "Industry-Wide Converter Survey." The report is further supported by U.S. Census Bureau data. These reports are available for purchase and were provided to The Recycling Partnership by FPA for use in this summary.

The 2020 report indicates continued growth of flexible packaging sales at about 2% per year. FPA reports that 2019 sales figures for flexible packaging are \$33.6 billion, making it the second largest valued packaging segment in the U.S. behind only corrugated containers and ahead of bottles and other rigid plastic packaging. There is a single reference in the 2020 report indicating a total volume of 21.8 billion pounds of flexible packaging in the U.S. in 2019, however, the report does not state how this number was derived. While this type of data provides important insights on growth trends and the relative size of key segments, it does not lend itself directly to calculations such as residential recycling rates.

The report creates segmentation by four major material categories described as follows:

- Multi-material laminates and film
- Polyethylene (PE) retail bags and film, which are a single layer package.
- Predominantly polyethylene laminates, which consist of multiple layers of PE.
- Non-polyethylene single material film and bags which includes paper foil and other materials.

Segmentation is further represented in several ways, typically by end use (e.g., food, beverage, personal care, medical, etc.) but the report does not provide a breakdown of commercial versus residential end use markets. Food is reported as the largest end use category by far (52% of sales) followed by beverages at 10%.

In 2013, FPA commissioned a separate study entitled *Flexible Packaging Industry Segment Profile Analysis*. The authors of this report converted sales data to a weight basis by converting the value of sold goods to raw materials using a factor of 56% of net sales across all packaging types. The authors acknowledged that this approach has limitations, due to the wide range of converting value operations, different materials etc. In general, more expensive materials would be assigned more weight and as such this approach may not be suitable for supporting accurate calculations of recycling rates.

RESIDENTIAL CAPTURE STUDIES

To understand how effectively consumers are recycling, first we need to know how much packaging consumers are using. To learn more about what packaging types households use, discard and recycle, The Recycling Partnership has conducted numerous capture rate studies. These studies collect trash and recycling from communities and compare the contents of each to learn how much waste households are generating, how much households are putting into their recycling, and how much recycling is ending up in the trash. In addition to The Partnership’s own capture rate research, The Partnership has gathered additional capture data through reports provided by local governments and consulting firms.

BELLEVUE, NEBRASKA

Community Size: Approximately 15,500 households

Date of Study: 2018

Number of Film Categories Sorted: 19

Description: MSW Consultants conducted a “back-of-truck” capture study to characterize the capture rate prior to and after implementation of cart-based curbside collection that included [Hefty® Energy Bag®](#)¹⁴ materials as an accepted item in Bellevue, NE. This work was partially sponsored by Dow. Samples were sorted into 19 material categories, including film, wrap bags (described as “Shrink wrap, film and flexible plastic used for packaging and plastic bags”). The City of Bellevue reported 15,498 households at the time of the study. Select data from the study is presented Table 8.

Table 8: Bellevue, Nebraska Household Material Generation

Energy Bag Phase	Film, Wrap Bags in Waste (tons)	Film, Wrap Bags in Recycling (tons)	Film, Wrap Bags Total (tons)	Total (reported as pounds per household)
Pre-implementation	712	31	743	96
Post-implementation	870	74	944	122

¹⁴ The Hefty® Energy Bag® program is an initiative led by Dow, Reynolds Consumer Products, Firststar Recycling and other organizations. The program, started in 2016, aims to divert resources from landfills through curbside collection of hard-to-recycle plastics alongside curbside recycling of traditional recyclables. These plastics are recovered for either energy or recycling, depending on local markets.

PORTLAND METRO, OREGON

Community Size: Approximately 510,000 households

Date of Study: 2019

Number of Film Categories Sorted: 60 plus

Description: Cascadia Consulting and More Recycling conducted a capture study in the Metro Portland, Oregon area which includes 510,000 households. This work was partially funded by ACC. The study included over 60 material categories including 10 subcategories of film and flexible packages.

Film and flexibles comprised approximately 40% by weight of all residential plastics generated curbside (19,000 tons of 47,298 total plastic tons). This level of sortation reveals that PE mono-material film, recyclable through store drop-off channels, made up 7,089 tons. The authors specifically noted that these materials do not include material collected through drop-off programs.

Table 9: Portland Metro Household Material Generation

Material Type	Curbside Generation (tons)	Pounds per Household
PE Shopping Bags	1,362	5.3
PE Other Household Bags	2,093	8.2
PE Product Overwrap	547	2.1
PE Shipping/Transport Film	805	3.2
PE Other Film & Flexibles	2,282	9.0
Plastic Pouches	572	2.2
Garbage Bags	4,310	16.9
PE Shopping Bags (used for garbage bags)	546	2.1
Contaminated PE Film & Flexibles	802	3.1
Other Film & Flexibles	5,682	22.3
Total Film & Flexible Plastics	19,000	74.5
Total Film & Flexible Plastics (w/o garbage bags)	14,690	57.6

Of the 19,000 tons collected, 1,318 tons (6.9%) was found in the curbside recycling stream. While 10 subcategories were identified, nearly one third (30%) of the material was characterized as “Other.”

RED WING, MINNESOTA

Community Size: Approximately 7,500 households

Date of Study: 2019

Number of Film Categories Sorted: 7

Description: Circular Matters, a consulting firm, conducted this study to measure the impact of transitioning from bin-based weekly multi-sort recycling collection to single-stream recycling collection using 96-gallon carts collected every other week. Red Wing is a small community with 7,500 households. It was observed that compared to national averages, the City has a significantly higher than average capture rate for curbside recyclables and a lower-than-average contamination rate. In this study the results were reported as pounds per household per year. Seven categories of flexible plastics were used for characterization.

Table 10: Red Wing, Minnesota Household Material Generation

Material Category	Waste (lb/hh)	Recycling (lb/hh)	Total (lb/hh)
Trash Bags	9.44	.20	9.64
Retail Carryout Sacks Reused	1.82	.10	1.92
Retail Carryout Sacks	4.55	.15	4.70
E-Commerce Film (Mailers)	1.64	.15	1.79
Other PE Bags & Wraps	8.80	.91	9.71
Non-PE Film & Flexibles	14.09	.21	14.30
Unknown Film Type	0	.07	0.07
Total Flexible Plastics	40.35	1.78	42.13
Total w/o Trash Bags or Reused Carryout Sacks	29.09	1.48	30.57

SOLID WASTE AUTHORITY OF CENTRAL OHIO

Community Size: Approximately 20,000 households

Date of Study: 2019

Number of Film Categories Sorted: 2

Description: The Recycling Partnership conducted a capture study in the central region of Ohio as part of grant project to convert two small towns, Reynoldsburg and Gahanna, from bins to cart-based curbside collection. The study did not target film and flexibles for granular analysis, but it did attempt to include general sorts of recyclable plastic bags and other recyclable plastic film. For these two categories, the study consultants sorted the fraction of each that was contaminated versus clean. Table 11 shows the results from the back-of-truck post-cart implementation phase of the study.

Table 11: Solid Waste Authority of Central Ohio Household Material Generation

Material	Clean (lbs./hh/yr)	Contaminated (lbs./hh/yr)	Total (lbs./hh/yr)
Plastic Bags	1.6	22.2	23.8
Other Plastic Film - Recyclable	3.3	41.2	44.5
Total	4.9	63.4	68.3

CARY, NORTH CAROLINA

Community Size: Approximately 61,500 households

Date of Study: 2019

Number of Film Categories Sorted: 4

Description: In 2019, as part of a larger study of waste and recycling composition for Wake County North Carolina, a sub-study was conducted on the waste and recycling streams of Cary, North Carolina. The study covered a very wide set of sorting categories, including “recyclable plastic film” that effectively aligned with the materials specified in the WRAP program. The study also included a category of “non-recyclable film” that likely contains some amount of potentially recyclable film and flexible material, but the portion is unclear from the data presented. Table 12 shows the results of the sort of residential material applied to tonnage and household figures provided by Town of Cary staff.

Table 12: Cary, North Carolina Household Material Generation

Material	Trash (lbs./hh/yr)	Recycling (lbs./hh/yr)	Total (lbs./hh/yr)
Recyclable Film	42.7	2.46	45.14
Non-Recyclable Film	64.66	1.64	66.30
Total	107.33	4.11	111.43

CALIFORNIA STATEWIDE

Households at the Time of the Study: 12,965,435

Date of Study: 2018

Number of Film Categories Sorted: 6

Description: Cascadia Consulting conducted a statewide characterization study of disposed waste for the California Department of Resources Recycling and Recovery (CalRecycle), called the *2018 Facility-Based Waste Characterization of Solid Waste in California*. The report uses data at the county and regional average and deems the results to be representative of a statewide average. The study included 94 material types grouped into nine material classes, including six that are considered film and flexibles. This study does not include analysis of recycled materials (either through store drop-off or MRFs) and is therefore not fully representative of household generation.

The report did not include data for the number of single or multifamily homes. In order to estimate household generation, the amount of single-family and multifamily material was divided by 12,965,435 households, which reflects [U.S. Census Bureau](#) data for California as of the 2014-2018 American Community Survey. This is equivalent to an average of 2.96 persons per household.

Table 13: California Statewide Disposal Characterization

Material Category	Single Family Waste (tons)	Multi-Family Waste (tons)	Total (lbs./hh)
Plastic Trash Bags	175,185	19,000	30
Plastic Grocery & Other Merchandise Bags	66,961	11,947	12.2
Non-Bag Film	14,576	525	2.3
Film Products	34,075	690	5.4
Flexible Plastic Pouches	8,346	1,263	1.5
Other Film	263,928	40,267	46.9
Total	563,071	73,692	98.2
Total w/o Trash Bags	387,886	54,692	68.2

Note: While several sorting categories were used, nearly half of the volume for film and flexibles was lumped into an “other” category.