

FLEXIBLE FILMS MARKET IN EUROPE

STATE OF PLAY

**PRODUCTION, COLLECTION
AND RECYCLING DATA**

GLOSSARY OF TERMS

AI	Artificial Intelligence
APE EUROPE	Agriculture Plastic Environment Europe
APR	Association of Plastics Recyclers
B&C	Building and construction
BOPET	Biaxially-orientated polyethylene terephthalate
BOPE	Biaxially-oriented polyethylene
BOPP	Biaxially-orientated polypropylene
C&I	Commercial and Industrial (waste stream)
C&D	Construction and Demolition
CITEO	French Producer Responsibility Organisation (PRO)
CONAI	Consorzio Nazionale Imballaggi (Italian PRO)
EPR	Extended Producer Responsibility
EU28+2	With reference year 2018, EU data includes the United Kingdom, Norway and Switzerland
FLEXIBLE FILMS	Term encompassing films, bags/sacks and flexible packaging made of PE
FOOD PACKAGING	Packaging exclusively used for the containment, protection, handling, delivery and presentation of foods, from raw materials to processed foods, from the producer to the user or the consumer.
FLEXIBLE PACKAGING	All packaging made of any flexible materials to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer.
HDPE	High-density polyethylene
KT	Kilotonnes
LDPE	Low-density polyethylene
LLDPE	Linear low-density polyethylene

MRF	Materials Recovery Facility
MT	Million tonnes
MPO	Mixed Polyolefins
MULTILAYER	Comprised of multiple (often co-extruded) layers
MULTI-MATERIAL MULTILAYER	Comprised of layers of different types of plastics (e.g. PET layer with PE) and/or other material types e.g. aluminium, papers.
MDPE	Medium-density Polyethylene
NIR	Near infrared
PET	Polyethylene terephthalate
POLYOLEFIN (PO)	Polymer group: PE and PP
POLYETHYLENE (PE) FLEXIBLES	Polymer group: LDPE, LLDPE, MDPE and HDPE
POLYMER	Plastic type (when in form with large molecular structure)
POM	Placed on the market
PP	Polypropylene
PPWD	Packaging and Packaging Waste Directive
PRE	Plastics Recyclers Europe
RECYCLATES	Secondary raw material output (e.g. flake, pellet) from recycling operations
RECYCLER(S)	Entity that transforms plastic waste into plastic products (agglomerates, flakes, pellets or finished products)
REGRANULATE	Granulated form of recycle
VIRGIN	Raw material used in manufacturing that has not yet become a product (in contrast to recycled material derived from end-of-life products)

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ABOUT PLASTICS RECYCLERS EUROPE



Plastics Recyclers Europe (PRE) is an organization representing the voice of the European plastics recyclers who reprocess plastic waste into high-quality material destined for the production of new articles. Recyclers are important facilitators of the circularity of plastics and the transition towards the circular economy. Plastics recycling in Europe is a rapidly growing sector representing €3bn in turnover.

PRE is working actively towards improving design for recycling for plastic packaging, in scope of which RecyClass was established. Three main pillars guide the activities of RecyClass: Recyclability Evaluation Protocols, Design for Recycling Guidelines and the RecyClass Online Tool. These three pillars are interlinked, leading to sound/coherent and lab-based conclusions on plastic packaging recyclability that are incorporated throughout the initiative. In addition, the RecyClass Platform was created as an autonomous platform which allows for a value chain cooperation and exchange of best practices, allowing for testing of packaging compatibility with existing plastic waste streams.

Today the platform consists of over 30 members representing a large share of the worldwide market of brands active in the plastic packaging sector.

INTRODUCTION

This report, delivered by PRE, provides the latest data and trends regarding:

- the current state of the flexible film market in Europe;
- key changes impacting the market and the challenges faced by the supply chain; and
- what the future flexible films recycling chain might look like.

PRE intends to update and re-publish this 'State of the Market' report every second year.

This report uses best available data sources to present data estimates, alongside results from a survey of market experts from the industry of flexible film recyclers.

PRE has also launched an internal survey of its members to check and improve on data estimates with figures collected directly from facilities, but in this case statistical representativeness will only be achieved in future updates to the report.

The first year's data presented here will provide a benchmark from which to analyse future developments and trends, including outlining remaining gaps in data to support full supply chain analysis.

2. CURRENT STATE OF THE MARKET

Figure 1 illustrates the supply chain of flexible films (including films, bags & sacks and flexible packaging) in the context of the circular economy. The key elements are covered in our analysis of the flexible films market within this section.

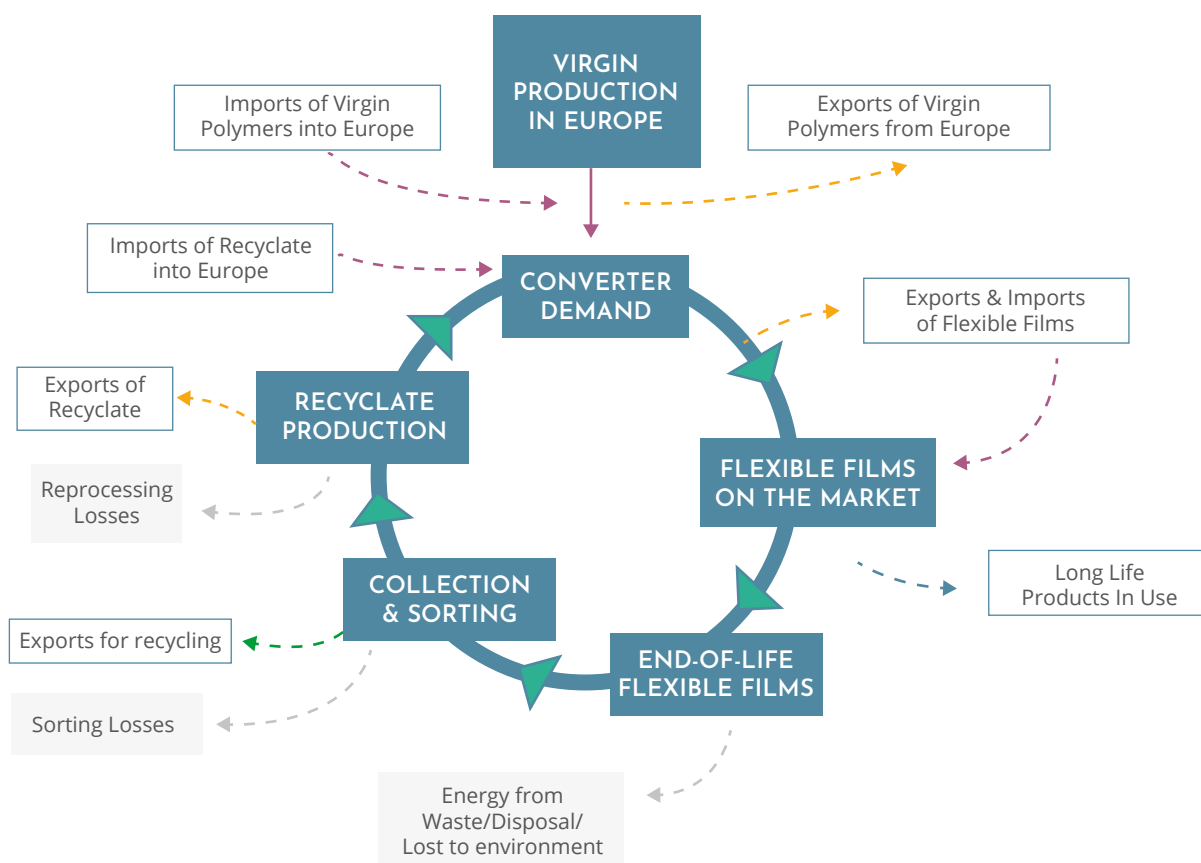


FIGURE 1: Flexible Films Lifecycle in the Circular Economy

The data provided in this section is used to identify the key challenges facing the flexible films recycling market (and specifically its mass balance), across the EU28+2. More information can be found in Section 3.

PRODUCTION AND CONSUMPTION

- AFTER INCREASED PRODUCTION IN 2017, 2018 PRODUCTION AND DEMAND FOR LDPE AND LLDPE (THE MAIN POLYMERS USED IN FLEXIBLE FILMS) WERE BACK TO LEVELS SEEN FOR MOST OF THE PREVIOUS DECADE.
- DEMAND FOR LDPE AND LLDPE USED IN FLEXIBLE FILMS EXCEEDED PRODUCTION BY 0.5 MT (WITHIN EU28+2 BOUNDARIES)

In 2018, demand for polyethylene (PE) flexible films was estimated at between 8.5-9 Mt, of which 1.2-1.3 Mt was met by recycle produced within the EU28+2.¹

The main polymers used for flexible films are LDPE and LLDPE. In 2018, demand from the EU28 for virgin LDPE and LLDPE was 7 Mt: 6.5 Mt of which was supplied from virgin production and 0.5 Mt from net imports.²

Figure 2 shows that net demand for virgin LDPE and LLDPE, the main polymers used for PE flexible films, has remained relatively consistent over the last decade, with production of between 6.1 and 6.7 Mt and net demand of between 6.5 and 7.1 Mt. 2017 is the exception to the trend, with increased production reported at 8 Mt.³



FIGURE 2: Production, Imports and Exports of LDPE and LLDPE in primary forms in EU28, 2010-2018, Mt (Source: Eurostat PRODCOM, code 20161035)

Estimates for total PE flexible films on the market are at between 8.5-9 Mt, similar to total LDPE demand (some HDPE is also utilised for flexible films, whereas LDPE is also utilised for applications such as pipes, crates & pallets).⁴ Differences are negligible between the amount of LDPE used for non-film applications and HDPE utilised in flexible films.

Total flexible films demand across all polymers is estimated to be in the region of 13-15 Mt, with quantities of PP and multi-material multilayer flexible films on the market estimated by market experts at 2-2.5 Mt each (though estimates vary between studies) and smaller quantities of other single-polymer (PET, PVC) and biodegradable film.

IMPORT AND EXPORT

THE EU28 IS:

- A NET IMPORTER OF PRIMARY FORM LDPE/LLDPE (VALUE OF IMPORTS 20% HIGHER THAN EXPORTS)
- A NET EXPORTER OF FILM AND SHEET (EXPORTS VALUE 25% HIGHER THAN IMPORTS)
- A NET IMPORTER OF SACKS AND BAGS (IMPORTS 3 TIMES THE SIZE OF THE EXPORT MARKET)

“ THE EU28 IS A NET IMPORTER OF LLDPE (720 KT PER ANNUM) AND A NET EXPORTER OF LDPE (330 KT PER ANNUM), WITH A COMBINED NEGATIVE TRADE BALANCE OF €200M.

THE EU28 IS A NET EXPORTER OF FILM & SHEET WITH A POSITIVE TRADE BALANCE OF CIRCA €950M. IT IS A NET IMPORTER OF SACKS AND BAGS WITH A NEGATIVE TRADE BALANCE OF €700M. ”

Eurostat reports export and import data on primary form of LDPE/LLDPE, and two main types of flexible films products: film & sheet, and sacks & bags.

The EU28 is a net importer of LLDPE (720 Kt per annum) and a net exporter of LDPE (330 Kt per annum), with a combined negative trade balance of €200m.⁵ The level of exports and imports have been relatively consistent over the last decade at between 600 Kt and 1,000 Kt annual net imports of LLDPE, and between 150 Kt and 400 Kt annual net exports of LDPE. According to Prodcom data,⁶ Saudi Arabia is the largest source of imports to the EU28, and China and Turkey are the largest export destinations.

The EU28 is a net exporter of film & sheet with a positive trade balance of circa €950m. It is a net importer of sacks and bags with a negative trade balance of €700m.⁷ Imported sacks and bags are made mainly of virgin HDPE.⁸

Within the EU28, relatively few countries maintain positive trade balances (in value terms) in respect of primary LDPE and LLDPE. Belgium and the Netherlands have the largest positive trade balances; Italy and Poland have the largest trade deficits, measured by value.⁹

MARKET SECTORS (PRODUCTS)

- ROUGHLY 80% OF PE FILMS ARE USED FOR PACKAGING APPLICATIONS
- 41% OF PE FILM IS USED FOR NON-FOOD PACKAGING FILMS (STRETCH FILMS, SHRINK FILMS AND FILM ON REELS), MAKING THIS PRODUCT GROUP THE LARGEST APPLICATION FOR PE FILM.
- INTERNET SALES AND DEMAND FOR CONVENIENCE FOODS WILL CONTINUE TO INCREASE DEMAND FOR FLEXIBLE PROTECTIVE PACKAGING.

PE flexible films have a wide variety of product uses, the majority of which are packaging applications (food packaging, non-food packaging films, and sacks and bags used for packaging), with refuse bags, agricultural and B&C films also constituting key sectors. An approximate split of the 8.5-9 Mt of PE flexible films use across key product groups is shown in Figure 3.

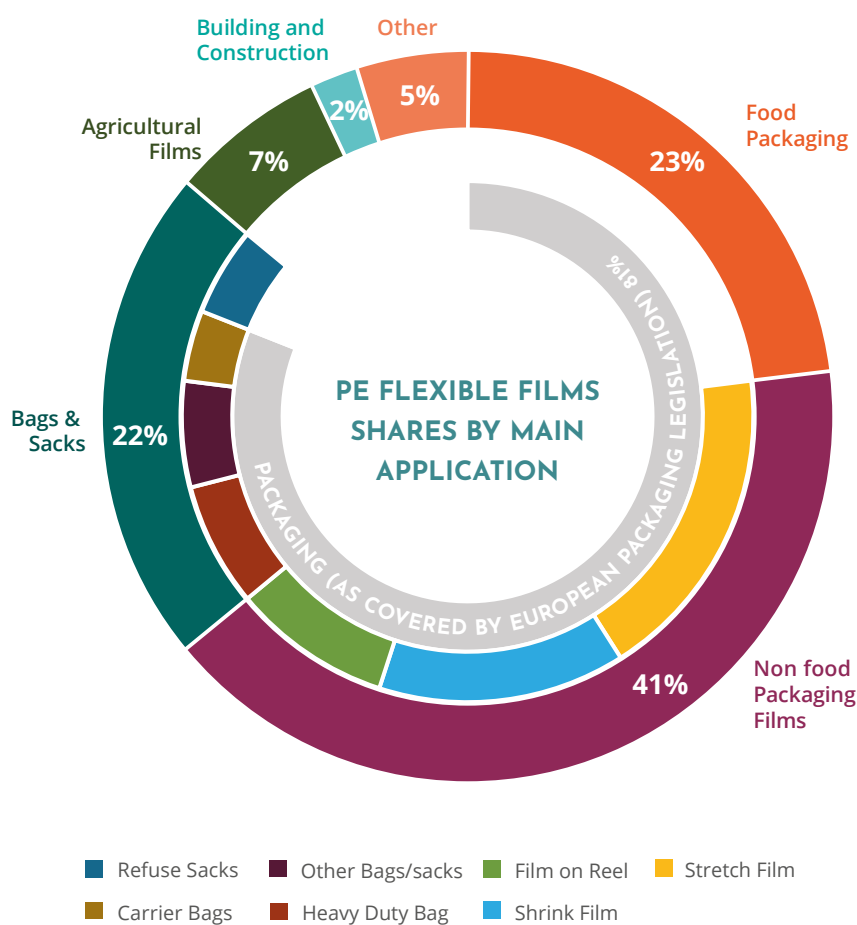


FIGURE 3: PE Flexible Films Shares by Main Application (Source: PRE)

FOOD PACKAGING (23% OF PE FLEXIBLE FILMS)

Food packaging is the flexible films product group with the highest ratio of non-PE films, with both PP and multi-material films used extensively in food packaging. Studies suggest as low as 40% of food flexible packaging is mono-material PE, up to 35% PP, and in the region of 20% multi-material films.¹⁰ Biaxially-orientated PP (BOPP) is increasingly used for snack packaging for its toughness, enhanced clarity, oil and grease resistance, and barrier properties to water vapour and oxygen.¹¹ Common materials used for layers alongside PE or PP include polyethylene terephthalate (PET) (as a barrier against moisture and chemicals), aluminium (as a barrier also against light and UV) and nylon (polyamide, for strength and barrier properties).

NON-FOOD PACKAGING FILMS (41% OF PE FLEXIBLE FILMS)

The largest product group use for flexible films is non-food packaging films for the protection of goods. This comprises:

- **Stretch film (18% of PE flexible films), Shrink film (14% of PE flexible films):** Stretch film (or stretch wrap) and shrink film (or stretch wrap) are both used to bind or wrap items together (such as pallet loads, as well as smaller packaging items).
- **Film on Reel (9% of PE flexible films):** flexible packaging films supplied on rolls, incorporating lamination if required, and used in various wrapping and packaging applications where shrink or stretch properties are not required. Applications include e.g.: washing powder or dishwasher tablets.

PLASTIC BAGS/SACKS (22% OF PE FLEXIBLE FILMS)

Sacks & bag products, including heavy duty bags/sacks, refuse sacks, carrier bags, and other bags/sacks, make up a combined 22% of PE flexible films.

OTHER PRODUCTS (14% OF PE FLEXIBLE FILMS)

- **Agricultural Film (7% of PE flexible films):** Films are used in multiple applications to enhance crop growth and yields. The main agricultural film applications are mulch films to moderate soil temperature, limit weed growth and maintain moisture levels; greenhouse, low tunnel films; stretch and silage films (used in animal production).
- **Building Films (2% of PE Flexibles):** Medium- and heavy- duty PE sheets are used for a range of applications in the construction sector, broadly for waterproofing properties.¹²
- **Other Sectors (5% of PE flexibles):** For instance as sheeting or lining in other household, commercial and industrial applications.

KEY PRODUCT TRENDS

Increasing internet sales (growing at 13% per year compared to 2.5% for traditional retail) will likely continue to increase demand for protective packaging films (primarily shrink and stretch films).¹³

Flexible food packaging demand is also likely to continue to rise with convenience products such as prepared fruit and vegetables. The number of single-person households is increasing in Europe, associated with more demand for single-serve and small packaging.¹⁴ BOPP demand (predominantly for snack and small portion packaging) grew at an average of 8.6% per year from 2016 to 2018.¹⁵

Consumption of single-use carrier bags is expected to continue to decline as more Member States implement measures to reduce their use, due to the impact of the EU Directive 2015/720 that requires their reduction across Member States.¹⁶

Consumer attitudes to plastic packaging and pressure on retailers to reduce plastic packaging may have some impact though the scale of this impact is uncertain. The use of biodegradable film as an alternative to conventional plastics has grown in recent years, especially within France and Italy. Its use in household and commercial applications presents a challenge with regards to recycling due to a lack of separate collection, sorting and processing systems and incompatibility with recycling processes for other plastic film. However, it may be suited well to some applications.

The European agricultural films market is relatively mature having grown steadily over the last decade. Following a period of expansion driven by increases in greenhouse horticulture, agricultural film is expected to grow at a slower pace over 2017-2022.¹⁷

COLLECTION AND SORTING

- AN ESTIMATED 13-15 MT OF FLEXIBLE FILMS, OF WHICH 8.5-9 MT IS PE FLEXIBLE FILMS, ENDED ITS USEFUL PRODUCT LIFE AND WAS THEREFORE AVAILABLE FOR COLLECTION IN 2018.
- 46% OF FLEXIBLE FILMS WERE ESTIMATED TO BE COLLECTED ACROSS THE EU28+2 IN 2018. DATA ON COLLECTION OF NON-PE FLEXIBLE FILMS IS NOT AVAILABLE.
- ADJUSTING FOR OTHER MATERIALS WITHIN SORTED FILM BALES, AN ESTIMATED 2.0 MT OF PE FLEXIBLE FILMS (WITHIN A TOTAL SORTED WEIGHT OF 2.7 MT) WERE SENT TO FILM RECYCLING IN 2018. THEREFORE, IN THE REGION OF 23% OF END-OF-LIFE PE FLEXIBLE FILMS WAS SENT TO FILM RECYCLING IN 2018.
- PP FLEXIBLE FILM DOES NOT TEND TO BE SORTED INTO A SEPARATE STREAM FOR RECYCLING, DUE TO A LACK OF REPROCESSING ROUTES AND LOWER PRESENCE IN COLLECTED FILM STREAMS.

The amount of film packaging consumed is expected to equal the amount of packaging requiring collection, sorting and recycling within the same year, because of the short lifetime of film packaging. Due to stability of demand for agricultural film, a similar amount of film is placed on the market each year, so the weight of end-of-life films is likely to match the amount placed on the market in any given year. Certain flexible films with a longer life span (such as films used within building materials, have a correspondingly longer time period between manufacture and collection and growth and so there is a time lag between increased production and increased arisings in collected streams.

As shown in Figure 4, the commercial sector (incl. retailers) is the single largest source of PE flexible films collected for recycling, accounting for 67% of all PE flexible films collected (excluding production scrap tonnages). Scrap from production processes, which is not included in Figure 4, is a further key source of PE flexible films for recycling.

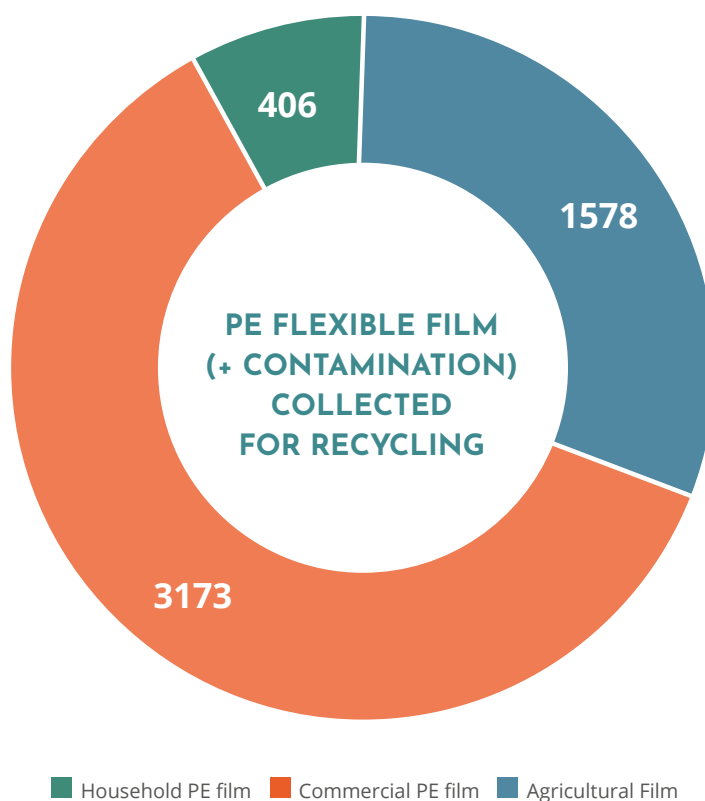


FIGURE 4: PE Flexible Film (+ Contamination) Collected for Recycling by Sector, in kilotonne (Source: Market data)

The total PE content in sorted film bales sent for recycling is estimated by a PRE market expert at a maximum of 70% in household streams, 85% in commercial streams, and only 50% in agricultural streams. Bales of household films contain high amounts of other polymers, materials and food contamination, whilst collected agricultural films contain high amounts of soil, organic content, moisture, and chemical contamination. The effects of the stated polymer content against flexible films weight are illustrated in Figure 5, which shows the tonnes of PE flexible films on the market and the tonnes of sorted film streams sent to recycling (both sourced from PRE market estimates), against the actual weight of the PE content in those sorted streams (using the above PE film content estimates). The resulting 'sent for recycling' rate estimate is shown, calculated as the weight of PE material within bales sent for recycling compared with the weight of PE material placed on the market. Of the total PE films POM, 23% was sent for recycling in 2018.

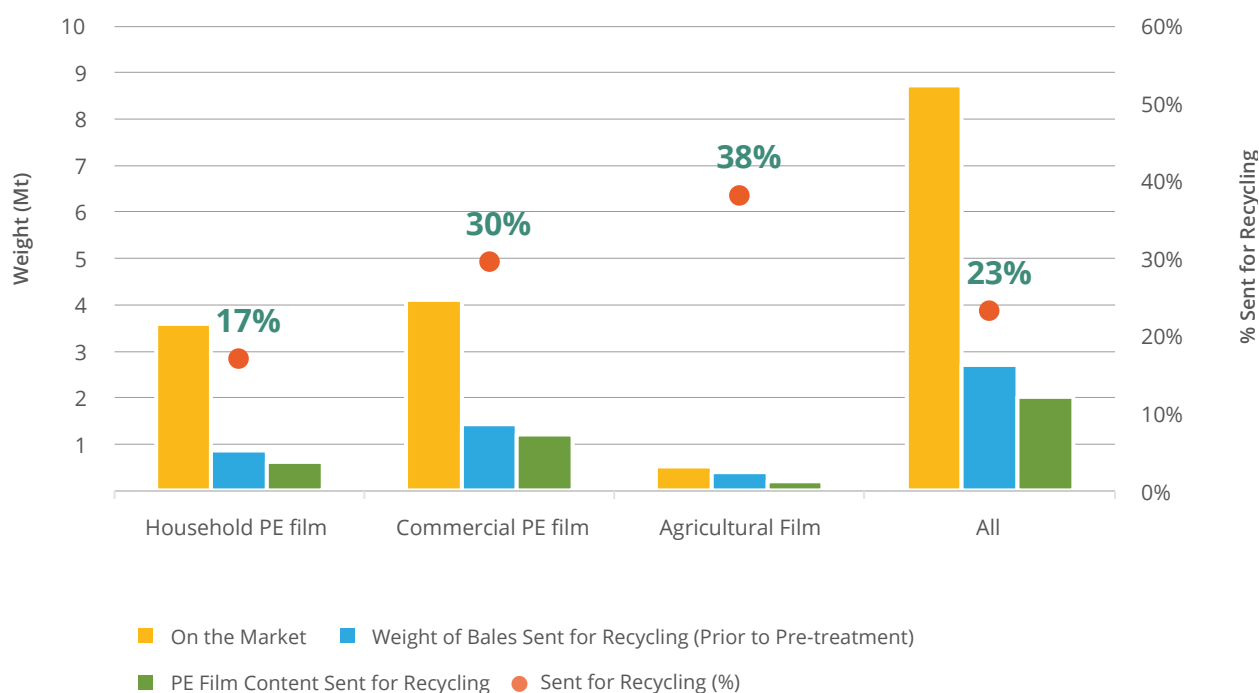


FIGURE 5: PE Flexible Film Sent for Recycling by Sector, Mt (Source: Market Data, APE)¹⁸

Collection and recycling rates are higher for commercial and retailer packaging than for household packaging, with the latter involving greater quality challenges due to the diversity of materials and greater contamination from organics, inks and multilayer materials.

COLLECTION AND SORTING SYSTEMS

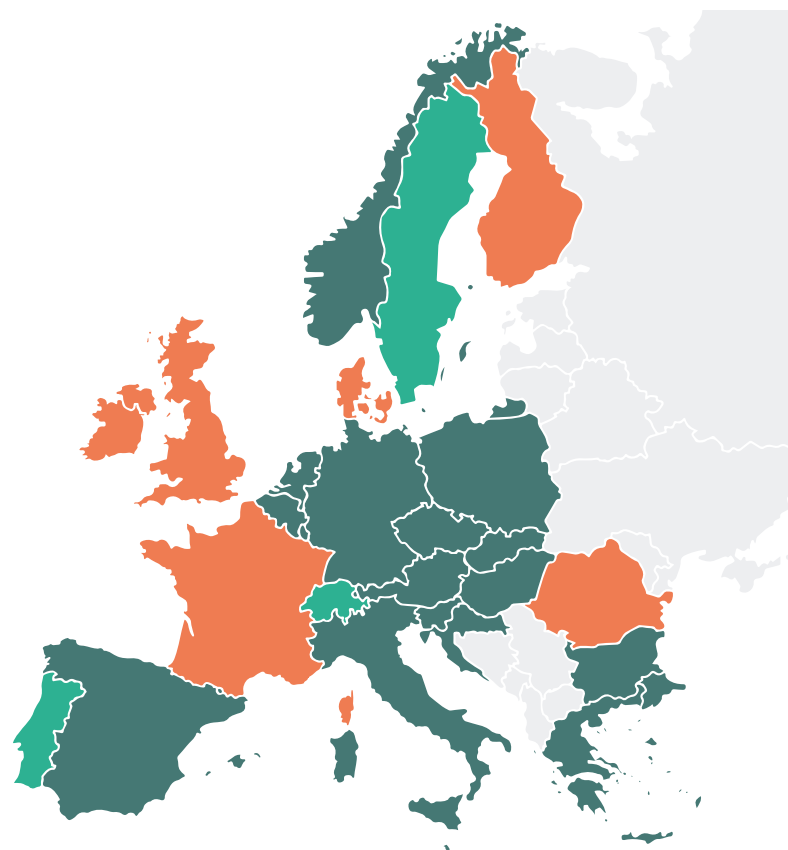
Collection and sorting systems of flexible films for recycling in Europe target the main sources of end-of-life films: households, businesses, agriculture, and building and construction.

Household packaging: Household packaging films are most commonly collected at kerbside or bring sites, co-mingled with other packaging materials. Household flexible films tend not to be collected separately from other plastics in Europe, however a fully separate household PE film collection (separated distinct from other plastics and dry recycling) has been trialled in Belgium.

At MRFs, flexible films from household packaging are either: sorted into separate streams; or sorted into the mixed plastic fraction which can be expensive to send to a recycler. In Germany and Italy, larger films, primarily PE, are sorted into a PE film output grade, and smaller flexible films (including pouches and snack packaging) are included in a mixed plastic output. The smaller flexible films fraction typically contains higher levels of food packaging and other polymers and materials.

Household collection systems continue to develop to improve recycling performance in line with policy ambitions. Whereas not instrumental to the analysis of the market in 2018, the following examples show an incrementation in such policies. Since 2017, a revised household collection scheme targeting all types of plastic packaging, including flexible packaging, has been provided to 25% of the French population and is due to be rolled out nationally in 2022. In Poland, but only since January 2020, all municipalities have been required to set up systems for the separate collection of plastic packaging waste (alongside metals but separate from fibre and glass).

In the region of 65-70% of the population of the EU28+2 live in countries where film is included in the predominant form of household separate recycling collections: these countries are shown in Figure 6.



TARGET OF FILMS IN HOUSEHOLD RECYCLING COLLECTION

- Not included in Predominant Household Recycling Collection
- Included in Some Regions
- Included in Predominant Household Recycling Collection

FIGURE 6: European countries where film is included in predominant household recycling collection, 2019 (Source: PRE collection scheme review)

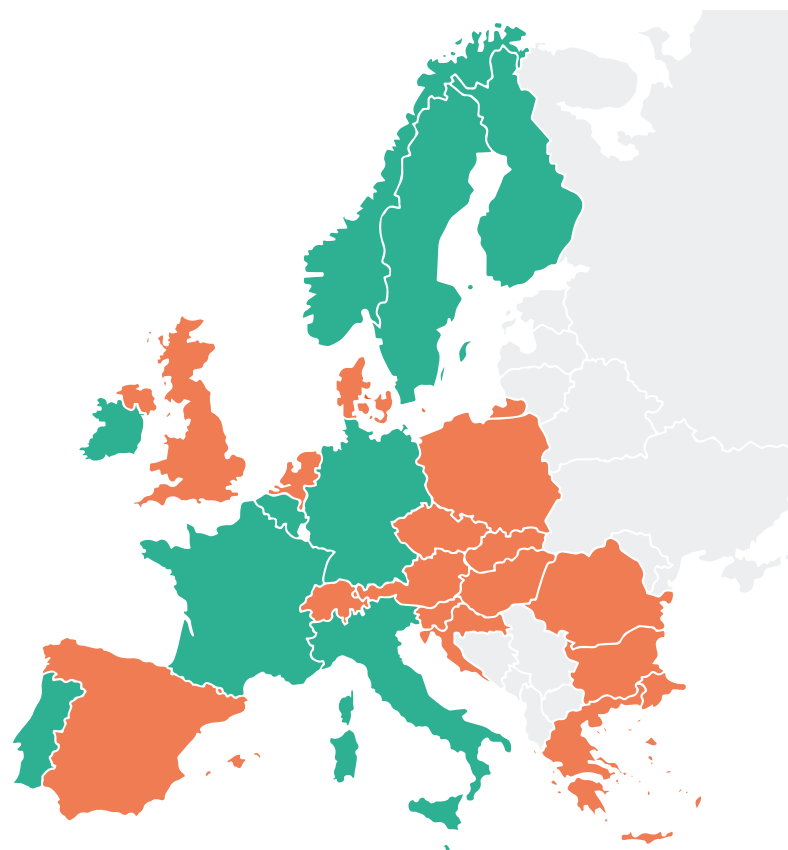
Note: Data sources used did not cover Malta, Cyprus, Estonia, Latvia, Lithuania, Luxemburg or Iceland. The UK operates a retailer-based collection scheme.

Commercial and Industrial packaging: Commonly, privately organised collections of end-of-life commercial and industrial packaging films generate larger volumes per pick-up compared to household packaging PE film. These collections consist largely of secondary packaging, tending to be relatively clean in volume and more predominantly made up of mono-material PE film. Most packaging EPR schemes cover packaging from commercial sources in addition to household packaging.¹⁹

Agriculture: Agricultural films are collected in bulk quantities of similar material whether collected for recycling or for disposal. EPR schemes, with the right incentives, can achieve high collection and recycling rates. EPR schemes for agricultural plastics are not currently mandated, however, as of 2019, seven countries across the EU28+2 (see Figure 7) have EPR schemes for at least some types of agricultural films.

Building and construction: Some films used in building and construction are source segregated by site contractors at larger sites, and some may be sorted from mixed C&D waste sorted at facilities. However, there is little data on tonnages of flexible films sorted for recycling from C&D sites and quantities are likely to be low.

“IN THE REGION OF 65-70% OF THE POPULATION OF THE EU28+2 LIVE IN COUNTRIES WHERE FILM IS INCLUDED IN THE PREDOMINANT FORM OF HOUSEHOLD SEPARATE RECYCLING COLLECTIONS”



EPR COVERAGE OF AGRICULTURAL FILMS

- EPR Scheme does not Exist for Agricultural Films
- EPR Scheme Exist for Agricultural Films

FIGURE 7: European countries with EPR schemes covering agricultural films, 2019 (Source: IEEP, Eunomia)

Sources: EPR scheme coverage from IEEP (2017), “EPR in the EU Plastics Strategy and the Circular Economy: A focus on plastic packaging”; Eunomia experts
A regional EPR scheme in Spain was established by the government of Andalusia, but operation ceased in 2016 until a national scheme is established.²⁰

RECYCLING

- IN 2018, AROUND 1.8 MT OF THE 2.7 MT PE FLEXIBLE FILMS STREAMS SENT FOR RECYCLING WERE SENT TO RECYCLERS WITHIN THE EU28+2 (ALONGSIDE AN ADDITIONAL 0.5 MT PRODUCTION SCRAP). THE TOTAL INPUT OF PE FLEXIBLE FILMS TO EU28+2 RECYCLERS WAS THEREFORE BETWEEN 2.2-2.3 MT, WITH THE FOLLOWING SPLIT OF SOURCES:

- 14% HOUSEHOLD FILM,
- 44% OF COMMERCIAL AND INDUSTRIAL FILM,
- 18% AGRICULTURAL WASTE,
- 24% PRODUCTION SCRAP.

- THE AVERAGE YIELD OF RECYCLATE FROM POST-CONSUMER PE FLEXIBLE FILMS WITHIN THE EU28+2 IS ESTIMATED AT 70% OF INPUT TONNAGES, SUGGESTING AROUND 1.8 MT OF RECYCLATE OUTPUT WAS THEREFORE PRODUCED IN THE EU28+2 (1.3 MT FROM POST-CONSUMER FLEXIBLE FILMS AND 0.5 MT FROM PRODUCTION SCRAP).

PRE data shows that around 1.8 Mt of the 2.7 Mt of flexible films sorted from collections (including moisture, organics, other materials) were sent to recyclers within the EU28+2. Additionally, 0.5 Mt of production scrap was recycled, making total input to recyclers 2.2-2.3 Mt.²¹ The 1.8 Mt post-consumer bale weight is estimate to contain a weight of 1.35 Mt PE films (see Figure 5 for more detail).

Installed European recycling capacity for flexible films (including production scrap) has increased over the past few years, from 1.5 Mt in 2014 to 2.5 Mt in 2018.²² France, Germany, Italy, Netherlands, Poland, and Spain account for 80% of recycling capacity (see Figure 8). Utilisation of plant capacity in 2018 was high, estimated at 90%.²³

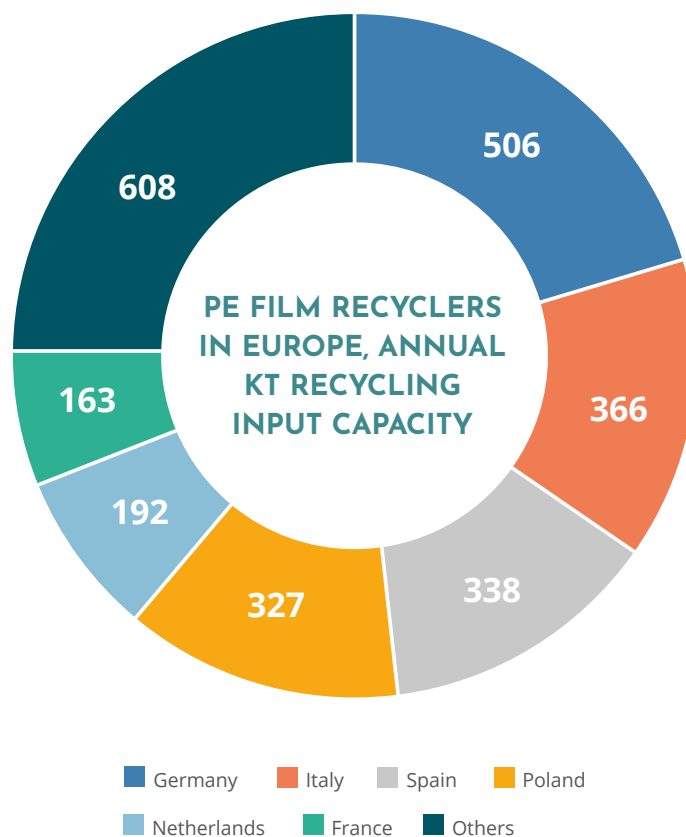


FIGURE 3: PE Film Recyclers in Europe, annual Kt recycling input capacity, 2018 (source: PRE Mapping)

The recycling of smaller household flexible films sorted into mixed plastic/MPO streams is not included in Figure 8. The PRE mapping exercise did not identify capacity to reprocess separated streams of PP films or multi-material multi-layer films in the EU28+2.

Based on the market knowledge of experts from PRE, in 2018 the average output yield (output as a proportion of input tonnages) from recyclers of post-consumer flexible films was roughly 70%. Including the recycling of production scrap, output of recycle was estimated at 1.8 Mt overall, of which an estimated 1.2-1.3 Mt was suitable for film applications.²⁴

Typical output yields from recyclers vary by sector:

- Due to high rates of soils and organics in collected agricultural films, output yields are in the region of 45-50% (as a proportion of input) for agricultural films. Mulch films, for example, have an output yield of about 33-35%, whereas greenhouse films have an output yield of 60-70%.
- Due to high levels of non-PE films (PP films, multilayers) in household waste, output yields are similarly low at around 50%.
- For commercial waste, higher yields of 80% are achieved, due to lower contamination in the material collected, and well functioning sorting arrangements in shop and business centers.

European recycling capacity is weighted towards reprocessing commercial flexible films: an estimated 44% of flexible films processed within the EU28+2 come from commercial flexible film streams compared with 24% production scrap, 18% processing agricultural flexible films, and only 14% processing household flexible films.²⁵ In 2018 the EU28+2 reprocessed approximately 70% of commercial PE flexible films sent for recycling, and 34% of household PE flexible films sent for recycling.²⁶

All mentioned yields are supposed to grow in the upcoming time period due to improved design for recycling, efficiency of waste sorting, and the evolution of the recycling technology.

“INSTALLED EUROPEAN RECYCLING CAPACITY FOR FLEXIBLE FILMS (INCLUDING PRODUCTION SCRAP) HAS INCREASED OVER THE PAST FEW YEARS, FROM 1.5 MT IN 2014 TO 2.5 MT IN 2018.²² FRANCE, GERMANY, ITALY, NETHERLANDS, POLAND, AND SPAIN ACCOUNT FOR 80% OF RECYCLING CAPACITY”

EXPORTS

Eurostat does not report baled film scrap separately from other PE waste, or quantities of flexible films in mixed plastic waste exported. Therefore exported flexible films are estimated at 950kt based on the difference between estimated quantities of sorted waste and inputs into European recycling capacity, a figure similar to net PE waste exports recorded in Eurostat.²⁷

Eurostat data (Figure 9) shows a sharp decline in net exports of PE waste from the EU since 2016, driven by changes markets related to restrictions on international exports, particularly to China.

“EUROSTAT DATA SHOWS A SHARP DECLINE IN NET EXPORTS OF PE WASTE FROM THE EU SINCE 2016, DRIVEN BY CHANGES MARKETS RELATED TO RESTRICTIONS ON INTERNATIONAL EXPORTS, PARTICULARLY TO CHINA.”

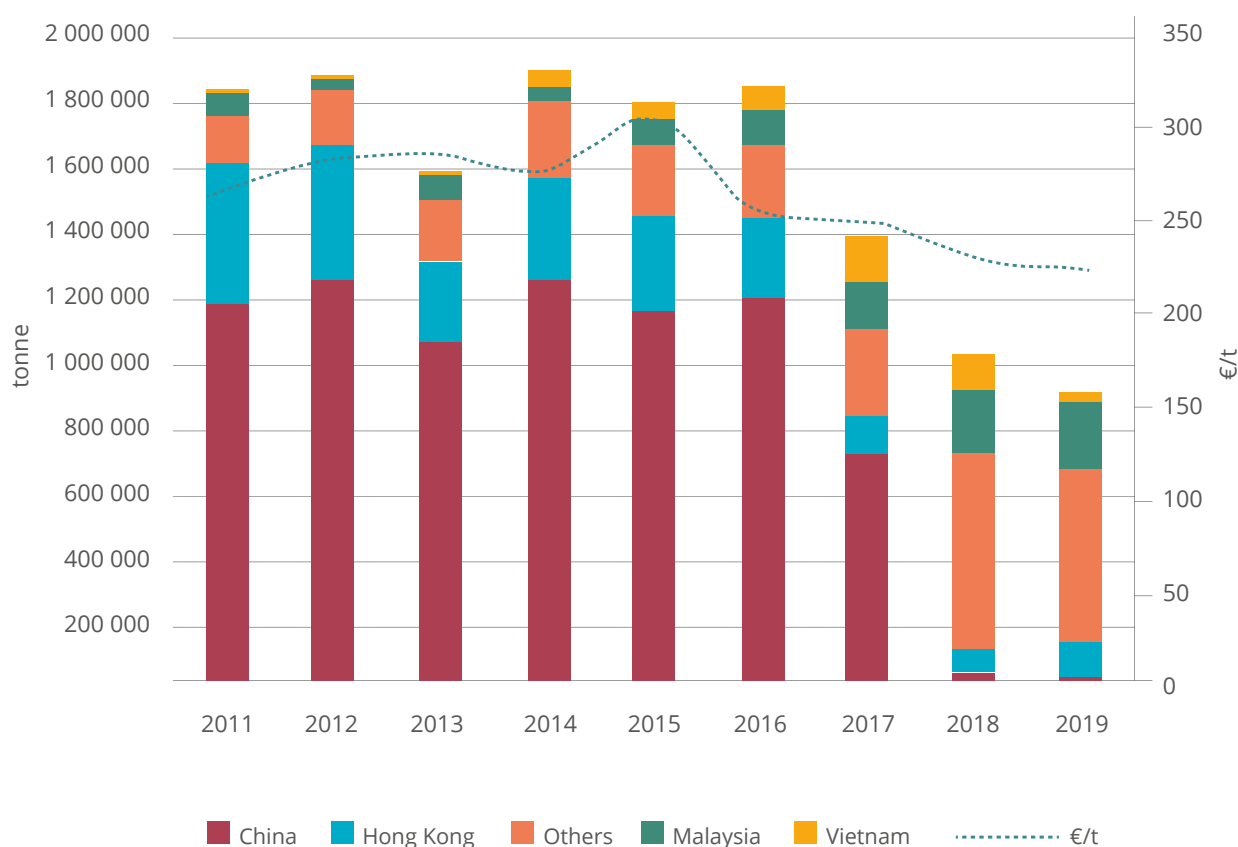


FIGURE 9: PE Waste Exports by Destination, 2011-2019, tonnes (source: Eurostat, code 39151000)

END MARKETS (RECYCLED FLEXIBLE FILM)

- **THE LARGEST END MARKETS FOR FLEXIBLE FILM RECYCLATE REPORTED BY THE PRE SURVEY ARE NON-FOOD FILM AND FOIL PACKAGING, AND REFUSE BAGS, WITH SMALLER AMOUNTS GOING TO OTHER BAGS & SACKS, BUILDING AND CONSTRUCTION, AGRICULTURE AND OTHER APPLICATIONS.**
- **1.2-1.3 MT OF RECYCLED PE FLEXIBLE FILMS OUTPUT IS SUITABLE FOR USE IN PRODUCTION OF NEW FLEXIBLE FILMS (SUPPLYING IN THE REGION OF 20% OF TOTAL DEMAND FOR PE ACROSS NON-FOOD FLEXIBLE FILM APPLICATIONS).**

The 1.8 Mt output of recycled PE films in 2018 equates to ca. 20% of total European PE flexible films demand. An estimated 1.2-1.3 Mt of this output is suitable for film applications, equating also to ca. 20% of demand for PE in non-food flexible film applications.

Table 1 below, presents one market expert's estimate of total recycled content uptake in different PE film product sectors. The average recycled content by product group is illustrated in Figure 10.

	Flexible PE Films Demand 2018, kt, est.	Recyclates Used 2018, kt, est.	Recycled Content, 2018
Film and foil (non-food)	3,410,000	400,000	12%
Bags/sacks (refuse)	440,000	300,000	68%
Carrier bags	110,000	100,000	91%
Bags/sacks (others)	1,540,000	200,000	14%
Building film	180,000	100,000	56%
Agricultural film	536,000	118,800	22%
TOTAL NON-FOOD	6,216,000	1,218,800	20%

TABLE 1: Use of Recyclate in Key Flexible Film Products, EU28+2 in kt (source: Market Expert)

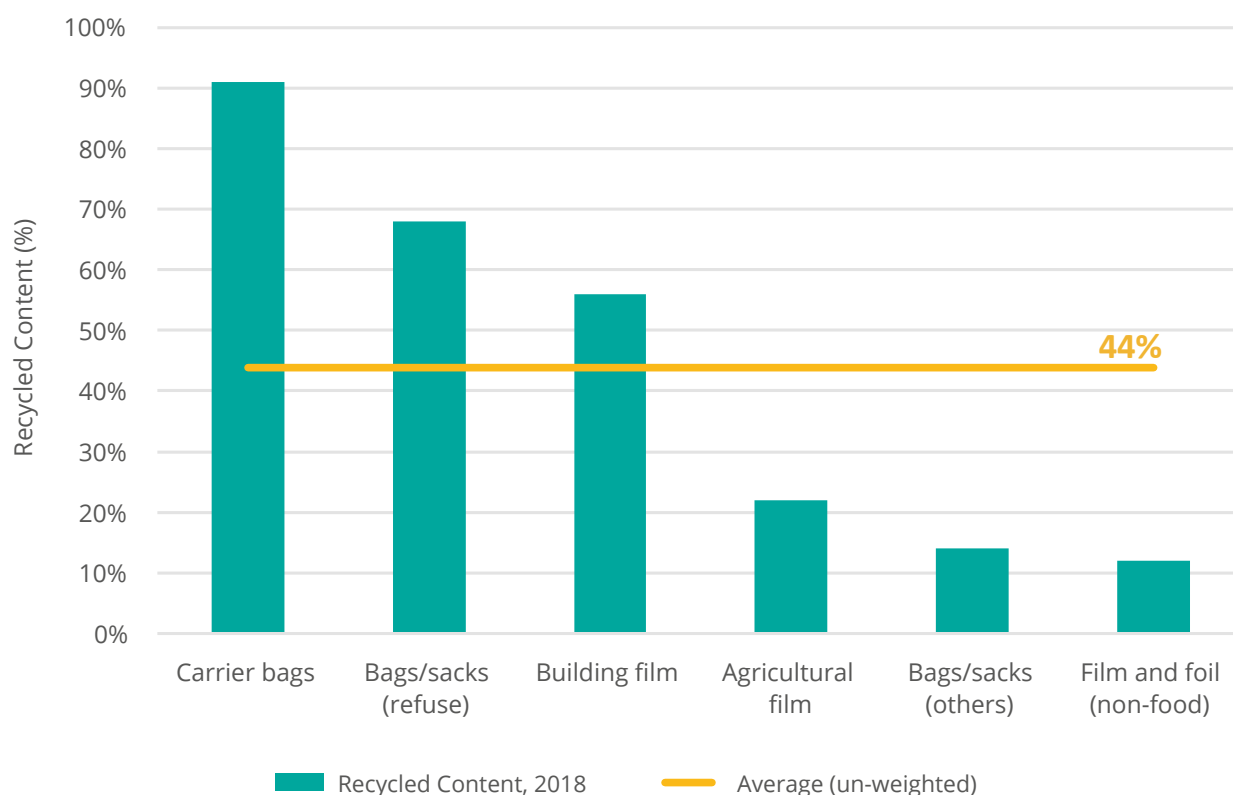


FIGURE 10: Recycled content in non-food end applications, 2018 (source: Market Expert)

Out of the different non-food applications for recycled flexible films, the sectors with the highest use of recycled content are carrier bags (91%), bags/sacks for refuse (68%), and films used in the building sector (55%). The average use of recycled content in agricultural films (silage films, mulch films and stretch films) is also above 20%.

There are some limitations in applications for recycled flexible films due to the quality of outputs related primarily to colour, additives and odour, among others. For example, recyclates from household waste are typically used in dark refuse bag production due to the fact that household packaging typically contains a range of heavy printed colours (i.e. inks), and sometimes aluminium coatings. Together, these elements make the output of the recycling process a dark recyclate that, where suitable for film applications, is mostly used for low quality applications (e.g. refuse bags). Other applications, such as

street furniture, panels, and components for agricultural irrigation systems, offer a market demand for lower quality recycled flexible films (covering the remaining 500kt)²⁸ An economically viable business model for producing higher quality, light coloured output from household films is needed, in order to produce a product that meets the requirements of the largest non-food flexible films sectors (non-food packaging films and other bags and sacks), with the aim to displace virgin production.

PE film recycling capacity certified under the EuCertPlast scheme has grown from 540 Kt to 622 Kt from 2017 to 2018.²⁹ This shows that the certification provides the transparency needed by stakeholders in the plastics value-chain (converters, component makers, brand owners, retailers and end-consumers) to increase the uptake of recyclates in new products.

3. KEY CHALLENGES FACING THE RECYCLING MARKET

- THERE IS A NEED TO STRENGTHEN COLLECTION SERVICES FOR FLEXIBLE FILMS, BOTH TO ADDRESS GAPS IN COVERAGE AND TO RAISE COLLECTION RATES, SO THAT FLEXIBLE FILMS RECYCLING CAN MAKE A GREATER CONTRIBUTION TO PLASTIC PACKAGING RECYCLING TARGETS.
- FOR COLLECTED PE FLEXIBLE FILMS STREAMS (PARTICULARLY FROM HOUSEHOLDS AND AGRICULTURE), THERE ARE GREATER CHALLENGES ASSOCIATED WITH REACHING HIGHER-QUALITY OUTPUT AND WIDER END-MARKET APPLICATIONS THAN FOR OTHER POLYMERS (E.G. PET). IN 2018, ONLY 50% OF PE FLEXIBLE FILMS COLLECTED FOR RECYCLING WERE SENT FOR RECYCLING.
- THERE IS THEREFORE A NEED TO IMPROVE THE FATE OF FLEXIBLE FILMS IN COLLECTED STREAMS, THROUGH A FOCUS ON TACKLING QUALITY CHALLENGES, INCREASING DEMAND IN SOME KEY PRODUCT SECTORS AND ENSURING ADEQUATE EUROPEAN PROCESSING CAPACITY.
- FLEXIBLE FILMS MADE FROM OTHER POLYMERS TEND NOT TO BE RECYCLED. VIABLE SORTING AND RECYCLING ROUTES NEED TO BE DEVELOPED IN ORDER FOR PP FLEXIBLE FILMS TO BE PROPERLY CONSIDERED 'RECYCLABLE'.

This section explores the key challenges facing the flexible films recycling market in Europe. It takes the data from the previous section and looks at the mass balance across the supply chain, the recyclability of products and the resultant impacts on the sorting and recycling industry.

QUANTITY: FLEXIBLE FILMS MASS BALANCE

Figure 11 shows the current mass balance of flexible films across the EU28+2. The stages are shown across the horizontal axis, with the coloured blocks indicating the flows in or out at each stage. The major sources of leakage of flexible films out of the system are in collection and sorting, though some product design issues limit yields at recyclers. The bulk of exports are understood to be lower quality film grades, for which there is comparatively less recycling capacity within the EU28+2.

Collection coverage for PE flexible films is not comprehensive, and an estimated 46% of the quantity of PE flexible films placed onto the market in 2018 were collected

for recycling (see section 2.I). Additionally, PP (and PET) flexible films are not sorted out for separate recycling, resulting in the majority of these films ending up in reject streams. Only 23% of PE flexible films (and 15% of flexible films overall) were sent for recycling, and a portion of that was lost in further sorting stages.

In addition to the data presented in Figure 11, it should be noted that recyclate output is mainly PE, predominantly larger LDPE, films. Smaller flexible films may end up in mixed plastic streams instead, whilst a proportion of flexible films are PP and multilayers which, even if collected and sorted, tend to be discarded by PE reprocessors.

As such, the key quantity challenges are to:



Underpinning these challenges, there is a need for better data collation and reporting of POM tonnages for different film applications, and of collected/sorted quantities, in order to improve understanding of the full scale of the challenge.

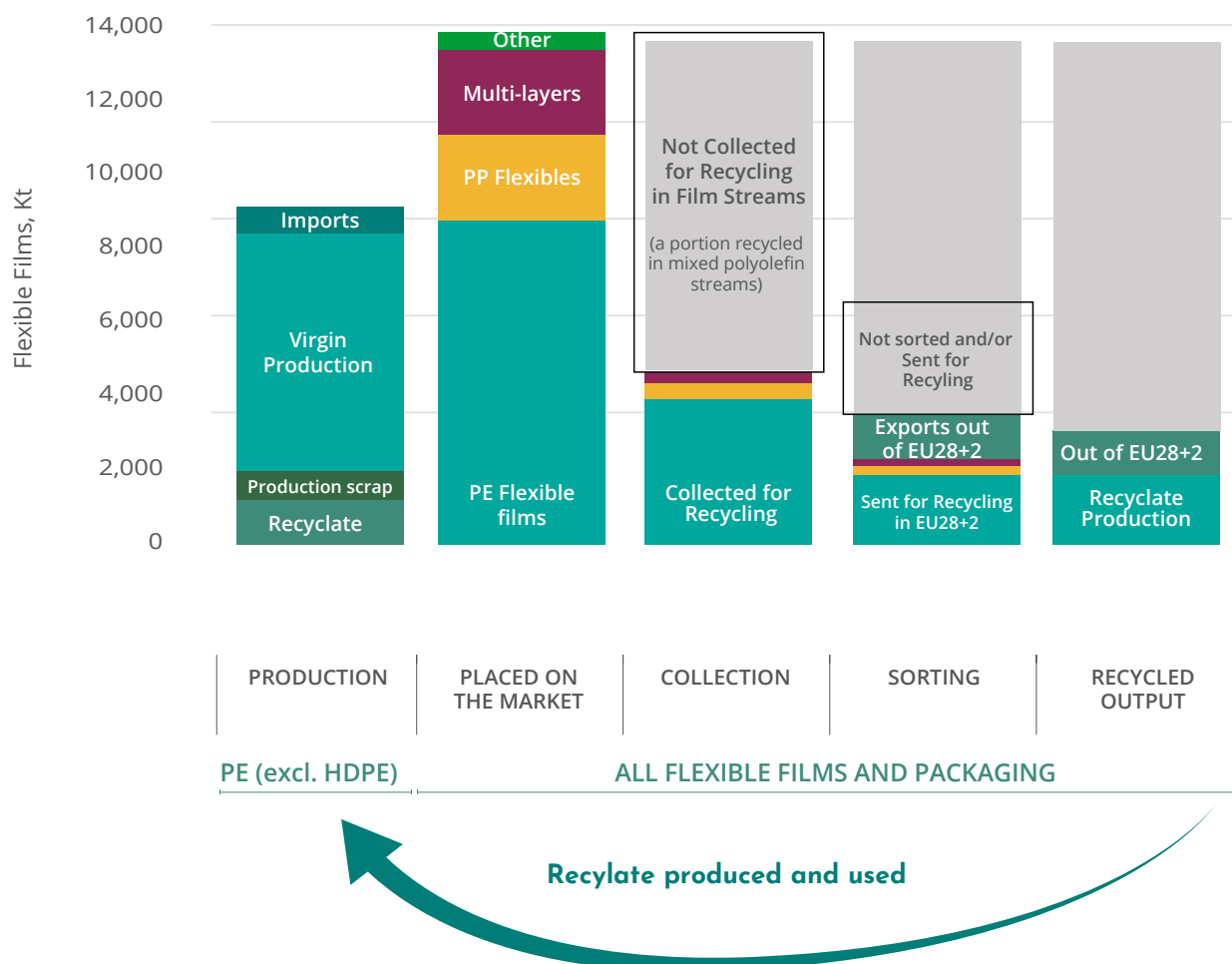


FIGURE 11: Overall Flexible Films Mass Balance, 2018, Kt (source: PRE/Eunomia, summarised data from this research)

Note: Green section of bars represents PE flexible films. Flexible films not collected for recycling, and those lost between collection and sorting, are typically used as fuel, for energy recovery, or are disposed of. Quantities are displayed excluding estimates of moisture, organics and other materials in collected and sorted streams.

QUALITY: RECYCLABILITY OF FLEXIBLE FILM AND PACKAGING

Ensuring a product is readily recyclable requires more than simply manufacturing the main product body from a technically recyclable polymer. Other features of product design (adhesives, labels, pigments) can hinder recyclability, and increase the costs of producing and/or reduce the value of secondary material. The technical and economic practicability of arranging the collection and onward sorting and management of the material must also be considered. The RecyClass initiative aims to help the plastics value chain find the correct way to approach and evaluate the design of packaging products with recyclability in mind, with the goal of improving their recyclability.³¹

According to the definition released by PRE and by the Association of Plastics Recyclers (APR) in the USA, plastics must meet four conditions for a product to be considered recyclable:

1. The product must be made with a plastic that is **collected for recycling**, has **market value** and/or is supported by a legislatively **mandated program**.
2. The product **must be sorted and aggregated** into defined streams for recycling processes.
3. The product **can be processed** and reclaimed/recycled with commercial recycling processes.
4. The recycled plastic becomes a **raw material** that is used in the production of new products.

The definition references the economic viability of collection (condition 1, relating to the concept of market value or legislative support) and of recycling processes (condition 3, with the reference to commercial recycling processes).

Table 2 examines each main flexible films product group against all four conditions. The table highlights the challenges faced in particular in the recycling of non-PE films, and the recycling challenges for films from households and agriculture.

Within the concept of recyclability, it is possible to distinguish between uses of recycle that are circular (material is recycled into products of the same product group), versus a recycling cascade use, where recyclates are used in alternative product groups with less demanding specifications. The range of uses of PE recycle relates to its mechanical strength for film-blowing, its colour, transparency, and odour. The use of additives, pigments, adhesives, and other polymers all impact the strength and quality of the recycle; organic and chemical residues have an impact on odour and colour. Household film is particularly high in pigments, other polymers, papers, and organics, making the economics of producing higher quality recycle more challenging. 57% of plastic converters responding to a recent survey rated the quality of current PE recycle as not sufficient for use in their applications.³²

















Currently there is little recycling of non-PE flexible films, and in addition no current mechanical approach to separating different polymer layers exists. This leads to increased costs in sorting, recycling and disposal of such materials and if ineffectively sorted out from the PE stream can affect the recyclates quality.

The key quality challenges are therefore to:

- reduce the diversity of polymers used for flexible films,
- avoid imports of PVC flexible packaging,
- avoid multi-material, multi-layer flexible packaging,
- reduce the use of pigments, problematic adhesives, inks, fillers,
- continue to invest in R&D for sorting by polymer and colours, and,
- inform, enable and reward customers and industry to increase the yield of separately disposed plastics and therefore decrease the contamination in the collected waste.

TABLE 2: Flexible Films Recyclability Assessment

→ Assessed Flexible Product Groups for Recyclability	PACKAGING						Agriculture	Building and Construction
	C&I ³³	Household				Bio-degradable		
		Mono-material			Multi-layer, multi-material			
		PE	PP	Other polymers ³⁴				
Recyclability Criteria ↓								
OVERALL	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
Collection	<div></div> <p>Collected relatively economically</p>	<div></div> <p>Included in many packaging EPR collection schemes, though coverage is not fully comprehensive across countries and regions</p>	<div></div> <p>Collected alongside other films but currently are not sorted.</p>	<div></div> <p>Collected alongside other films but currently are not sorted.</p>	<div></div> <p>Collected alongside other films but currently are not sorted.</p>	<div></div> <p>No wide-spread funding of separate collection; not targeted in any other stream standardly collected for recycling/composting</p>	<div></div> <p>Only partial EPR scheme coverage across EU28+2. (see figure Figure 7) Requires correct procedure for gathering and storing films for collection</p>	<div></div> <p>May not be segregated for collection, as minor and low value part of building and construction waste streams</p>
Sorting	<div></div> <p>Primarily larger films sorted into defined streams</p>	<div></div> <p>Mostly sorted into a mixed PE film grade as it is typically not viable for sorters to sort into clear and coloured film grades. Smaller films may be lost to mixed plastic/residue streams.</p>	<div></div> <p>Rarely sorted into distinct PP stream, instead either a contaminant in film bales or sorted into mixed plastic outputs or rejects</p>	<div></div> <p>Quantities too low to sort into separate streams, instead either a contaminant in film bales or sorted into mixed plastic outputs or rejects</p>	<div></div> <p>No market value, so either contaminant in film bales or sorted into mixed plastic outputs or rejects</p>	<div></div> <p>Not sorted out into compostable film stream, and treated as a contaminant in most other composting/recycling streams.</p>	<div></div> <p>Collected in defined streams, yet too high polluted</p>	<div></div> <p>Some (e.g. packaging films) may be sorted out of mixed construction waste. Films used in construction often attached to other materials so unlikely to be sorted</p>

Assessed Flexible Product Groups for Recyclability	PACKAGING						Agriculture	Building and Construction
	C&I ³³	Household				Bio-degradable		
		Mono-material			Multi-layer, multi-material			
		PE	PP	Other polymers ³⁴				
Recyclability Criteria								
Recycling	 Compared to other film streams, relatively free from contamination and pigments, and reprocessed with high yields	 Recycling viable, though lower yields and higher losses (compared to C&I films) due to contamination and other films within bales.	 Only generally reprocessed into MPO grade	 No current Recycling	 There are no commercially viable processes for separating polymer layers.	 If not effectively sorted out of film recycling streams, it is detrimental to the quality of recycled film outputs. Unless it meets home composting standard, it can only be composted in industrial composting processes	 Technically viable to recycle, but, because of high levels of organics, soils, dirt, and presence of stabilisers, additives and fillers (UV absorbers) there is currently a limited market (e.g. mulch films). For other agricultural flexible films recycling today is not economically viable.	 Cleaner films likely processed alongside commercial packaging films. Others unlikely to be reprocessed.
End Markets	 Wide range of possible end markets	 Film uses tend to be restricted to darker, less odour sensitive applications such as refuse bags	 If recycled, likely to be in lower quality mixed polyolefin outputs	 No current usage (primarily energy recovery or fuel)	 No current usage (primarily energy recovery or fuel)	 Only if properly composted	 Range of end markets for recycle from agricultural film, often non-film uses (e.g. irrigation pipe)	 Variable
Key Challenges	Exports still too high Current sorting and collection (automatic sorting needed) Suboptimal separate collection and sorting of waste, from consumers choices to industry practices	Collection services in many European countries, but in some collection and sorting is insufficient due to poor market value / lack of EPR scheme support; Low value and yields due to presence of organics, ink, moisture, UV barriers and other polymers including in some cases biodegradable films; Limited capacity for recycling within Europe; Small food flexible films generally end up in mixed plastics fractions (see Chapter 2, which when reprocessed have insufficient mechanical strength for film blowing. ³⁵				Only compostable if effectively separated at source from other plastics and sent to industrial composting facilities treating mixed food and garden waste.	Coverage and performance of EPR schemes, farmer adoption of correct storage, recycling routes for e.g. mulch films	With an EPR system for B&C, there would be an uptake in sorting of plastics also from this industry segment.

Key: the extent to which each product group meets the recyclability criteria is shown with a colour indicator, with green representing a high score, yellow indicating some challenges, and red indicating un-recyclability against one or more of the criteria for recyclability.

4. WHAT IS CHANGING?

- **LEGISLATION WILL PLAY A VITAL ROLE IN CHANGING THE COLLECTION AND SORTING OF PLASTIC RECYCLING IN THE EU27, SUPPORTED BY CIRCULAR ECONOMY AND EPR PACKAGES.**
- **THERE ARE POLICY GAPS REGARDING INTEGRATION OF RECYCLED CONTENT IN PRODUCTS TO SUPPORT DEMAND, AND IN MEASURES TO SUPPORT THE QUALITY OF MATERIAL SORTED AND COLLECTED.**
- **R&D IS NEEDED TO PROVIDE CONTINUAL IMPROVEMENT IN PROCESSES, TO SOLVE PARTICULAR PROBLEMS IN RECYCLABILITY, AND TO OPEN UP THE POTENTIAL FOR STEP CHANGES IN HOW COLLECTION, SORTING AND RECYCLING IS OPTIMISED FOR A CIRCULAR ECONOMY.**

Figure 12 summarises the consumer and legislation pressures on the flexible films supply chain, and key areas of research and development within each part of the supply chain.

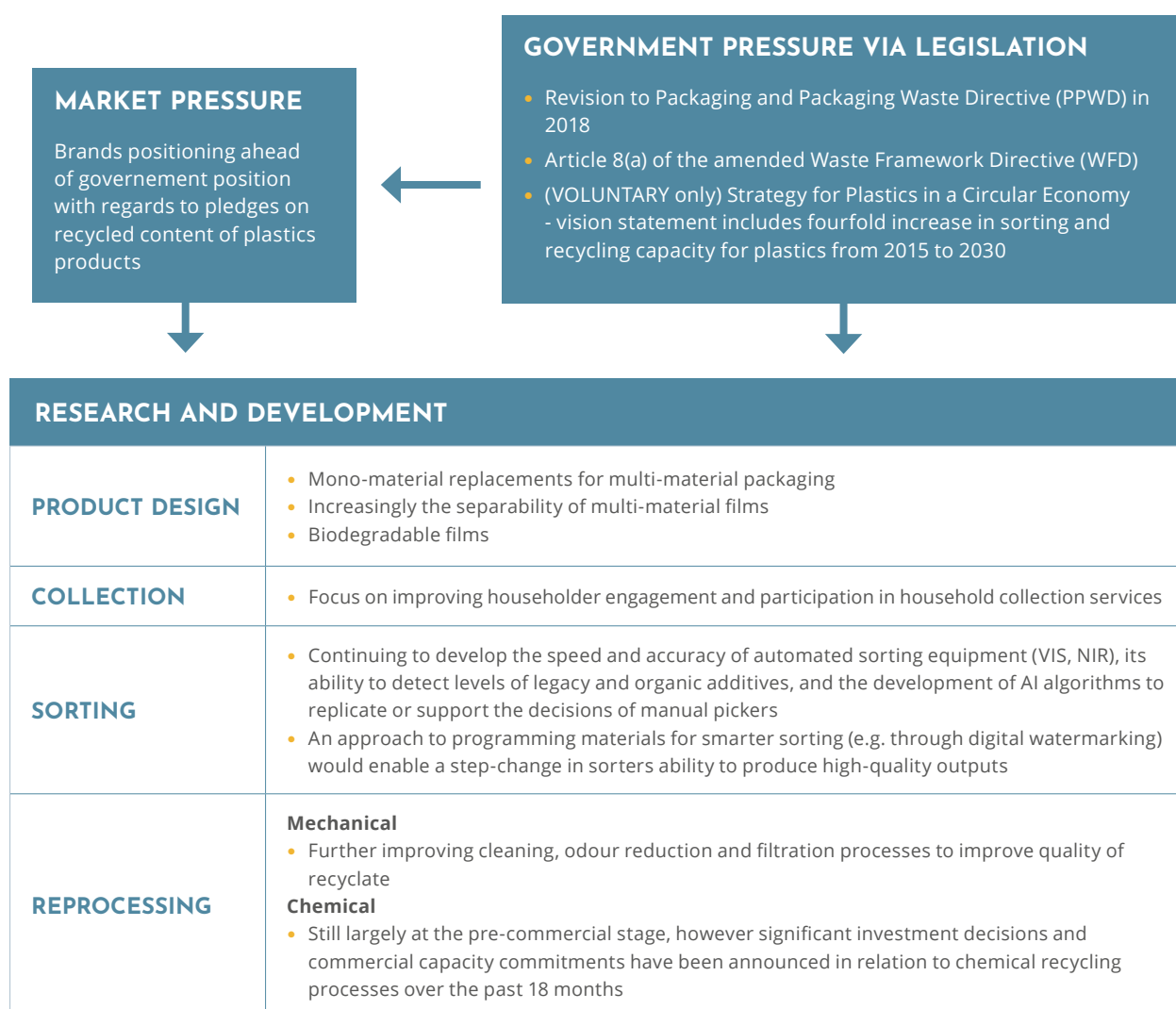


FIGURE 12: Changes across the Flexible Films Market

LEGISLATION AND INDUSTRY COMMITMENTS

The following legislation will result in changes to both the collection and sorting of plastic for recycling within the EU27:

- The revision to the Packaging and Packaging Waste Directive (PPWD) in 2018 established in European law a 50% target for the recycling of plastic packaging by 2025 which rises to 55% by 2030.
- The revised calculation method for reporting against these targets applies stricter and more accurate approaches to the measurement of recycling rates of municipal and packaging waste.
- The PPWD references the amended Waste Framework Directive (WFD), which requires, in Article 8a, that the producer responsibility schemes cover the full net costs of the separate collection of packaging (including for the clean-up of litter), and that the fees charged to producers are modulated according to one or more of a range of criteria, including recyclability.
- Member States and EPR schemes will need to continue improving the quantity of plastics collected and sorted for recycling. EPR schemes should transfer the end-of-life costs of products to producers, and so create an incentive for eco-design (where this reduces end-of-life management costs).

Most of this legislation is focused on providing for collection and increasing the quantity of material collected for recycling (and in turn increasing the quantity recycled). However, there are policy gaps regarding integration of recycled content in products to support demand, and in measures to support the quality of material collected and sorted, and of the recyclate produced.

In 2018, the European Commission published its 'Strategy for Plastics in a Circular Economy', announcing within its vision statement a fourfold increase in sorting and recycling capacity for plastics from 2015 to 2030, inviting voluntary commitments and pledges from industry groups across the supply chain.³⁶ The European Commission has also launched the Circular Plastics Alliance.³⁷ The signatory organisations to the alliance (which include over 175

organisations representing industry, academia and public authorities) 'take action to boost the EU market for recycled plastics to 10 million tonnes by 2025'. A separate initiative, the European Plastic Pact (EURPP) was created to bring together government and industry across the whole value chain, to work together to address challenges of design, responsible use, recycling capacity and use of recycled content for packaging and single-use plastics.³⁸

“ IN 2018, THE EUROPEAN COMMISSION PUBLISHED ITS 'STRATEGY FOR PLASTICS IN A CIRCULAR ECONOMY', ANNOUNCING WITHIN ITS VISION STATEMENT A FOURFOLD INCREASE IN SORTING AND RECYCLING CAPACITY FOR PLASTICS FROM 2015 TO 2030, INVITING VOLUNTARY COMMITMENTS AND PLEDGES FROM INDUSTRY GROUPS ACROSS THE SUPPLY CHAIN.”

TECHNOLOGY RESEARCH & DEVELOPMENT

Research and development (R&D) is needed to provide continual improvement in processes, to solve particular problems in recyclability, and to open up the potential for step changes in how collection, sorting and recycling is optimised for a circular economy.

DESIGN FOR RECYCLABILITY

Design determines whether packaging can be recycled. RecyClass, an initiative and toolkit for checking and certifying the recyclability of packaging, has published design for recycling guidelines for flexible film packaging together with a protocol for evaluating the recyclability of PE flexible films.³⁹ Improvements in recyclability should:

- continue to decrease the use of surface colouring of films, ensuring more recycled polymer is suitable for colour-sensitive product applications (e.g. packaging); and
- reduce contamination from other polymers, adhesives, and fibre, reducing losses in processing and improving the visual and mechanical properties of outputs.

R&D in this area focuses on innovative packaging design that tackles recyclability challenges whilst meeting the function and brand requirements of packaging. One example is the development of new monomaterial flexible packaging in place of multi-material flexible packaging. The recently developed Biaxially-oriented Polyethylene (BOPE), for instance, allows for stronger mono-material PE flexible packaging, reducing the need for other polymers or materials. Additionally, research is ongoing into design alterations to multi-material, multi-layer films, for example in the use of 'detachable' adhesives between layers to separate the different polymer types. PET-G (PET with added glycol) can also be used to increase the separability of PET layers from other materials.⁴⁰

SORTING

Near Infra-Red (NIR) technologies are widely used in sorting plants to sort specific polymers from each other and to remove contaminants. Ongoing development of NIR sorting technology has already provided an increasing ability to sort smaller items with increasing accuracy, including sorting material post flaking operations.

R&D into a number of areas has been proposed to better sort flexible films.

Induction sorters can sort metal and trials suggest it has a higher efficiency than eddy-current separators when sorting foil laminated packaging, though they are more costly. Information embedded in packaging, for example, digital watermarking of products, would enable a step-change in sorters' ability to control the quality of sorted output streams, allowing specific problematic products to be removed, or desirable products to be selected, in a highly targeted way.

RECYCLING

Hot-washing of plastic flake, often with added caustic soda or other detergents, reduces the levels of inks, adhesives, organic contamination, odours and microorganisms, improving the suitability of flake for a wider set of outputs. However, hot-washing is not widely used in the recycling of flexible films. Other methods might be used, to include sink/swim and friction/density split separation.

Fine filtration during extrusion further removes physical contamination, while decontamination through vacuum-based degassing, whether in flake form or during extrusion, provides a final step in removing volatile compounds and gases.

R&D is ongoing in further improving the de-inking, degassing, odour reduction and filtration of recyclate to improve quality. The measurement of composition needs to improve and the presence and use of additives and stabilisers to be better understood.

A key focus for R&D related to cleaning is removing surface-printed inks and aluminium coating through the use of surfactant-alkali and alkali solutions or other techniques, since the presence of inks and aluminium coating results in darker colour and lower value recyclates. However, these methods are not currently economically viable for removing ink from household films during recycling.^{41,42} Other cleaning R&D focuses on contaminants such as organics, paper, and adhesives, through the use of friction washing and altering variables including temperature, pH and surfactant type and concentration.

Approaches to odour reduction being developed include counter odour (such as citrus or vanilla) into the extrusion of secondary material. Other solutions being researched include microporous additives, neutralizing agents (for reducing the volatility of odorous compounds), and stripping agents (for removing volatile compounds by degassing during extrusion).⁴³

Development is also ongoing in improving filtration technologies (which remove lumps, fine particles and other polymer contamination).⁴⁴

CHEMICAL RECYCLING

Chemical recycling of plastics generally refers to a range of different processes that can break down or depolymerise polymers into their original monomers or other chemical feedstocks to then create new polymers. These processes are still largely at the pre-commercial stage; however, they are generating interest as a replacement for unsustainable feedstock sources.

The main processes applicable to PE (and PP) flexible films are as follows:

- Solvent-based purification – dissolving the polymer in a specific solvent, removing additives and impurities through filtration or phase extraction, and precipitating the polymer using an appropriate anti-solvent. This kind of process may not remove all impurities and does not restore the chain-length of polymers. Thus the output of current technologies is more comparable to that from mechanical recycling.⁴⁵
- Pyrolysis – using heat (without oxygen) to break down polymers into smaller hydrocarbon molecules, resulting in a hydrocarbon mix resembling the composition of oil. The output can be used as fuel or refined using conventional refining processes to produce value-added chemicals including building blocks for polymers.⁴⁶

Solvent-based purification processes for PE and PP are still largely at the pre-commercial stage. Industry-scale pyrolysis has failed in the past, but new pilots are emerging. According to Suschems' recent research report, high costs of utilities, low yields, and low-quality of the final product need to be addressed in order to make these processes more financially, industrially and environmentally attractive.⁴⁷ However, with increased focus on circular industrial processes, considerable scale-up effort is underway by a number of chemical industry players, including major resin producers such as BASF, Dow, Sabic and Eastman.

Development of chemical recycling capacity at scale is likely to be necessary in the longer term to improve the recycling of more difficult to recycle film and flexible packaging streams such as multi-material films. However, it is doubtful whether chemical recycling will scale up quickly enough to make a meaningful contribution to EU packaging recycling targets for 2025 and 2030.

5. WHERE NEXT ?

This section draws together our analysis of the current state of the flexible films market and the key challenges facing reprocessors in order to reflect on the future state of the market. This is set into the context of recent legislative changes and industry developments, and where/how the supply chain should focus its efforts going forward in order to provide a robust view on the markets as it continues to develop.

- **THE RECYCLING OF PE FLEXIBLE FILMS WITHIN EUROPE HAS THE POTENTIAL TO MORE THAN TRIPLE IN SIZE OVER THE NEXT DECADE, IF COLLECTION AND RECYCLING RATES CAN BE RAISED TOWARDS TARGET RECYCLING RATES FOR OVERALL PLASTIC PACKAGING.**
- **IT IS ESTIMATED THAT PE FILM PRODUCT SECTORS COULD INCORPORATE 36% RECYCLED CONTENT OVERALL: IN-EU DEMAND FOR PE COULD REQUIRE 3.6 TO AROUND 5 MT OF PE RECYCLATE BY 2030 COMPARED TO JUST 1.8 MT IN 2018.**
- **THERE ARE POLICY AND R&D GAPS WHICH THE INDUSTRY NEEDS TO WORK ON, TOGETHER WITH POLICY-MAKERS, TO ENSURE THAT INCREASED QUANTITIES OF COLLECTED FILMS CAN BE PROCESSED INTO HIGHER-QUALITY RECYCLING OUTPUT AND USED AT A GREATER SCALE IN PRODUCING MORE FILM PRODUCTS.**

FUTURE STATE OF THE MARKET

DEMAND FOR FLEXIBLE FILMS IN PRODUCTS

Demand for flexible film packaging is likely to continue to grow. Whilst total consumption of bags and sacks reported to Eurostat is at a level comparable to consumption in 2011, consumption of all film and sheet reported to Eurostat has grown 22% from 2010 to 2018. Even though the use of biodegradable plastic film has increased in market share, it is likely to remain suitable only for a limited number of film applications with a small proportion of overall market tonnages.

Products should be increasingly made in accordance with design for recycling guidelines, helping to:

- encourage the use of more recyclable PE film and discourage use of PVC and PET films;
- continue to decrease the proportion of coloured films, ensuring more recyclate is suitable for colour-sensitive product applications (e.g. film packaging); and
- reduce surface-printed inks, adhesives and paper fibres, thereby reducing losses in processing and improving the visual and mechanical properties of recyclate.

INCREASING COLLECTION RATES

European targets for the recycling of plastic packaging waste should continue to drive improvements in collection services, although no specific target applies to flexible films. Only 65-70% of the population of Europe (EU28+2) live in countries where the predominant household recycling services (provided door-to-door or via bring sites) cover PE film and flexible packaging (see Figure 6), therefore there is scope for increasing tonnages collected from improving service coverage, as well as improving captures of films into recycling collections where they are provided.

Recycling rates should increase in the near term, driven by momentum in policy and industry to improve recyclability, collection and sorting. Increased recycling of PE film will contribute to the overall 50% recycling rate for plastic packaging for 2025. If PE film recycling were to reach up to a 50% recycling rate, in the region of 6 Mt of sorted bales of PE film would be available for recycling, taking into account yields at recyclers and prior to factoring in growth in overall arisings (see Figure 13).⁴⁸ Flexible films may make a lower contribution than other plastics to the overall targets.

EPR schemes for agricultural plastics can be effective at ensuring agricultural films are collected and recycled (the Irish scheme has a recycling rate in excess of 70% compared to the current EU28+2 estimate of 34%).⁴⁹ However, EPR schemes for agricultural plastics are not currently mandated by the EU, and only exist in seven countries (see Figure 7). The European Commission is currently conducting a study to help ensure that agricultural plastics are managed appropriately across the EU in line with the objectives of the Plastics Strategy, which may inform development of specific policies in this area.⁵⁰

RECYCLING CAPACITY AND RECYCLATE PRODUCTION

Estimates for the tonnages of sorted PE film inputs to recyclers at different PE film packaging recycling rates (progressing up to 50%) are shown in Figure 13. The bars show the total tonnage (inclusive of non-PE content) sent for recycling, whether in Europe or exported. The black line shows the total input tonnages (excluding post-production scrap) into European recyclers in 2018.

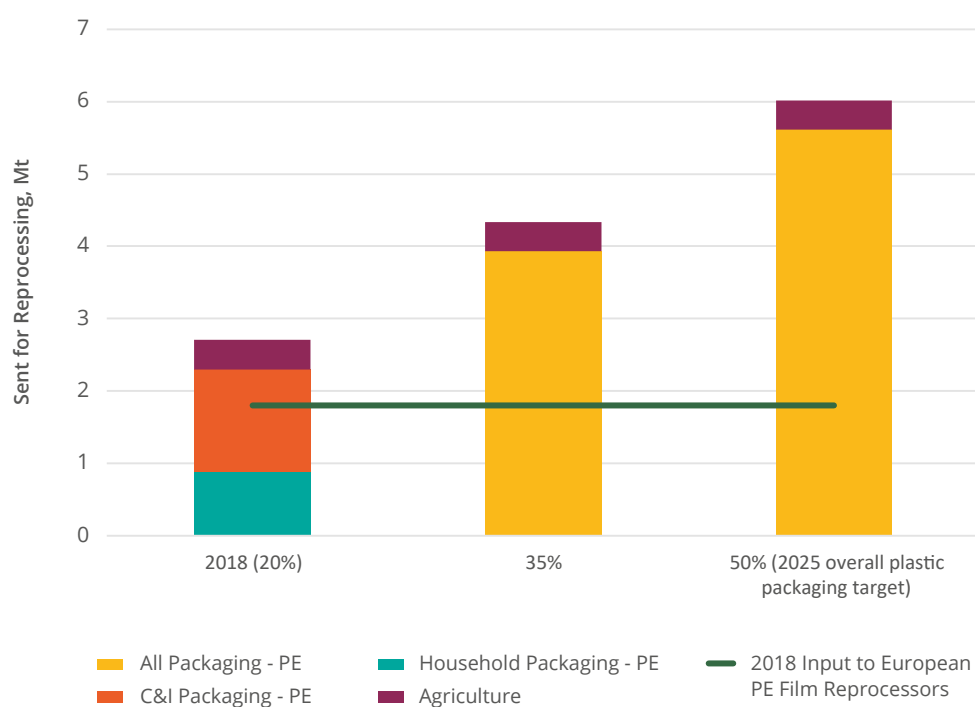


FIGURE 13: PE Film Input Volumes at Different Recycling Rates of Packaging Flexible Films, Mt

As shown in Figure 13, if recycling of PE films is to match the targets for plastic packaging overall, the tonnage requiring recycling would more than double by 2025 and reach 6.6 Mt by 2030. This may be even higher when growth in arisings over the time period is factored in. Improvements in the design for recycling and bale quality should increase reprocessor yields from packaging film streams, reducing the overall input tonnage required to produce the same amount of recyclate.

Current European-based recycling capacities for flexible films fall short of the supply of films for recycling. As shown in Figure 13, recycling 50% of PE flexible films

placed on the market would require over three times the current European recycling capacity.⁵¹

There is also estimated to be in the region of 2 to 2.5 Mt of PP flexible films currently available for collection and recycling annually. If viable sorting and recycling routes for PP flexible films can be established, then achieving a 50% recycling rate, for instance, would mean (supposing yield performance at the higher end of PE flexible film recycling due to higher quality sorting) in the region of 1.3 – 1.6 Mt available for recycling, producing in the region of 1 to 1.25 Mt recyclate from PP flexible films.⁵²

THE MARKET - RFLEX

Whilst recycle from films cannot be used for food packaging applications, there is potential to substantially increase the use of recycled content within most other major film market sectors, as shown in Table 3.

	Current estimate of use of recycled content across EU28+2 (%)	Future estimate of potential use of recycling content across EU28+2 (%)
Film and Foil (Non-food)	12%	40%
Refuse Bags	68%	90%
Other Bags	18%	70%
Agricultural Films	22%	39%
OVERALL FLEXIBLE FILM PRODUCTS	14%	36%

TABLE 3: Future Markets (source: PRE Market Experts)

Depending on the growth rate of PE flexible packaging production up to 2030, this would equate to a total potential demand for PE flexible films recycle for film products of between 3.6 Mt (at 1% annual growth) and 5 Mt (at 4% annual growth) by 2030.

The use of recycle for film applications will depend on achieving sufficient quality from enough recycle for use in film-blowing, as well as the relative demand for the manufacture of non-film products such as pipes. Only a relatively small additional amount of recycle (up to 200kt) is likely to be able to be used in refuse bags, one of the main current applications for household films.

Recycle from PP film may be utilised alongside other PP recycle in other PP pipe and injection-moulded products, though some may be suitable for film to film products.

Understanding further the limitations of utilising recycled content for different sources in different product applications – mapping end markets against barriers – would allow for a more detailed assessment of prospects for recycle uptake.

MARKET SUPPORT

Various pieces of legislation have come into force to support the recycling of plastics. However, there remains a number of policy and R&D gaps to increase the quantity of material collected that can also feed high-quality recycling output into more mature markets. This requires collaboration between industry and European policy makers.

A COMMON APPROACH TO ASSESSING RECYCLABILITY

CITEO in France, and to a lesser degree CONAI in Italy, use eco-modulation of fees to provide specific cost incentives for producers to ensure products meet recyclability criteria. Eco-modulated fees should be used across all EPR schemes as a key way of helping meet increased targets for the recycling of plastic packaging.

For calculation of eco-modulated fees, and to provide additional clarity to brands who are aiming to increase the recyclability of their packaging, a common framework is needed. Recyclability should be assessed in the same way across the industry, underpinned by a clear definition, and with claims of recyclability tested against reliable protocols. This framework needs to be based upon:

- technical data and current/latest processes; and
- capacities of recyclers to recycle products without prohibitive cost.

In addition, such a framework should be:

- updateable in response to developments in technology and processes; and,
- able to assess recyclability at the level of individual products.

RecyClass could provide the basis for such a framework, with protocols already in place for the assessment of PE films, and developing protocols for PP films.⁵³ PRE has also already released a definition of recyclability in co-operation with APR, taking into account the viability of collection and recycling, further referred to in section 3 ('Quality: Recyclability').

SORTED PACKAGING BALE QUALITY STANDARDS

High levels of contamination within sorted bales, particularly from household packaging, increases the cost and complexity of recycling operations, and high quality recycled flexible film materials. Where PRO are involved in contracting sorting plants, such as CITEO in France, or Green Dot in Germany, there is a greater opportunity to mandate a certain quantity of outputs. Common European quality standards for sorted packaging waste bales could be agreed and implemented across the industry, which would place the onus on collectors and sorters to reduce problematic contamination within sorted bales. If the required bale standards cannot be achieved by better quality sorting of plastics collected with other materials (paper and glass), then the industry should consider the collection of plastics recycling separately from paper and glass.

CERTIFICATION PROCESS FOR RECYCLED MATERIAL

Responding to consumer awareness, brands are making commitments to integrating recycled content into their products. There is currently no certification process in place to verify the claims made by brands and producers to guarantee the quality of the recycled material they are incorporating. There is a need for greater certification and traceability in the supply chain, the components of which should be:

- an EU-wide quality certification (comparable to an EN643 standard for paper) for recycled polymers; and,
- a Chain of Custody (CoC) certification management system of an unbroken chain of organisations legally owning the material throughout the supply chain, from the certified recycler output into the final product.

This would allow brands and producers to meet internal targets or legislative requirements regarding recycled content with confidence in the traceability of the material. It would also ensure that commitments to incorporate recycled content will create equivalent demand for certified recycled output from reproducers. A possible distinction between certified recycled waste and reprocessed production waste needs to be secured by unweaving the material streams.

EUCertPlast, created by PRE, EPRO, EuPC and Recoviny, is an existing quality certification scheme based on the European Standard EN 15343:2007. It is recognised by German and Italian authorities and could form the basis for an EU-wide certification.^{54,55}

FURTHER R&D

To achieve a step-change in the technological potential of current sorting machinery, producers and brands should align behind an information solution for product packaging, such as digital watermarking, that opens up new opportunities for targeting sorting of high-quality output flexible films streams.

In addition, to achieve an increase in recycling rates of flexible films, further research is required to explore design opportunities to enable the separation of multi-layer films into their constituent polymer types, thereby improving recyclability of the various film types.

Finally, more information and research into the use of additives within flexible films is needed, in order to understand what is present in recycle and how that affects its potential uses.

ROBUST DATA SOURCES

Whilst this report goes some way to examining the state of the flexible films market, it has also identified a number of data gaps regarding the total flexible films supply chain and how it is changing over time. This data is needed to ensure that the EU continues to develop appropriate capacity and technology to meet the demands of the changing world of packaging.

To improve the data and enable better tracking of progress towards higher recycling rates for flexible films, there is a need for EPR schemes to publish information on tonnages of flexible films placed on the market by polymer, colour, size and sector, as these are relevant to different recycling streams.

To understand the evolving market for flexible films recycle there is a need for the flexible films recycling and recycling sector to produce better resolution on the amounts of non-PE and non-film/flexible packaging in sorted film bales.

To understand the recycling routes and destinations of smaller flexible film products, better data is needed on the amounts and types of flexible films in mixed plastic and reject streams from MRFs.

A FINAL NOTE

In order to support the growth in recycling of flexible films industry and policy makers need to work together to:

Improve the recyclability of flexible films, through the creation of a common approach framework for product-level recyclability assessments, and an agreed definition for recyclability. This needs to be supported with the development of bale quality standards, and improved, comprehensive collection systems for flexible films.

Continue to improve technology in the recycling process, to cost-effectively improve cleaning of contaminants and odours from recycled materials and increase the quality of outputs.

Improve markets for recycled material, by developing a certification process for the quality of recycled polymer resins, and compounds, and the use of certified material within product applications. Explore the best approaches to raising recycled content use across major flexible films product groups, and continue efforts to address the barriers for recycled films in end market product applications.

Provide support to make the recycling of more challenging flexible film streams viable. The level and variability of virgin prices of PE for flexible films means that the costs of recycling household flexible films to a higher quality typically exceeds the revenues available. The business model for recycling streams with greater quality challenges needs a greater level of support.

Build European recycling capacity to reprocess a greater proportion of PE flexible films collected for recycling and reduce exports, ensuring best practice recycling and supplying European demand.

Understand commercial limitations for sorting and recycling of flexible PP films, to unlock a new processing market, and achieve increased recycling rates for flexible films.

We would like to take this opportunity to thank the PRE members and experts who participated in the creation of this report.

We end with a call to all PRE members to help us to get the additional data listed so that we can continue to build on our understanding of the state of the market, enable forward planning, work on your behalf to engage relevant supply chain players at the right time to help investment decisions, and ultimately keep as much flexible films in the European supply chain as possible, for as long as possible.

ANNEX

1. PRE market expert. Excluding 0.5 Mt production scrap not counted as recyclates.
2. Eurostat, PRODCOM: Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data (DS-066341); last accessed: 28/04/2020 <https://ec.europa.eu/eurostat/data/database>; PRE mapping data.
3. Eurostat, PRODCOM: Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data (DS-066341); last accessed: 28/04/2020 <https://ec.europa.eu/eurostat/data/database>.
4. PRE Market Experts.
5. Eurostat, PRODCOM: Statistics on the production of manufactured goods, Sold production, exports and imports (DS-056120); last accessed: 14/04/2020 <https://ec.europa.eu/eurostat/data/database>.
6. See note 5.
7. See note 5.
8. Experts from the market agreed on this figure.
9. See note 5.
10. Based on market expert information and the ratio of PE to other materials in food packaging, Axion Consulting (2016) Reflex Project Summary Report.
11. Science Direct (2018) Manipulating Dielectric Properties by Modifying Molecular Structure of Polymers, <https://www.sciencedirect.com/topics/engineering/biaxially-oriented-polypropylene>.
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13. Don, Davis (2019) European consumers shop more online—and with Amazon, <https://www.digitalcommerce360.com/article/european-e-commerce/>.
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17. Modor Intelligence (2019) Agricultural Films Market - Europe Market Shares, Trends and Forecasts (2020 - 2025), <https://www.modorintelligence.com/industry-reports/europe-agricultural-films-market>.
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20. Press, E. (2018) Cicloagro cesa su actividad como sistema colectivo de gestión de plásticos agrícolas en Andalucía, accessed 30 April 2019, <https://www.europapress.es/andalucia/noticia-cicloagro-cesa-actividad-sistema-colectivo-gestion-plasticos-agricolas-andalucia-20180419161643.html>.
21. PRE Data Mapping.
22. PRE Press Release (2018) Plastics Recycling Grows in Europe.
23. Representative of 2.2-2.3 Mt input tonnage (including 0.5 Mt production scrap) as a proportion of 2.5 Mt input capacity.
24. PRE Market Experts.
25. PRE (2019) Flexible polyethylene recycling in europe: accelerating the transition towards circular economy. Available online at: <https://www.plasticsrecyclers.eu/plastics-recyclers-publications>.
26. Based on a comparison of market data on PE films sent for recycling with amounts recycled by stream.

27. Since Eurostat data on PE exports also includes sorted bales of HDPE, Eurostat data alone would imply an export weight of PE film bales at some level below 950kt.
28. PRE (2019) Flexible PE film recycling.
29. See note 1.
30. Including awareness raising measures, labelling and promoting best waste management practices.
31. More information available at <https://recyclclass.eu/>.
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33. There is a high percentage of transparent PE films used in this sector and lower levels of other materials in collected streams, making the recycling of these easier compared with other industry segments.
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38. For more information see <https://europeanplasticspact.org/>.
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51. Comparing 6 Mt input tonnage needed for 50% recycling rate, with 1.8 Mt input to European reproducers in 2018.
52. Figures presented based on 50% recycling rate and 80% yield (at the higher end of PE film yields, assuming improved recyclability and higher quality sorting).
53. RecyClass, <https://recyclclass.eu/>.
54. Full scheme details available at <https://www.eucertplast.eu/downloads-links>. EuCertPlast certification of PE Film recycling capacity rose from 27% to 36% of EU28+2 installed capacity between 2018 and 2019.
55. Bund/Länder-Arbeitsgemeinschaft Abfall (LAGA, <https://www.laga-online.de/>) and Consorzio nazionale per la raccolta, il riciclaggio e il recupero degli imballaggi in plastica (COREPLA, <http://www.corepla.it/>).



PLASTICS RECYCLERS EUROPE

Avenue de Broqueville 12,
1150 Brussels - Belgium
+32 2 315 24 60
info@plasticsrecyclers.eu
www.plasticsrecyclers.eu