# 2023 FLEXIBLE FILMS MARKET IN EUROPE

## STATE OF PLAY

### PRODUCTION, COLLECTION AND RECYCLING DATA

PLASTICS RECYCLERS EUROPE

I·C·I·S
Independent Commodity Intelligence Services

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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 to produce 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 industry representing over €8.7 billion in turnover, 11.3 million tonnes of installed recycling capacity, more than 730 recycling facilities and over 30,000 employees.

# ABOUT ICIS

Independent Commodity Intelligence Services (ICIS) connects data, markets, and customers to create a comprehensive trusted view of global commodities markets, enabling smarter business decisions that help optimise the world's resources.

ICIS helps businesses across the chemical, fertilizer and energy markets make strategic decisions, mitigate risk, and capitalise on new opportunities. A trusted source and benchmark for price information and insight across key commodities markets worldwide. Our independent, transparent market intelligence informs thousands of quality decisions every day, taking the pressure out of negotiations and giving customers space for more innovative thinking.

# 1

# INTRODUCTION

This report, published by PRE in partnership with ICIS, provides latest data and trends on:

- the current state of flexible films market in Europe including production, demand, collection, and recycling;
- key constraints and challenges faced across the flexible films value chain;
- key factors driving future growth of flexible films recycling; and
- way forward to develop a robust system for flexible films recycling in Europe.

This is the second iteration of this market report with the first one published in 2020. PRE intends to continue to update and re-publish this 'State of Play' report biennially to provide a periodic narrative and assessment of the progress of flexible films recycling in Europe.

While the reference year for data used in this report is 2020, updated positions on legislations, challenges faced, market drivers and other current developments over the past year are also discussed within this report. Whilst the aim of this report is to provide data and narrative on the EU27+3, in some instances we have deviated from this due to data availability but made reasonable estimates wherever possible to provide a regional perspective.

This report uses the best available sources to present quantitative data estimates and qualitative insights, alongside results from market research with industry players and experts across the flexible films value chain. The data available in this report mostly reflects the current state of the flexible PE market since the market for PP flexibles is still developing. PRE has also supported with a survey of its members to improve data estimates with figures collected directly from facilities. We would like to express our deepest gratitude and thank PRE and their members, industry participants and market experts who have participated and contributed to the development of this report. We hope you would like this collaborative effort in providing a greater transparency to the rapidly evolving market landscape.

# 2.

# FLEXIBLE FILMS VALUE CHAIN OVERVIEW

**An overview of the flexible films value chain is presented in Figure 1 to outline the context of circular economy for flexibles through the different stages of production, demand, end-of-life, collection / sorting and recycling.**

Flexible films are produced from virgin polymers and recyclates at the converters' plant (converter demand) to be utilized for packaging of goods and other film applications (placed on the market). Once the flexible films have served their purpose and reached their end-of-life, they are disposed-off by the consumer and enter the waste management system. Waste flexible films are first collected, either via kerbside collection or by private waste management companies, depending on the source of waste. They are then sorted into various bales and taken to the recyclers. Bales of waste flexible films go through sorting once again at the recyclers' plant and recycled into pellets. These recyclate pellets are processed again into packaging or other applications by the converters.

The key elements of this value chain have been further elaborated in the analysis of flexible films market for Europe within this report.

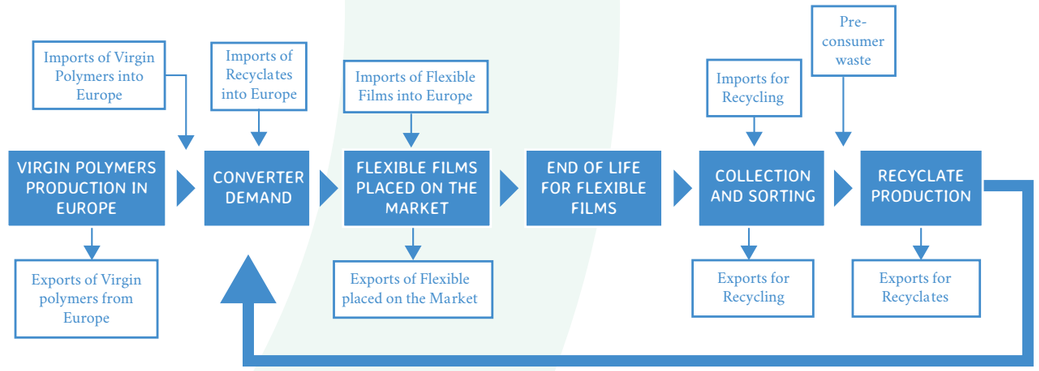



*Figure 1: Flexible films lifecycle in the circular*

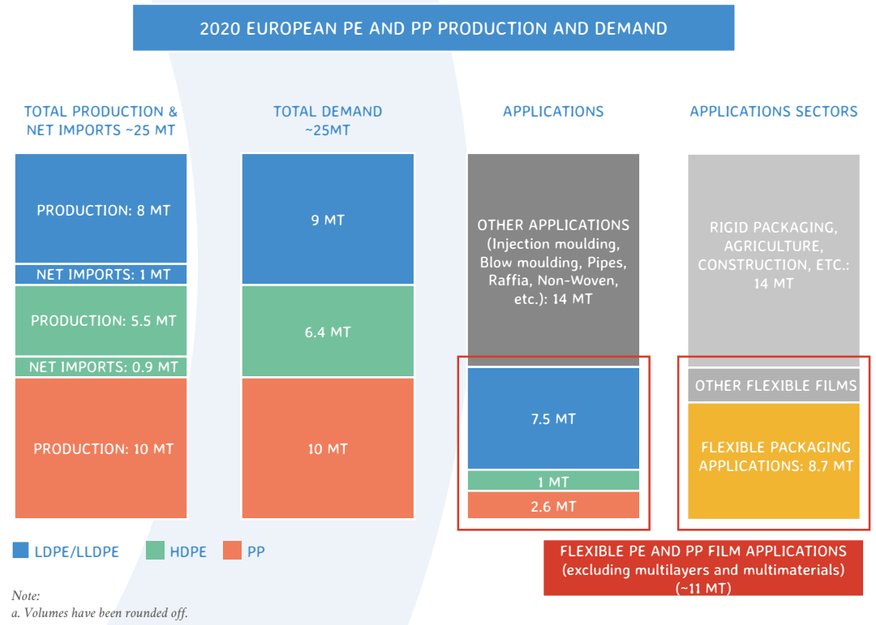
3.

# POLYMERS PRODUCTION AND CONSUMPTION

## TOTAL PE AND PP PRODUCTION AND DEMAND IN EUROPE

- 2020 European PE & PP demand was affected by COVID-19 but has seen swift recovery from 2021.
- PP & PE demand is expected to grow at CAGR 2.4% during 2020-2025 while production is expected to increase by about 1.5 million tonnes by 2025.

In 2020, the combined Polyethylene (PE) and Polypropylene (PP) total production (rigids and flexibles) in the EU27+3 region stood at about 23 million tonnes. The region's converter demand for PE and PP reached about 25 million tonnes and around 5 million tonnes of PE and PP were imported in 2020. Considering the trade flows, the region was a net importer (imports minus exports) of 2 million tonnes of PE and PP, LLDPE accounting for the vast majority of net imports. Figure 2, shows an overview of PE and PP value chain in Europe, highlighting flexible films applications that will be further detailed in the next subsections.




*Note:*
*a. Volumes have been rounded off.*

*Figure 2: Overview of PE and PP Market in Europe, focusing on flexible film applications. Source: ICIS Supply & Demand Database, ICIS Analysis.*

Both production and demand of PE and PP figures in 2020 have been impacted by the COVID-19 induced economic slowdown. While production figures declined around ~1%, demand dropped by 4% in relation to 2019. Despite the negative impact in 2020, demand recovered by healthy ~4% (1 million tonnes) in 2021, summing 26 million tonnes. Production, on the other hand, kept at 24 million tonnes in 2021, due to the overall industry activity slowdown.

### The Impact of COVID-19 on PP and PE Converter Demand in Europe

Europe was strongly affected by the spread of COVID-19 between Q1 and Q2 2020, but LDPE and LLDPE converter demand did not fall as low as expected thanks to a peak in demand for packaging applications. Because people were going out less, spending in supermarkets and e-commerce increased, boosting food packaging use. Additionally, COVID-19 also led to an increase in the use of secondary packaging due contamination concerns. When analysing the impact by polymer, LLDPE demand witnessed the smallest year-on-year decline in 2020 (~1%), strongly favoured by higher prices of LDPE during the period. LDPE, on the other hand, faced a demand drop of over 3% year-on-year due to the reduced industrial activity and higher prices, while HDPE demand declined by ~2% year-on-year. PP witnessed the largest demand decline (~6% in relation to 2019) as a result of reduced demand for consumer durables. Because of the economic uncertainty, consumers tended to postpone non-essential expenses, directly impacting the demand for durable goods.

As indicated in Figure 3, PE accounts for the majority of PE and PP converter demand in Europe (61%), reaching ~15.5 million tonnes in 2020, while PP follows second with a demand of 9.8 million tonnes. The largest application for the combined PE and PP demand is flexible films at 42%, followed by injection moulding (25%) and blow moulding (11%).

Moving forward, the combined PP & PE demand is expected to grow at CAGR 2.4% during 2020-2025, reaching over 28 million tonnes in 2025, while production is expected to increase by about 1.5 million tonnes by 2025, growing at a CAGR of 1.2% during the same period.

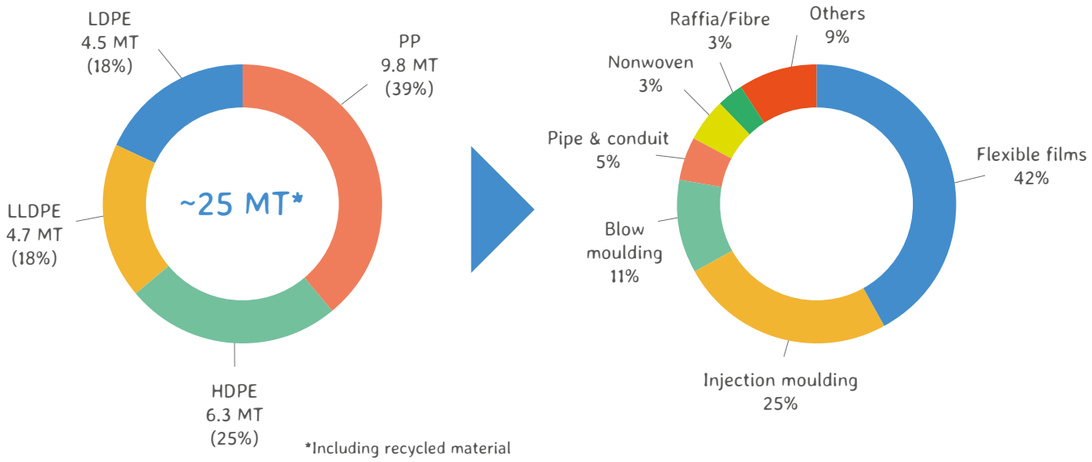



*Figure 3: Converter demand by polymer and by application in Europe in 2020.*
*Source: ICIS Supply & Demand Database and ICIS Research & Analysis.*

# KEY POLYMERS FOR FLEXIBLE FILM APPLICATIONS IN EUROPE

- **2020 European PE and PP demand towards flexible films was around 11 million tonnes.**
- **LDPE and LLDPE are the key polymers for flexible film applications, accounting for more than half of the consumption.**

Flexible films are comprised of several polymers. PE (including mainly LDPE and LLDPE as well as some HDPE) and PP represent by far the largest volumes, but other polymers such as PVC, PA, PET, etc. are also used in the production of flexible films.

The combined PE and PP consumption for the production of flexible films stood at about 11 million tonnes in 2020. PE accounted for the vast majority of flexible films applications representing 77% of the total, whereas PP represents the remaining 23%, as shown in Figure 4. 15% of PE and PP consumption into flexible films was covered by recycled LDPE.

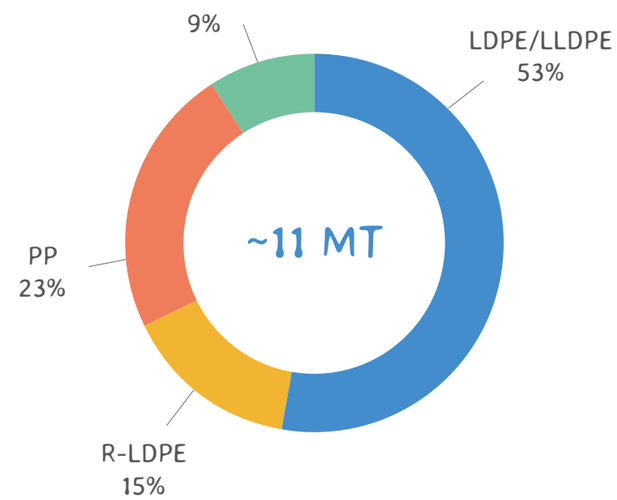



*Figure 4: Consumption of PE and PP in flexible films in Europe in 2020.*
*Source: ICIS Supply & Demand Database, ICIS Analysis.*

In Europe, LDPE is expected to gradually lose its share to LLDPE in some applications driven by the cheaper and better performing characteristics of LLDPE especially in the packaging segments of food and non-food films. However, in other applications such as shrink film and extrusion coating, penetration of LLDPE has so far been low.

# EUROPEAN FLEXIBLE FILMS BY INDUSTRY SECTORS

**Commercial & Industrial was the largest application of flexible films (39%) in Europe in 2020, followed by Bags and Sacks (24%) and Food packaging (23%).**

Figure 5 illustrates the breakdown of PE and PP films converter demand in Europe in 2020. Commercial & Industrial is the largest sector in flexible films (39%), comprised mainly of stretch (17%), shrink (13%) and film on reel (9%) sub-uses. Bags & Sacks is the second largest group (24%), including heavy duty bags (7%), carrier bags (5%), refuse sacks (6%) and other bags/sacks (6%). Agricultural films (6%), Building & Construction (3%) and Others (5%) account for the rest of the PE and PP films.

Within LLDPE demand uses, the Commercial & Industrial and Building & Construction sectors are expected to witness the highest growth at CAGR of about 2.4 % during the next 5 years, followed by Food Packaging at about 2%. LDPE film consumption will also be driven largely by these segments, albeit at lower growth rates of about CAGR 1% and 0.7% respectively, owing to the relative saturation of the LDPE market. It is estimated that over 80% of the flexible films are covered by the EU packaging legislations[1]. The PPWD review proposal launched in November 2022, proposed targets for recycling rates of plastic packaging of 50% by 2025 and 55% by 2030, with no distinction of polymers/category/formats.

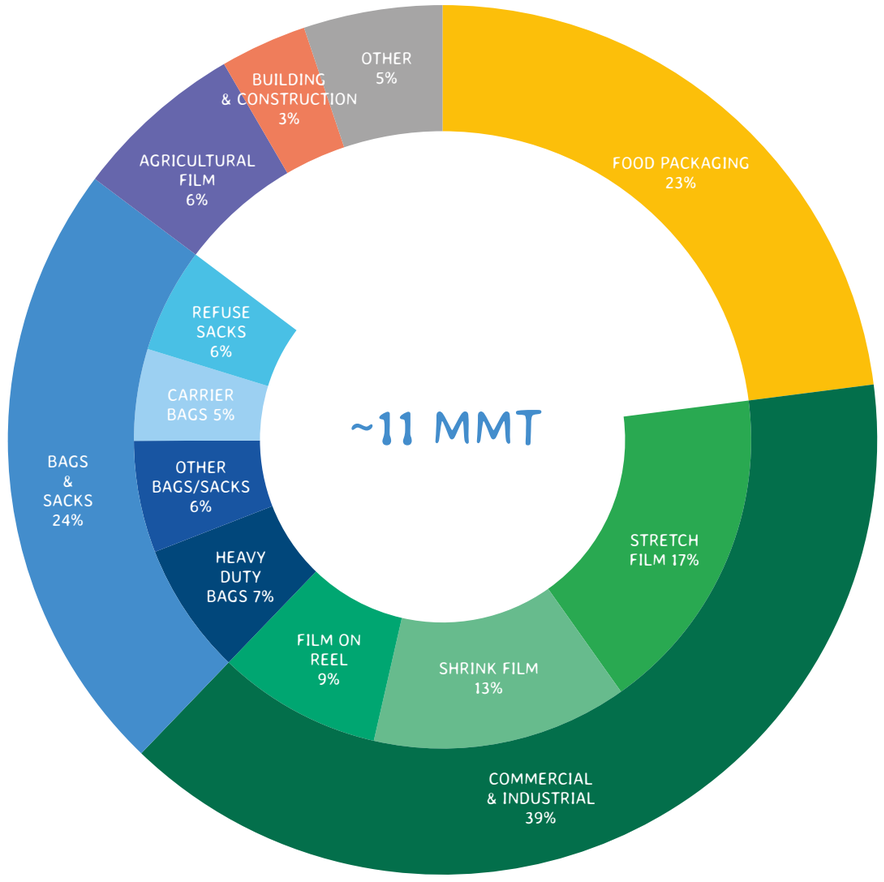



*Figure 5: PE and PP flexible films by industry sector in 2020.*
*Source: PRE, ICIS analysis.*

*1. In September 2020, the EU Commission has published the Regulation No 2022/1616 on recycled plastic materials and articles intended to come into contact with foods, which applies to the placing on the market of plastics materials and articles that can reasonably be expected to be brought into contact with food or to transfer their constituents to food under normal or foreseeable conditions of use. It is the interpretation of the Commission that recycled plastics used in carrier/grocery/shopping bags in grocery stores must meet the requirements of Regulation (EU) No 2022/1616, even if the recycled plastic (for example R-LDPE) is used behind a functional barrier. The functional barrier is considered a novel technology under the new Regulation.*

# POLYMER CONSUMPTION FOR FLEXIBLE FILM APPLICATIONS BY KEY EUROPEAN COUNTRIES

**Over 70% of demand for PE and PP flexible films in Europe was from 6 countries with Germany leading the pack.**

As shown in Figure 6, Germany is the country with the largest share of European PE and PP consumption for flexible films (17%), representing over 1.8 million tonnes. Italy is the second largest market with a consumption of 1.6 million tonnes, followed by France (1.2 million tonnes), UK (870 KT), Spain (850 KT) and Poland (830 KT). These 6 countries accounted for more than 70% of PE and PP consumption into flexibles in 2020.

In 2020, France and Germany witnessed the largest year-on-year demand decline (~3.6% in relation to 2019) of PE & PP towards film applications due to the COVID-19 economic slowdown, while the UK suffered the least (0.7% decline in relation to 2019).

Moving forward, PE and PP consumption for flexible films in Poland is expected to grow the most at CAGR 4.4% during 2020-2025, driven by the country's overall economy growth. Consumption of PE and PP for flexible films in Western Europe is expected to grow at lower pace, reflecting more mature markets: Germany (CAGR 1.6%), France (CAGR 1.2%), and Spain (CAGR 1.4%).

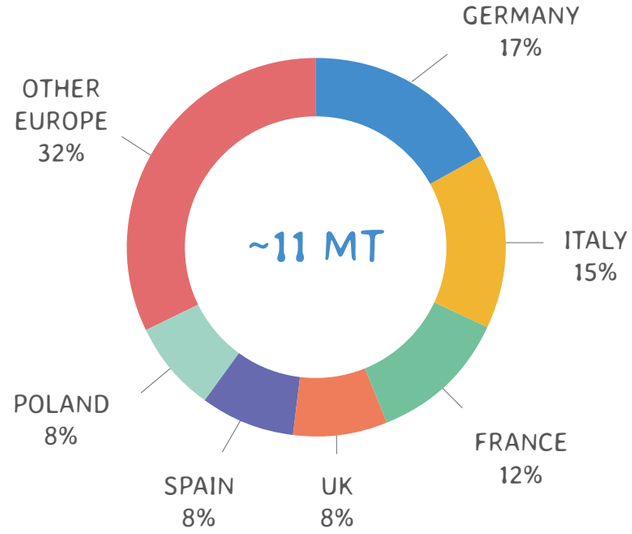



*Figure 6: Consumption for PE and PP films in Europe by country in 2020*
*Source: ICIS Supply & Demand Database, ICIS Analysis.*

# FLEXIBLE FILM APPLICATIONS BY KEY EUROPEAN COUNTRIES

The split of flexible films applications by industry sector varies across the countries of EU27+3 as illustrated in Figure 7 for the 6 top countries in terms of consumption. It reflects overall country's industrial profile, being also influenced by other factors such as consumer behaviour and socio-economic aspects.

Germany, Italy and Poland have the largest share of flexible films being consumed in the commercial & industrial sector. The non-food packaging sector is the largest consumer of flexible films in France and UK, while food packaging ranks the highest in Spain.

Overall, the building & construction and agricultural sectors have a relatively lower consumption of flexible films when compared to others. Spain has the largest share of flexible films going towards agricultural applications across all the countries due to its prominent agricultural industry.

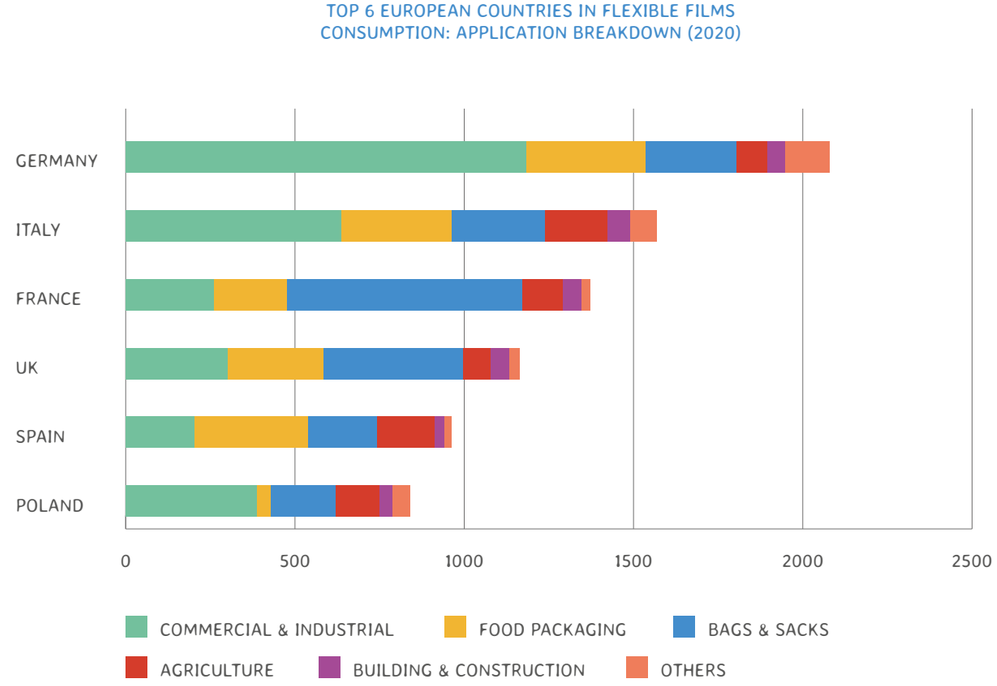



*Figure 7: Flexible films application breakdown for the top 6 largest consumer countries in Europe.*
*Source: ICIS Supply & Demand Database, ICIS Analysis.*

4.

# FLEXIBLE FILMS WASTE COLLECTION AND RECYCLING

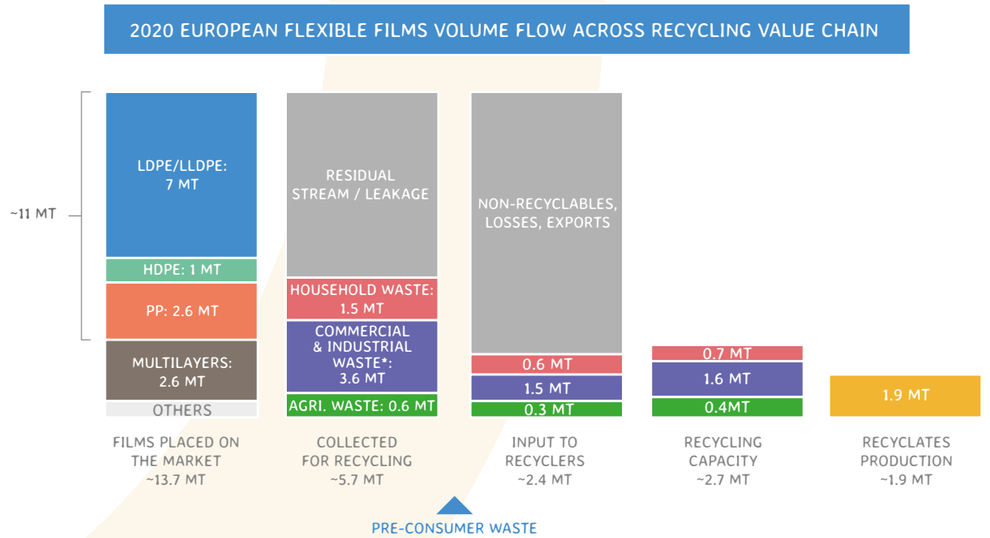
# FLEXIBLE FILMS WASTE MANAGEMENT IN EUROPE

**In 2020, 5.7 million tonnes of flexible films were collected for recycling by separate collection schemes in Europe. However, only 2.4 million tonnes of flexible films were used as input for recyclers in the EU27+3, representing a recycling rate of 18% in relation to the films placed on the market.**

In 2020, a total of 13.7 million tonnes of flexible films were placed on the EU27+3 market, comprising of 11 million tonnes from PE and PP streams and the rest from multi-layers and others. Although separate collection (along with other recyclables) of flexible films has been implemented in most countries, the coverage of these systems to the wider population is still rather limited, as the volume flow in Figure 8 indicates. It is estimated that only 40% of these films placed on the European market were collected for recycling, wherein PE flexible films accounted for a vast majority. While other types of films (such as PP films, multilayers, etc.) were also a part of collected volumes, only limited quantities of PP films and almost no multilayers were sorted for recycling due to the design/processing limitations and they often ended up as rejected fractions that are eventually incinerated.

Following sorting to remove contamination from non-recyclables (including compostable waste, moisture and non-recyclable plastics), only 2.4 million tonnes of flexible films were used as input for recyclers in the region in 2020. This represents a recycling rate of 18% in relation to the films placed on the market.

Waste management systems for flexible films in Europe are designed to cover mainly plastic waste streams from Household, Commercial & Industrial, Agriculture and Building & Construction. The existing flexible films waste management process for each one of these streams will be described in the following subsections.




*Notes:*
*a. Volumes have been rounded off*
*b. Recycling capacity refers to waste input. Both recycling capacity and waste input to recyclers include pre-consumer (production waste)*
*c.*Waste from Building & Construction is included in the Commercial & Industrial Waste Stream*

*Figure 8: Volume flow of flexible films across recycling value chain in 2020*
*Source: ICIS Supply & Demand Database, ICIS Research & Analysis, Market experts.*

## Commercial & Industrial Waste Stream

**Commercial and Industrial waste stream accounted for 3.6 million tonnes of collected volumes consisting of secondary and tertiary film waste such as shrink wraps, stretch films, etc. from logistics firms, supermarkets and other B2B activities. This waste stream is very clean and recyclates produced from this stream tend to go into higher value-added applications. With growing pressure for companies to incorporate recycled content in their products, there has been competition in the market to secure access to this stream.**

The Commercial and Industrial (C&I) waste stream for flexible packaging includes secondary and tertiary film waste from logistics applications, supermarkets and other B2B activities. The film type typically consists of shrink wraps, stretch films, etc. Waste from this stream is of high value as it is much cleaner (as compared to other streams like household and agriculture), with high volumes of mono-material PE films.

Collection and sorting of this stream largely depends on voluntary schemes by the industry, including partnerships across the value chain such as with supermarket/retail chains. While this stream is mainly managed privately by the industry, Valipac in Belgium is an example of an EPR scheme catering solely to the Commercial and Industrial waste stream. In Spain, the draft Royal Decree on Packaging and Packaging Waste published on 8 April 2022 is proposing expanding EPR across more types of waste, including an EPR for C&I packaging.

Due to the private nature of collection and the high quality of films, this market is quite fragmented and competitive. It is considered a 'free market' in some countries. With the growing demand from companies to incorporate recycled content in their products (particularly major brand owners and retailers), the interest in keeping their waste is growing as a way to not only secure own access to it but also to avoid competitors to have access to it. In this way, securing supply is becoming a challenge to recyclers and integration and partnerships into collection/waste management is becoming increasingly common. Moreover, some big brand owners are acquiring recyclers, trying to secure their own source of supply.

This stream has higher collection and recycling rates due to better quality driven by mono-material films and limited contamination owing to the nature of applications as well as separation at source. While this material is mainly sorted at source, an additional level of sorting and cleaning is done at the recyclers' end. This typically involves removing paper labels and dust. Most of the market does not separate LDPE from LLDPE, however, some players do separate LDPE from LLDPE to achieve a higher quality recyclate that can be used to substitute virgin material at higher percentages. The typical bale qualities include 98-2, 95-5, 90-10, 80-20 and 50-50 which typically is an indication of the percentage of natural colour film versus non-natural film material. Non-natural film material could be either mixed colour films or other types of plastics such as rigid materials or even non-plastics, etc. Hence, with a natural film content of 98%, 98-2 bales are the most sought-after ones with the highest recycling yields.

Since the collection of Commercial and Industrial waste stream is a closely managed private system, there is a lack of standardisation and harmonisation of reporting structures leading to limited data transparency. The need for standardisation of systems could be supported by the deployment of EPR regulations covering this stream.

## Household Plastic Packaging Waste Stream

- **Household packaging waste stream accounted for 1.5 million tonnes of collected volumes within flexibles. This stream has high levels of contamination and includes a mix of film types like LDPE/LLDPE, HDPE, PP, and multilayers. Multilayers are particularly challenging for recycling and hence, have been the focus of several design for recycling initiatives to encourage the use of mono materials.**
- **There is a growing focus on enhancing the collection and sorting infrastructure in countries across the region supporting the recycling ambitions set out by legislations brand owners and industry groups.**

As shown in Figure 9, 29 of the EU 27+3 countries had collection systems for flexible films from the household plastic packaging waste stream in place in 2020. These films are mostly collected in comingled systems with other types of recyclables like rigid plastics packaging, aluminium packaging and others.

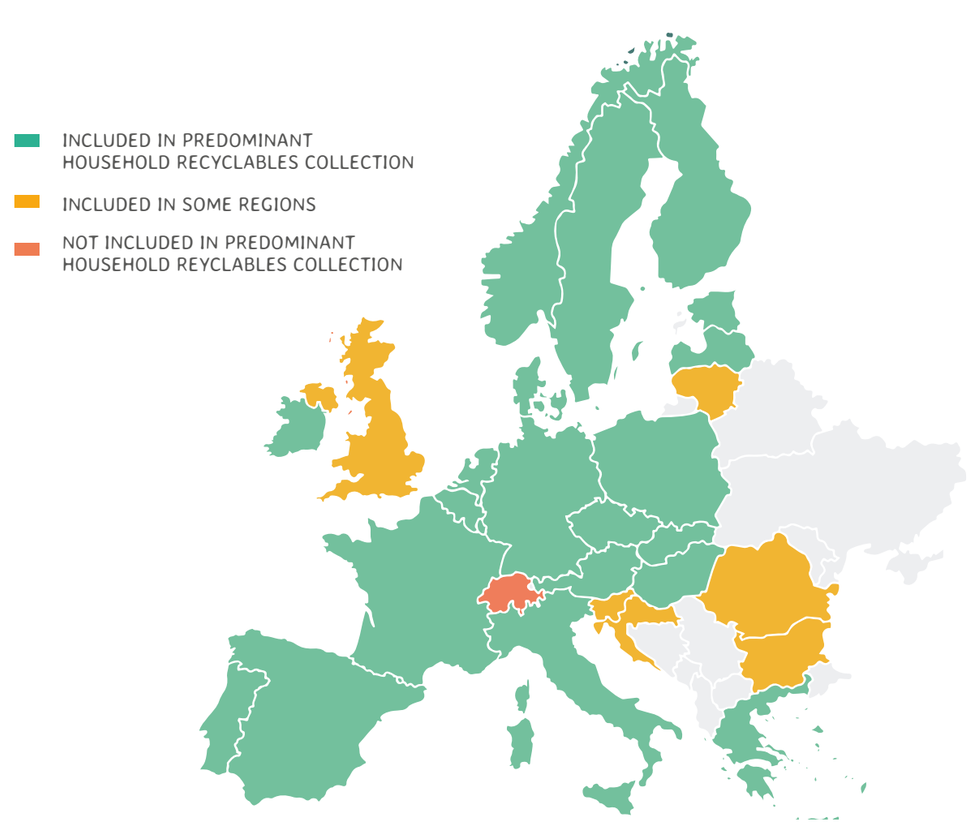



*Figure 9: Coverage of flexible films collection for household waste stream in 2020. Source: PRE.*

Kerbside collection is the most common collection system for flexible films. However, the maturity and reach of the collection system varies across countries. For example, countries like Germany, Spain and Italy have been collecting flexible films for decades whereas France and Belgium have included flexible films in the recyclables collection only recently.

In France, collection of films in the yellow bins has been progressively deployed since 2016 and the collection covers around 60% of the territory. Collection in the United Kingdom is focused on front-of-store collection points at supermarkets and collection of films is generally excluded from household recycle collection stream, although that is expected to change in 2027, when kerbside collection of plastic films will become mandatory.

Flexible films waste from the household packaging waste stream is characterized by high levels of contamination such as compostable waste (food, garden waste, etc.), moisture, glass, other non-recyclable plastics, composite paper/carboard materials, other materials like rubber, stones, wood, textiles, etc. This stream includes a mix of film types like LDPE/LLDPE, HDPE, PP and multilayers. Multilayers are particularly challenging in terms of recycling and have been the focus of several design for recycling initiatives to encourage the use of mono materials.

While countries like Germany, France, Italy, etc. have mature collection systems, there are countries that are in the process of overhauling their collection as well as sorting systems to support more efficient collection and sorting of film waste into multiple bales such as Belgium and Sweden. In Sweden, new legislations in 2024 will make the collection municipality owned 100% door-to-door collection, with collection rates expected to double.

While still small, there is a growing trend of sorting out PP bales from films waste which can already be seen in countries like Germany and Sweden. In France, from January 2023, all films are collected within the same stream (which had otherwise targeted only PE films) whereas the sorting will be up to recyclers based on the choice of recycling technology employed. In UK, EPR has come into effect in 2023 for all packaging including flexibles, and with the first EPR payment to be in 2024.

Once collected, household films are sorted in a variety of different ways across Europe. In some countries, they are sorted into a single stream containing a mix of PE, PP and multilayer films. When sorted further, the most common scenario currently is that there are two output streams, one for PE and the other a mix of PO, the latter also contains the multilayer films. Historically, the PE fraction has tended to be sorted based on a size criterion, with an assumption that anything over A4, or more recently A5, in size is mono PE. These typically end up into 2 types of bales after sorting - films larger than size A4 and smaller than A4. The films larger than A4 size usually consist of bags, carrier bags, shrink-wrapping film, etc. while the smaller films fraction consists of food packaging, multilayers, labels, etc. The bales with size A4 and higher are typically cleaner, have a higher PE content and are relatively easier to recycle. The other bales with smaller film are much more contaminated and can be more expensive to recycle.

NIR sorting equipment is also commonly used to ensure the purity of the PE films. The trend is towards more granular sorting and a small but growing number of sorting plants are now also producing a PP flexible fraction.

It should be noted that sorting can happen at multiple points in the supply chain, the packaging sorting centre, secondary plastics sorting centres, and at the pre-treatment at the recyclers. Collection is only the first step towards circularity and sorting for recycling of flexible films has been brought to focus only recently in light of the increasing recycling targets set by the EU Commission. As is evident from the developments, there is a growing focus on enhancing the collection and sorting infrastructure in countries across the region supporting the recycling ambitions set out by legislations, brand owners and industry groups.

## Agricultural Waste Stream

- **Agricultural waste stream accounted for 0.6 million tonnes of collected volumes, predominantly comprised of PE films such as greenhouse films, mulch films, silage films, etc.**
- **EPR schemes will be essential in driving efficient collection, sorting and recycling of agricultural films waste. This waste stream is rich in PE content, has consistent quality and can largely be recycled back into the same applications.**

Agricultural films include several PE films such as greenhouse films, mulch films, silage films, etc. Contamination in this waste stream tends to vary according to the application. In general, mulch films present the highest contamination levels while silage films tend to present lower levels. However, on average, contamination levels are high (about 50%), including soilage content, in addition to moisture and degradation from prolonged sunlight exposure owing to the nature of these film applications.

Currently, agricultural film waste is not included under EU circular economy legislation. As can be seen on Figure 10, there are a few countries with national legislations mandating or in the process of mandating EPR for managing farm waste, namely, Spain, Norway and Ireland. While Spain already has some private initiatives and voluntary schemes in place, the new national legislation, which reviewed the framework regulation on EPR in line with EU regulations, aims to ensure that producers of plastics for agricultural applications take financial and organizational responsibility for managing their waste. The deadline for implementing and approving these new royal decrees is April 2025. Vast majority of the countries have private initiatives for collecting and sorting film waste from this stream, which are then sold to the recyclers. Some countries such as France (ADIVALOR), Germany (ERDE, etc. also have voluntary collection schemes operated by the industry.

The growing penetration of voluntary or mandatory EPR schemes will be essential in driving efficient collection, sorting and recycling of agricultural films waste, which is rich in PE content, is of consistent quality and can largely be recycled back into the same applications.


*Figure 10: Coverage of collection mechanisms for flexible films from agricultural waste in 2020.*
*Source: PRE.*

## Building & Construction Waste Stream

**Flexible films waste from Building and Construction stream tends to be thick and presents very few labels. Although this stream is currently the least developed one in terms of collection, there is growing interest to manage it better.**

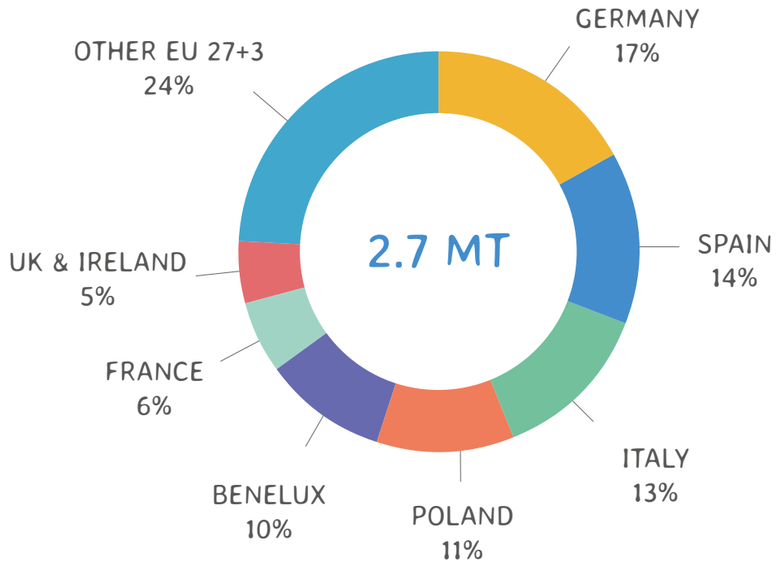
Films from the Building & Construction stream are typically used for wrapping the construction materials. These films are typically separated at source and collected by Waste Management companies engaged by the construction sites or in some cases may be collected together with Commercial and Industrial film waste. The collection mechanism could vary based on logistical and operational considerations. Films can also be used for protection/barrier (as cover) and other building applications. In this case, they are collected largely as a part of mixed waste collection from the sites.

Construction films are generally of good quality, despite dirt from bits of bricks, other construction materials and inert waste. These films also tend to be made of thick LDPE with very few labels, making the material somewhat desired by recyclers.

Currently, this stream remains the least developed of all with limited data availability. However, there is growing interest from environmental agencies in various countries to quantify and better manage this stream, even though the volumes are expected to be relatively low. The high quality, thick and mainly mono-material films used towards these applications are a key driver for developing efficient collection, sorting and recycling systems for this stream.

# MECHANICAL RECYCLING INFRASTRUCTURE FOR FLEXIBLE FILMS IN EUROPE

- **Installed recycling capacity for PE and PP flexible films in Europe was about 2.7 million tonnes, representing 28% of the whole plastics recycling capacity in the region in 2020.**
- **European recycling capacity of flexible films was distributed across more than 200 recyclers in 2020, which are mostly small players, with an average annual capacity of around 10,000 tonnes, with the biggest facilities reaching over 40,000 tonnes.**




*Note:*
*a. Benelux : Belgium, Netherlands, Luxembourg*
*b. Recycling capacities include production waste (pre-consumer waste)*

*Figure 11: PE flexible films recycling capacity in 2020.*
*Source: PRE, ICIS Recycling Supply Tracker.*

It is estimated that the installed capacity for recycling PE and PP flexible films in Europe stood at about 2.7 million tonnes in 2020. This represents 28% of the plastics recycling infrastructure in the region, which was 9.6 million tonnes in the same year.

As shown in Figure 11, with a capacity of about 450 kilo tonnes, Germany accounts for the largest share of regional capacity, closely followed by Spain with about 370 kilo tonnes capacity. Italy, Poland and Benelux are the next largest in terms of PE film recycling capacity followed by France and UK. Together, these 9 countries account for about 76% of the recycling capacity in Europe.

The European recycling capacity of flexible films was distributed across more than 200 recyclers in 2020, which are mostly small players, with an average annual capacity of ~10,000 tonnes, with only a few players holding annual capacity above 40,000 tonnes/year. Companies recycling flexible films accounted for one third of the total plastics recyclers in Europe in 2020.

In 2020, about 2.4 million tonnes of pre- and post-consumer PE films were sent as an input to recyclers. Taking into consideration EU27+3 members, installed recycling capacity was higher than the input received by recyclers in 2020. Waste from Commercial & Industrial stream accounted more than half of the input to recyclers, while Household, Agriculture and waste from production scrap (pre-consumer) accounted together for the remaining volume. Recyclate output in 2020 was estimated at about 1.9 million tonnes representing an overall average yield of over 75% (yield from commercial and industrial waste is the highest). Around 500 kilo tonnes of recyclate was estimated to be produced from pre-consumer waste i.e., convertors' production scrap.

The PE film input estimate to the recycling plants from the household stream includes both PE only and mixed polyolefin grades. Smaller films collected in the mixed polyolefin stream along with rigids are not considered. While there is some separation of the PP film being carried out in some of the sorting centres, dedicated capacity for recycling PP films is yet to develop. Currently the PP films are understood to be recycled for injection moulding applications due to the stringent quality requirements needed for PP films like BOPP. Multi-layer films also do not get recycled into films and are used into intrusion moulded applications or incinerated/landfilled.

# PREVAILING TRENDS IN EUROPEAN INTER-REGIONAL TRADE FLOWS OF PE WASTE

**Exports of PE waste from Europe to other regions have been declining since 2017 and are expected to continue this trend due to increasing legislation restrictions.**

Waste trade data for LDPE/LLDPE flexible films is not currently reported separately and data includes other PE waste such as HDPE rigids in the same HS code. However, according to market experts it is expected that most of the waste bales under category of PE waste are flexible films.

As shown in Figure 12, exported volumes of PE waste from Europe to other regions was about 1.8 million tonnes in 2016, but volumes have been on a constant decline following the implementation of China's National Sword Policy in 2017. The exported volumes are expected to decline even further with the amendment to Basel convention on transboundary movement of waste in 2021[2].

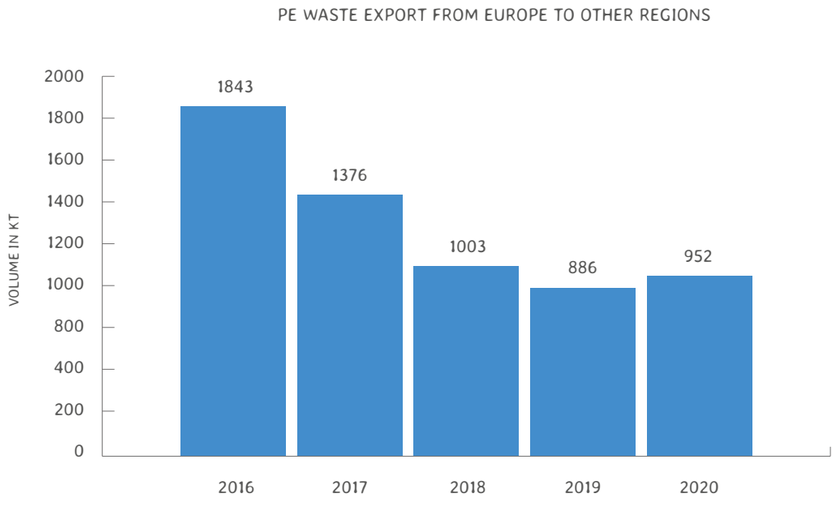



*Figure 12: Extra-Europe PE exports.*
*Source: ICIS Supply & Demand Database, ICIS Analysis.*

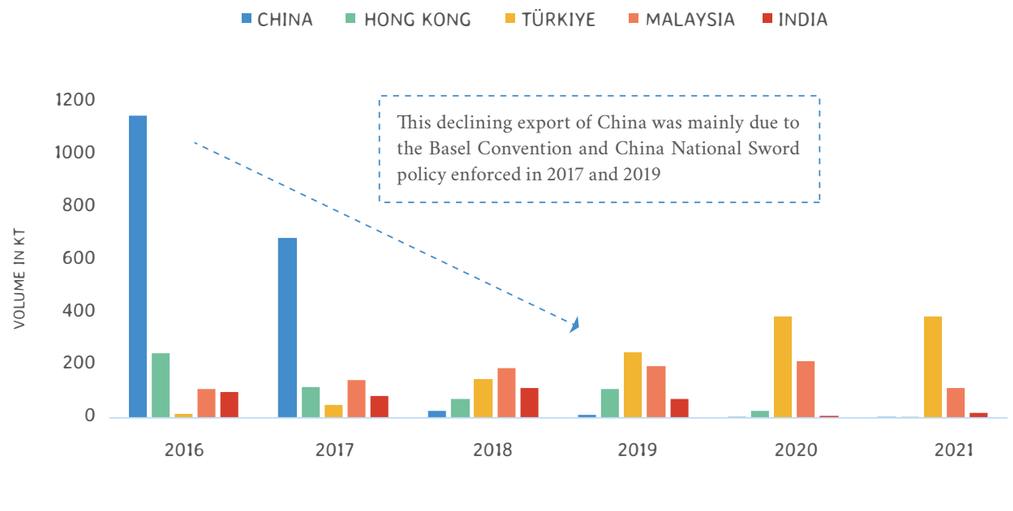



*Figure 13: Key destinations for extra-Europe exports.*
*Source: ICIS Supply & Demand Database, ICIS analysis.*

Following these policy changes, besides the decrease in overall waste volumes, a shift in the key export destinations for Europe's PE waste is evident. As show in Figure 13, while negligible exports to China (the previously largest market) have been seen after 2018[3], increasing exports to Turkey and Malaysia have been observed.

This transboundary movement of waste, however, is expected to become increasingly difficult with the ongoing global and EU-level policy changes (Waste Shipment Regulation ongoing revision).

*2. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, usually known as the Basel Convention, is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries. In May 2019 most of the world's countries (except for the United States) agreed to amend the Basel Convention to include plastic waste as a regulated material.*

*3. China's "National Sword" policy, enacted in January 2018, banned the import of most plastics and other materials headed for that nation's recycling processors, which had handled nearly half of the world's recyclable waste for the past quarter century.*

# KEY DRIVERS OF INTRA-EUROPEAN FLEXIBLE FILM WASTE & RECYCLATES TRADE

**Intra-European recyclates trade is expected to grow in the future driven by growing demand for plastics and increasing incentives for recycled content incorporation. Facilitating intra-Europe trade could help achieving more circularity across the value chain in the region.**

## a. Waste Management and Recycling Infrastructure

The waste management systems and recycling infrastructure in the EU27+3 varies significantly across the countries. Although most countries still face challenges regarding collection and sorting of flexible films particularly from household waste streams, each is in a different development stage in terms of waste management and recycling infrastructure for flexible films.

While in Belgium separate collection of flexible films is available and there are five sorting plants able to handle multiple streams of plastic waste including flexibles, recycling capacity is still a bottleneck. Conversely, Netherlands exports waste to be sorted in other neighbouring European countries due to the limited sorting capacity available in 2020 for flexible films. The sorted bales are then recycled in domestic plants. On the other hand, with no domestic household film recycling capacity, Sweden exports the sorted household bales to other European countries for recycling.

Spain, which holds the second largest PE films recycling capacity (14% in 2020), did not expand the waste collection system at the same pace as its recycling capacity, and recyclers import waste to be processed in the domestic plants and potentially exported. As collection expands, improving the quality of waste streams coming from household through better sorting both at source at and in sorting facilities will be key to ensure a more consistent waste source for recyclers. France is also expanding the collection system for household waste and by mid-2023 all types of flexible films (and not only PE) are expected to be covered by separate collection. The sorting system is also expected to change to improve flexible films separation.

These structural differences across the value chain in European countries lead to movement of waste bales and recyclates across the region. Trade is expected to grow in the future driven by growing demand for plastics and increasing incentives for recycled content incorporation. Facilitating intra-Europe trade could help achieving more circularity across the value chain.

## b. Non-harmonised Country Specific Legislations / EPR Schemes

Another factor driving the exports of PE film trade in Europe is the absence of standardisation of legislation and/or EPR schemes, which leads to the imbalances in collecting, sorting and recycling infrastructure. Depending on which part of the value chain gets incentivized, infrastructural investments can get skewed towards it. With a more harmonised legislative landscape, setting clear targets for collection, sorting and recycling, industry stakeholders across the whole recycling value chain will be more incentivized to make long-term investments in infrastructure.

# KEY END-MARKETS FOR RECYCLATES

Recyclate production was estimated at about 1.9 million tonnes in 2020. Once the film waste has been converted into pellets, it is challenging to trace their path to end-applications. There is limited transparency in this market, especially because of the involvement of traders and direct competition in the market to source this recyclate. However, based on the information gathered from market participants, recyclate consumption into major end-applications was mapped as follows.

As shown in Figure 14, in terms of recyclates consumption, heavy duty sacks/garbage bags was the main application accounting for 37% of total, followed by film and foil (33%), building & construction films (10%), agricultural films (9%) and others (11%).

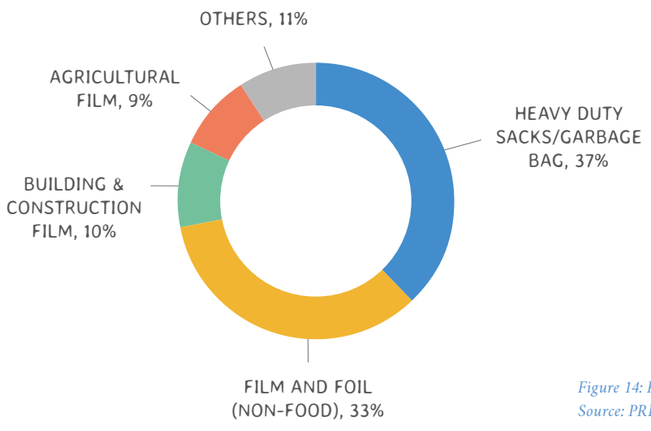



*Figure 14: Key end markets of PE recyclates. Source: PRE, ICIS Research & Analysis.*

Over the last few years, a positive trend towards increasing recycling of flexible films has emerged, also contributing to a boost in recycling capacity.

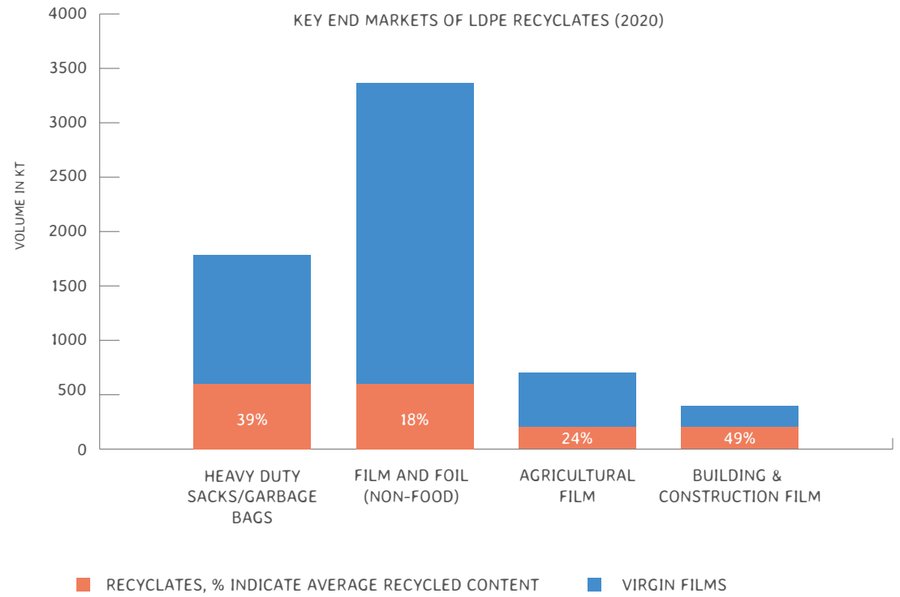
Until a few years back, the industry's focus was to use flexible films recyclate as a cheaper substitute for virgin feedstock in low-value applications. But the industry has now pivoted towards utilizing the recyclate for high-value applications such as stretch films, shrink films, agricultural films, etc., driven by legislations, growing consumer awareness and the drive towards circularity. This shift has created a differentiated demand for film recyclate which can also be seen in the price movements of some R-LDPE grades which have decoupled from the equivalent virgin pellets price references.

This progress has been possible thanks to the efforts of industry stakeholders across the value chain to face and overcome, to an extent, various challenges such as the efficiency of sorting and washing, the willingness to pay a premium for recycled content, etc. Despite the advances, there is still a long way to go for true circularity to be achieved, and the ongoing efforts of policymakers and industry are targeted in this direction. For instance, only 17% of the amount of recyclates produced in 2020 were put back on the market, considering that the total amount of flexible film applications consumed was around 11 million tonnes.

The share of recycled content varies across the different key end-markets, as Table 1 and Figure 15 indicate. However, the largest recycled content shares are seen in building films (49%) and sacks & bags (39%), while the film and foil group have the lowest (18%). This indicates the importance of recycled pellet quality in determining its end-markets.

| KEY END-MARKETS | FLEXIBLE FILMS DEMAND (KT) | RECYCLATES USED (KT) | AVERAGE RECYCLED CONTENT (%) |
|---|---|---|---|
| HEAVY DUTY SACKS/GARBAGE BAGS | 1,775 | 688 | 39% |
| FILM AND FOIL (NON-FOOD) | 3,364 | 614 | 18% |
| AGRICULTURAL FILM | 700 | 168 | 24% |
| BUILDING & CONSTRUCTION FILM | 354 | 175 | 49% |

*Table 1: Flexible films key-end markets and recylates penetration.*
*Source: PRE, ICIS Research & Analysis.*




Applications such as building films and sacks/bags do not require natural-coloured pellets and some grey/black colour is acceptable in the production as there is flexibility in the colour of the final product. Similarly, agricultural films can also accept some grey/black coloured waste films. However, when it comes to high value applications of non-food film & foil, it is important to have clear pellets because they allow any colour to be produced, while black pellets do not.

Among other aspects, quality of feedstock (flexible films waste) is critical in determining the quality of recyclates and thereby recyclates' end-applications. The presence of various inks, additives, contamination from other coatings like aluminium as well as odour are examples of challenges for improving waste quality, especially for household waste stream.

Better sorting, as well as design for recycling are key aspects to improve the quality of recycling input and allow uses in high-value applications. With the increasing interest in high-quality recyclates across the whole value chain, improving the quality of feedstock is necessary to meet the growing demand expected in building & construction, agriculture and non-food packaging sectors.

*Figure 15: Key end-market of LDPE recyclates in 2020.*
*Source: PRE, ICIS Research & Analysis.*

# 5.

# KEY CHALLENGES FACING THE FLEXIBLE FILMS RECYCLING MARKET

COLLECTION AND SORTING

RECYCLABILITY: LACK OF DESIGN FOR RECYCLING

LIMITED DATA TRANSPARENCY

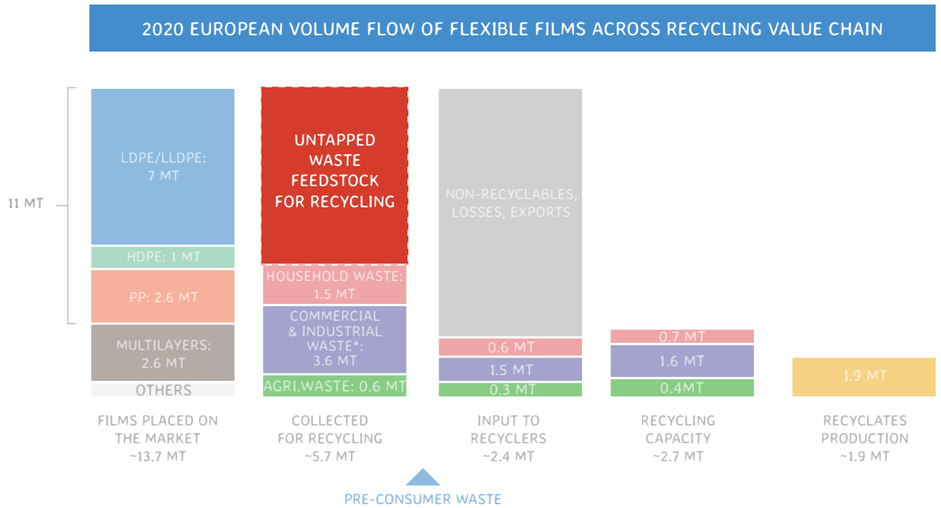
LACK OF CONSUMER AWARENESS

RISING ENERGY COSTS

# COLLECTION AND SORTING

- **Collection and sorting are the major gaps in the flexible films recycling value chain.**
- **Access to plastic waste feedstock in appropriate quantity and quality is one of the greatest challenges to achieving real scale in flexibles recycling.**

With the increasing policy pressure for recycling content targets coupled with brand commitments, the demand for R-LDPE is growing, which is also evident from rising prices of R-LDPE especially during the second half of 2022. This has resulted in a structural shortage of R-LDPE pellets in the market because the recycling capacity has been unable to keep up with the growing demand. One of the reasons contributing to that is the untapped waste feedstock for recycling, highlighted in Figure 16. In that context, flexibles films could play a key role towards legislative targets and brand commitments i.e., circularity of plastic packaging, if collected and sorted efficiently - overcoming challenges related to infrastructure and the waste's low density (high volume and low weight).




*Notes:*
*a. Volumes have been rounded off*
*b. Recycling capacity refers to waste input. Both recycling capacity and waste input to recyclers include pre-consumer (production waste)*
*c.*Waste from Building & Construction is included in the Commercial & Industrial Waste Stream*

*Figure 16: Untapped flexible films waste feedstock potential for recycling.*
*Source: ICIS Supply & Demand Database, ICIS Research & Analysis, Market Experts.*

It can be seen in Figure 16, starting from the volumes placed on the market, to the recyclate produced that the biggest gap in the very beginning of the value chain is collection. While there is loss of flexible films across the chain due to leakage to residual stream, other aspects such as contamination, inefficient sorting, processing losses, design limitations leading to non-recyclability of some packaging, etc. are also relevant. Sufficient collection of film waste in separate recycling streams is imperative for the further development of this value chain. There is also some loss of flexible films via exports to other regions - largely for the film waste which are hard to process in local plants. However, with the tightening of global and regional policies around waste trade, it is expected that the domestic availability of waste plastics volumes will increase moving forward.

Although separate collection (along with other recyclables) of flexible films has been implemented in almost all EU 27+3 countries, the reach of these systems to the wider population is still rather limited, demonstrated by the low collection volumes. Not all municipalities operate separate collection schemes for all materials. In 2020, it is estimated that about 40% of the films placed on the market were collected for recycling , a percentage which is around 60% if we only consider PE flexible films. While other types of films (such as PP films, multilayers, etc.) are also a part of collected volumes, only limited quantities of PP films and almost no multilayers are sorted for recycling due to the design limitations and end up becoming a part of the reject fractions which are eventually incinerated.

In addition to improving collection rates for films, there is also a need to improve the efficiency and quality of sorting and standardisation of sorted bales specification in the region. Currently there is a disconnect between the volumes as well as the quality of film bales supplied by waste managers as compared to what is required by the recyclers and stakeholders down the chain.

There is a strong need to enhance the collection volumes and improve the quality of sorting of flexible films. An increase in collection rates of flexible films will be crucial in achieving the targets for packaging recycling.

Availability of flexible films feedstock and thereby the recyclate can be improved with the following interventions:

- ✓ Increase the availability and accessibility of flexible films waste collection systems;
- ✓ Enhance and update the sorting systems to reduce losses, produce bales with better and standardised specifications consistently;
- ✓ Expand the recycling capacity to include films containing polymers incompatible with current infrastructure and reduce export dependency.

# RECYCLABILITY: LACK OF DESIGN FOR RECYCLING

**Standardisation of packaging design will be key to enable more effective sorting & recycling of flexible films.**

The next challenge in recycling flexible films is their recyclability. Recyclability of a product does not only mean that it is produced from a recyclable material or that the various components of its design (including labels, inks, layers, adhesives, closures, etc.) allow for its recycling. Recyclability is a wider concept applicable to the entire life cycle of a packaging product- starting right at the design stage, availability, and accessibility of infrastructure for its collection, sorting, and recycling once it has served its purpose, and lastly the availability of markets to consume the recyclate.

It must also be noted that the collection, sorting, and recycling must also be proven to be technically possible, economically viable and standardized in the majority of the regions where the product is sold.

RecyClass, an initiative with a vision to make plastic packaging, and eventually all plastics, circular by making them recyclable and boosting the transparent uptake of recycled materials, defines a plastic packaging as recyclable when the following criteria are fulfilled, as shown in Figure 17:

### DEFINITION OF RECYCLABILITY

Plastic packaging is recyclable when the following 4 criteria are fulfilled

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

*Figure 17: Recyclability definition.*
*Source: RecyClass.*

Design of plastic packaging will not only determine its ability to be collected and sorted into appropriate streams but will also impact the quality of recycling process and the recycleate produced, eventually playing the main role in the uptake of recyclate in high value applications. The industry must, therefore, ensure that the circularity of packaging is safeguarded from the first steps of the product's lifecycle.

Currently, of all the major types of flexible films including PE, PP and multilayers, PE films have the highest rate of recycling owing to their large volumes across varied applications in different types of films ranging from mono-materials to multilayers, across various sectors of household, commercial & industrial, agricultural, etc. The PE based multi-material films, PP films (largely BOPP) and other multi-material multi-layer films are less recycled currently due to the presence of contaminants such as inks/pigments, adhesives, other materials (PET, PA, aluminium, etc.) mainly used to achieve the required barrier properties for sensitive packaging and make the packaging attractive at the same time. The presence of these contaminants, besides the organics from the household stream, make this packaging hard to recycle mechanically. Thus, it is challenging to utilize the recyclate from household stream into circular applications and, instead, the stream is recycled into less demanding applications like garbage bags.

The main properties that determine the processability of recyclate into circular, high value applications include its melt flow index (MFI), colour, transparency, odour and traceability. All these factors require design for recycling.

In order to expand the recyclate market, the recyclability of flexible films to achieve better quality and quantity of recyclates can be improved with the following interventions:

- ✓ Standardised definition for Recyclability.
- ✓ Shift from multi-material multi-layer films to mono-material multi-layer films: multi-material films impact the sorting as well as the recyclate quality.
- ✓ Reduction of inks, pigments and adhesives: Presence of printing in film waste prevent the recyclate from achieving natural colours as these cannot be removed in the mechanical recycling process.
- ✓ Avoid / find alternatives for problematic co-materials generally used for barrier properties such as PET, PA, EVOH, PVC, PVDC, etc.
- ✓ Various components of the packaging should be of the same polymer.

# LIMITED DATA TRANSPARENCY

**Competition for waste and lack of standardisation are some of the main factors contributing to limited data transparency for flexible films.**

Despite the numerous initiatives and policies being introduced to tackle the packaging waste, there still exists the challenge of limited data transparency across the value chain, especially when it comes to flexible films. Besides competition in the market, other reasons for the data gaps include differences in definitions such as post-consumer/post-industrial and recycling yields, non-standardised specifications of bales and pellets, absence of harmonised legal reporting requirements, etc. Availability of accurate, dependable data is essential in ensuring the development of the necessary collection & sorting infrastructure, recycling technologies and capacities in order to achieve the end-goal of circularity.

On the upstream of recycling value chain, there is a need for the PROs, across all waste streams to be more transparent with the data relating to the volumes of flexible film packaging placed on the market according to the material composition, type of application, additives/pigments used, size, etc. since all these factors determine the recyclability of a particular packaging. On the other side of the value chain, the collection and sorting data for flexible films is required to estimate the efficacy of the current infrastructure and identify gaps in order to strengthen the system. Lastly, the data on the consumption of flexible films recyclate towards various end markets, and the required specifications is also necessary to facilitate application development.

# LACK OF CONSUMER AWARENESS

**Consumers play a relevant role in keeping a circular economy since they are both part of demand and supply. Correct segregation at source can prevent leakage of a valuable resource to residual waste streams that might go to incineration/landfill.**

Once the packaging has been designed for recycling, the next step playing a critical role in its recycling is disposal. This is where the role of consumer awareness comes in. Segregation at source by disposing the packaging into the correct collection stream is necessary to prevent leakage of a valuable resource to incineration/landfill via the residual stream. Not disposing contaminants like non-recyclables, organics, etc. into the recyclables stream is as important for effective sorting.

It is estimated that over 60% of the flexible films waste available for collection does not enter the recyclables stream and is lost. Although insufficient collection and sorting infrastructure also influence this number, consumer awareness is an important factor. Consumers need to be educated and enabled to ensure that they segregate the packaging waste appropriately at source. This can improve not only collection volumes but also the quality of film waste. Whilst it has been established that consumers are concerned about the environment, they are not always well prepared and equipped to make a positive contribution to film waste segregation at source.

Consumers have a significant role to play in creating and sustaining the plastic recycling ecosystem as they touch both supply as well as the demand side. Governments, brand owners & retailers can translate their recycling intention into action by nudging consumers towards better awareness and recycling habits.



# RISING ENERGY COSTS: CONFLICT IN UKRAINE

**Even though rising energy costs was not a major issue in 2020, the energy crisis caused by the conflict in Ukraine led to a significant increase in recyclers' production costs. There are concerns in the market that some smaller recyclers could face financial difficulties.**

Energy and utilities play an important role in plastics recycling processes and typically represent 15-20% of total operational costs.

The energy crisis caused by the conflict in Ukraine led prices to peak in 2022, dramatically increasing recyclers' production costs. As it is discussed later in the Pricing Section, recyclates' prices increased during the first half of 2022 – as demand outstripped supply. With declining prices in second half of 2022, margins were further affected also due to increased production costs. The film recycling industry comprises of many small/mid-size companies with limited cash reserves and a large portion of these recycling companies faced financial difficulties amid squeezed margins without governmental support around rising costs.

Wholesale energy prices have dropped in the second half of 2022, but changes might take time to be reflected into retail contracts. The prolonged pressure on recyclers' margins challenges some to be able to absorb any further costs, especially with buyers unwilling or unable to accept price increases. There are concerns in the market that some smaller recyclers, especially those not integrated either into feedstock or end-applications, could face severe financial difficulties, unable to pass through the costs during this challenging period or afford high bale prices to run the plant. The impact on margins and cash flow also limits buyers' options to source feedstocks, even if prices were lower. Ultimately, this could see some players exit the film recycling market if it remains financially unviable to continue to ensure the survival of the overall business. Eventually either outcome, withdrawal or bankruptcy, could reduce the available capacity to recycle films. Flexibles recycling remains a largely nascent market, although it has been growing quickly, and any reduction in investment now could exacerbate structural shortages in the mid-term.

6.

# KEY DRIVERS FOR FLEXIBLE FILMS RECYCLING

LEGISLATION

TECHNOLOGICAL ENABLERS

PRICING DYNAMICS AND DIFFERENTIATED DEMAND

COMMITMENTS BY THE INDUSTRY AND CONSUMER PRESSURE

# LEGISLATION

**Implementation and enforcement of EU regulations will be key to harmonise the differences between EU countries and improve the input to the recyclers.**

Legislation will continue to be the key driver in enabling flexible films recycling by establishing targets for separate collection, recycling rates, recycled content and recyclability which will ultimately result in enhanced collection and sorting systems.

In November 2022, the EU Commission published its proposal for a revision of the Packaging and Packaging Waste Directive (PPWD) which focuses on reducing and preventing packaging waste, driving design for re-use and recycling as well increasing recycled content in packaging. The Directive is expected to become a Regulation[4], once adopted. This will provide the basis for more harmonisation, circumventing the need of transposing the Directive into individual national legislations, since it will directly enter into force in all EU Member States.

Together with other EU Directives such as the Waste Framework Directive (WFD) and the Single-Use Plastics (SUP) Directive, the Packaging and Packaging Waste Regulation (PPWR) will have major implications for the entirety of the packaging and waste management chain by not only defining targets on recycling, incorporation of a minimum recycled content but also by establishing obligations related to separate collection, recyclability and recycling at scale as described below.

**The main goal of the PPWR draft is to reinforce the essential requirements that packaging must adhere to in order to be placed on the EU market:**

## PACKAGING TO BE RECYCLABLE AND RECYCLED AT SCALE

The new draft aims at defining a methodology for recyclability and set thresholds according to which a packaging is recyclable and when it cannot be placed on the market as well as recycling of packaging at scale. To be considered as "recyclable", packaging must be compatible with state-of-the-art collection, sorting, and recycling processes. According to the European Commission Proposal, to be considered as "recycled at scale" packaging must be "collected, sorted and recycled through installed state-of-the-art infrastructure and processes", covering at least 75% of the European Union population. These obligations will play a crucial role in accelerating design for recycling, availability, and accessibility of collection systems as well as enhancement of sorting systems for flexible films.

## RECYCLED CONTENT TARGETS

The proposal mandates a target of minimum recycled content of 35% by 2030 and 65% by 2040 for non-contact-sensitive plastic packaging, significantly impacting flexible films. Additionally, the proposal mentions a 10% minimum recycled content for contact sensitive packaging by 2030 and 50% by 2040. With about 23% of the flexible packaging going towards food packaging applications (2020), and no flexible films recyclate being used in food packaging applications, these targets will drive the development of the required infrastructure and technology to create this market. There are ongoing discussions on how implementation of these targets will take place. A possibility under discussion is that they may be set at batch/year level allowing targets to be achieved among the entire portfolio of a production plant.

## PACKAGING LABELLING AND PACKAGING WASTE MANAGEMENT

The draft includes wide-ranging new labelling obligations on packaging across the EU to include information on material composition and packaging reusability and facilitate separation at waste source. Part of these obligations will require both domestic and third countries' packaging producers to register with each individual Member State's extended producer responsibility (EPR) schemes before being allowed to place packaging into that Member State's market. The proposal also aims to harmonise producer reporting obligations under EPR schemes in order to streamline reporting for better data transparency. Additionally, Member States are required to establish systems ensuring that all packaging waste is subject to return and separate collection.


*Figure 18: EU regulatory landscape – key highlights.*

*4. i.e.: Packaging and Packaging Waste Regulation (PPWR)*

## The role of greater harmonisation

- **Greater harmonisation in the legislative landscape is key to improve collection, sorting and recycling systems across Europe.**
- **This would further benefit the whole recycling value chain by reducing legal uncertainty and further incentivising investments in sustainable, circular business models.**

The European legislative landscape for plastics circularity is extensive with many countries adopting their own individual regulatory approaches.

The EU plastics own resource came into effect in 2021 requiring a contribution by EU Member States of 800 Euros per tonne of non-recycled plastic packaging to the EU budget. This aims at incentivising reduction of plastic packaging waste while leaving to each Member State to define whether to cover the costs via the national budget or to pass it to the industry. Country specific plastic packaging taxes have been announced in Italy (implementation postponed to 2024) and already entered in force in Spain (2022) and in the UK (2022), varying in amount and separate from the EU Plastics Levy.

Furthermore, some of the Member States are working towards introducing additional push measures to boost recycled polymers uptake. For example, in the Netherlands the government is to introduce in 2027 a national obligation to apply either recycled plastics or biomass to produce new plastics. This obligation should increase to a level of 30% in 2030. The obligation will apply to all plastics and is foreseen to function like the current register for biofuels.

Similarly, there are differences in the Extended Producer Responsibility (EPR) schemes implemented across EU countries. This results in varying EPR practices that could lead to data transparency challenges (particularly in countries where there are competing Producer Responsibility Organisations (PROs), such as Germany). Additionally, in the absence of a common framework, modulating criteria considered in EPR fees varies significantly. Even though it is important that EPR schemes can accommodate country-level differences, the lack of a common framework, could result in practices that may lead to unintended consequences. One example is how weight-based fee structures may incentivise light-weighting of packaging and potentially adversely impact recyclability. Eco-modulated fees based on recyclability criteria, for example in France (CITEO), The Netherlands (Afvalfonds Verpakkingen), Italy (Conai), etc. can lead to improved adoption of Design for Recycling and improved collection and sorting of materials, if implemented consistently in the European region. This will necessitate a universal definition of recyclability, which is one of the points proposed in the PPWD revision.

With several policies under revision, the legislative European landscape is changing, and it is expected to evolve significantly. The Waste Shipment Regulation (WSR) proposal aims at improving harmonisation of waste trade rules on intra-EU shipments to facilitate the waste destined for recycling, on limiting the export of waste to non-OECD countries and on monitoring waste exports to OECD countries. The draft also proposed new digital reporting obligations on both intra- and extra-EU waste shipments, along with new auditing requirements for recycling facilities located in third countries.

The Ecodesign for Sustainable Products Regulation (ESPR), which is also under revision, will introduce a set of ecodesign requirements, including aspects on energy efficiency and on circularity as well as the creation of a Digital Product passport to facilitate sharing and tracking of information along the whole value chain, up to the consumers.

The new upcoming legislation should be aligned, especially on definitions, to ensure a coherent framework and facilitate their implementation. Greater harmonisation in the legislative landscape is key to improving collection, sorting and recycling systems across Europe. This could further benefit the whole recycling value chain by reducing legal uncertainty, boosting waste feedstock and recyclates' quality and supply and further incentivising investment in sustainable, circular business models.

# TECHNOLOGICAL ENABLERS

**Technology is a key enabler for the recycling value chain. Developments in packaging design, traceability, sorting, and recycling process will accelerate expansion of recycling value chain.**

Technology will accelerate the improvement of quality and enable further processes automation across recycling value chain. These are imperative to bring about a step change in the transformation of flexible films recycling value chain. The key technological enablers include packaging design (design for recycling), sorting technologies, recycling technologies and traceability, as shown in Figure 19.

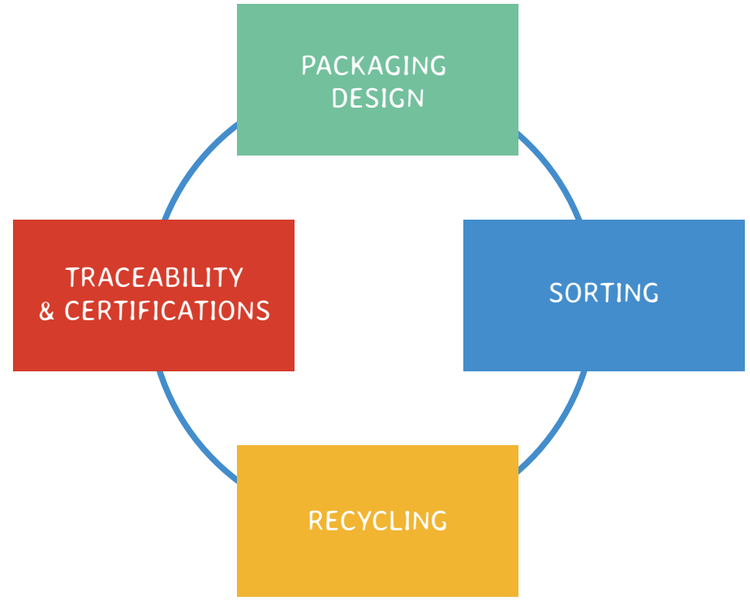



*Figure 19: Key Technological enablers for flexible films recycling.*

## Packaging Design

**Packaging design plays a key role in determining the recyclability of packaging waste and hence the quality of plastic waste, leading to improved recyclate quality.**

As clarified in the previous section, choice of material and design of a packaging product governs its recyclability. Numerous initiatives are ongoing by market stakeholders in this area which touch upon different aspects of design for recycling. One of these is RecyClass, which is a comprehensive cross-industry initiative that works to advance plastic packaging recyclability and to establish a harmonised approach towards recycled plastic content calculation and traceability in Europe. Activities within RecyClass include the development of Recyclability Evaluation Protocols and scientific testing methods for innovative materials which serve as the base for the Design for Recycling Guidelines and the Online Tool. RecyClass offers Recyclability Certifications for plastic packaging and Recycled Content Traceability Certification for plastic products.

On the recyclability front, a major investment towards development of recyclable multilayer films involves a new blown line technology with Machine Direction Orientation (MDO) to develop, design and produce polyethylene and polypropylene-based flexible packaging film using fewer polymers, increasing the recyclability of the product. The use of BOPE to replace BOPET and BOPP will also support the development of mono-material PE films.

During the recycling process of printed packaging films, the ink may get degraded leading to discolouration and unpleasant odours in the recyclate, leading to downgraded recyclate applications. Moving forward it will be essential to also assess the type of inks based on the different levels of degradation across the different types.

For the inclusion of recycled content in multi-material multi-layer films for food packaging, a 5-layer mono-material has been developed, multi-layer films designed for frozen food using A-B-A barrier (A- film made with virgin polymer, B- film made with recyclate). While the replicability and hence the scalability of this technology would be subject to the newly adopted Food Contact Material Regulation, it still is an important milestone in the application development for recyclate.

Scalability and commercialisation of these and other technologies in line with increasing recyclability of films are needed to make a step change in the recyclability of flexible films packaging.

## Sorting

**High efficiency sorting of films into mono-material bales like LDPE, PP with minimum contamination will need modernisation of the existing systems in Europe.**

Sorting plays a significant role in the availability of flexible films waste feedstock for the recyclers by reducing contaminants in the waste bale. High efficiency sorting of films into mono-material bales like LDPE, PP with minimum contamination will need modernisation of the existing systems in the region, as besides technology advancements, age of the plant also correlates with the quality and efficiency of sorting. Countries like Belgium and Sweden have invested in updating their sorting systems in recent years and some new advanced sorting centres have come up in Germany.

The sorting process includes a number of steps requiring a cascade (the sequence may vary depending on the prioritization of the waste stream by the waste management company / EPR scheme and other factors) of various equipment to sort the mixed recyclables stream. A typical equipment cascade for household films will be explained below. In cases where the input is source segregated, like commercial & industrial films, the number of steps in sorting will be rather limited- with most of the sorting taking place at the recycler's facility.

The first step in a typical household waste sorting process is sieving, where items are sorted by size. Typically, one-dimensional items smaller than 5cm are discarded and sent for incineration. Next is wind sifting, where the airflow separates lightweight materials from heavier material. This is followed by magnetic separation where ferro-metals in the packaging are checked. Plastic packaging containing metallic components will either be sent to the metal recycling stream, leading to material losses or remain in the plastic stream and contaminate the output bale. Then come eddy current separation and ballistic separation which separate out non-ferrous metals and rigid/flexible packaging respectively. Lastly, the Near Infra-Red (NIR) technology is used to sort out packaging polymer types, colours, etc.

Near Infra-Red (NIR) sorting technologies have been in use for a long time to sort out waste based on polymers as well as to remove contaminants. This technology has been undergoing enhancements to overcome sorting challenges which have inhibited efficient sorting of waste with the growing need of better sorting requirements. Improvement areas include increased sensitivity and reliability coupled with other sensor types like AI. Colour sorting is an upcoming trend wherein there is a shift from the size-based (>A4, <A4) sorting of films to colour based (transparent/coloured/black, etc.) to achieve more efficient sorting since good quality natural films can be lost in small film bales.

RecyClass has published the "Sorting Evaluation Protocol" describing the methodology that may be followed in order to determine the sorting behaviour and the recycling stream of the tested packaging. The Protocol evaluates the sorting behaviour of plastic packaging considering the waste streams including PE flexible, PP flexibles, mixed plastic flexibles, PET bottles, etc.

Sorting technologies currently find it challenging to identify and sort the different types and formats of packaging and packaging materials that are being placed on the market. These limitations result in low quality recyclate, impacting its further value and restricting the brand owners to achieve the goal of circularity and 'closing the loop'. One of the technologies working towards a solution links covert digital watermarks with a cloud-based repository of product attributes such as SKU, brand, food/non-food, etc. This way the sorting limitations can be overcome to drive a step change and improvement in the recyclate quality. The data generated can also be used to design more accurate EPR schemes and enable better insights leading to design for recycling improvements. Tracers introduced into the packaging by the Tracer-Based-Sorting (TBS) technology allow for sorting of recyclables stream into definable, relevant fractions enabling the production of high-quality recyclate and closed-loops. Examples for various fractions include differentiation of food/non-food, identification of specific multi-layers, brands or applications, etc. The key difference between tracer based and watermark-based technologies is that while tracer needs to introduce a new substance into the packaging, watermark just requires printing of a unique code.

# Recycling

- Recycling capacities for flexible films are mostly mechanical.
- Multilayers are particularly challenging for recycling and hence, have been the focus of several design for recycling initiatives to encourage the use of mono-materials.

## MECHANICAL RECYCLING

Mechanical recycling of flexible films starts with a sorting step, where the bales received from waste management companies are sorted to remove contaminants. It is followed by shredding the films to produce flakes, which are commonly then washed to reduce further contamination. Currently most of the recycling plants in Europe have cold wash lines. Hot washing helps in removal of labels, adhesives, inks, organics and other contaminants which improves the quality of recyclate, it can be an expensive step due to the energy costs involved and a trade-off between quality and cost needs to be made depending on the intended end-application. Next step after washing is separation by density, where different polymer types are separated based on their intrinsic density. After this the flakes are dried and extruded to produce plastic granulates.

Fine filtration (~100 microns) of the molten recyclate during extrusion is an important step to remove remaining contaminants (~5%) from the pellets such as paper, glue, etc. and produce homogenised R-LDPE pellets. Further reduction in the filter size will enhance the quality of recyclate, facilitating development of high-value end-applications. Stabilisers may also be used to enhance the recyclability and recyclate quality.

After extrusion, residual moisture and other potentially harmful substances are removed by the degassing step which improve the quality of recyclate by reduction in residual moisture content, better visual properties, reduced odour, and homogenous mixing. Most impact from degassing can be seen on hygroscopic contaminants like PET, PA, etc. that tend to absorb moisture. It is thus important to remove moisture from the polymer melt to prevent the degradation of the final recyclate.

The contaminants and other additives present in packaging materials, especially in household films can cause the plastic granulates to have odour in them, resulting in downgraded end-applications of the recyclate. Reduced odour is hence becoming an indispensable quality standard in household film recycling especially for high-value added end-applications like cosmetics and food driven by the ambitious legislative and brand targets. Pellets deodorisation technology reduces the presence of low volatile, high molecular weight organic compounds in the recycled pellets to reduce the odours.

De-lamination technologies can separate out LDPE films (and other layers) from multi-material laminated films to facilitate their recycling. This can be done by a separation liquid which penetrates between the layers of the multi-layer film. Many de-laminating and de-inking technologies (to remove inks from printed films) are being developed and are still in pilot phase at present.

Solvent based purification / dissolution technologies[5] are also being developed to recycle hard to recycle films. These technologies are still considered mechanical recycling (also known as physical recycling) and could help addressing some the current challenges posed by multi-layer films. However, most of these technologies are still at pre-commercial stages.

## CHEMICAL RECYCLING

While the sector is still in its infancy, chemical recycling is being seen as a potential solution to address the hard to recycle plastics challenges. Chemical recycling is an umbrella term for a variety of methods that use different production routes to create virgin-like polymers from plastic waste.

Chemical recycling has the potential to build upon mechanical recycling processes if it can treat the waste which cannot currently be mechanically recycled into high-quality plastics. However, the lack of design for recycling as well as the necessary infrastructure to provide feedstock at commercial scale whilst maintaining consistent the quality required by chemical recycling plants is still not fully developed. Technology challenges also include varying process yields, high CAPEX and operational costs and low selectivity (output can be often mixtures which need to follow additional purification and upgrading steps) while further studies are required to confirm how its environmental impact compare to other solutions.

*5. Covered under the physical recycling term which comprises both mechanical and dissolution technologies.*



# Traceability & Certifications

- Traceability is key to help bring transparency across the value chain and secure feedstock for contact-sensitive packaging.
- As legislation defining requirements related to recycled content and recyclability of products are expected to become more common, reliable certification schemes will be key to help in monitoring progress of the industry.

## TRACEABILITY

With the growing demand for recycled plastics, it is becoming increasingly necessary to track the plastic waste across the value chain for better traceability of the source, polymer type, packaging type, etc. especially when it comes to contact-sensitive packaging. Transparency across this value chain will be essential in scaling up and sustaining this raw material source for packaging production.

Blockchain based technologies are being explored to bring about transparency in the recycled plastics supply chain with reduced administrative effort. Open access blockchain technologies can also support data transparency, which is crucial especially for the flexible films value chain.

## CERTIFICATIONS

Plastics market is increasingly being influenced by the establishment of targets and commitment regarding circularity. At EU level legislation, requirements related to recycled content and recyclability of products are expected to become more common. In this context, it becomes increasingly important to establish a structured, consistent, and transparent approach to allow the verification of claims related to recyclability or recycled content. The successful implementation of these regulations will also demand transparent monitoring and reporting mechanisms.

Reliable certification schemes prove to be an efficient method of monitoring achievement of the set targets. Coherent & transparent methodology, independent audits, factual basis and recognition are among the key ingredients that would deem a certification scheme as a viable tool for monitoring and reporting. Examples of certification schemes available in Europe include RecyClass' certification on Recycling Process and on products Recyclability.

Certification of origin of plastic waste and traceability of its use in new applications across the plastics value chain is key to monitoring progress of the industry and is also critical to ensuring compliance to safety standards, reporting obligations and evidence to producers when they issue claims on recyclability and recycled content. This will eliminate any greenwashing activity, another area of focus for the EU, and ultimately protect the industry from such claims.

# PRICING DYNAMICS AND DIFFERENTIATED DEMAND

In 2022, flexible R-LDPE pellet prices in Europe have evolved from being linked to the virgin LDPE prices, to starting to decouple from them, with the natural grade rising above virgin prices for the first time in end-June'22 even as players were seeing increasing buyer resistance due to competition from virgin values and a negative macroeconomic outlook.

Although the increase in flexible R-LDPE pellet prices was largely driven by structural waste feedstock shortages coupled with increased demand from retail. Prices continued to be delinked from the virgin prices due to the emerging differentiated demand for recyclate driven by the ambitious sustainability targets for packaging.

The gap between sustainability commitments of fast-moving consumer goods (FMCG) firms/ brand-owners (many of which are due to mature in 2025) and available supply has seen recycled polymer markets decouple from virgin price movements and macroeconomic conditions in all packaging-dominated grades over the past few years. Figure 20 below outlines the major price drivers for R-LDPE, while there are several other factors considered during pricing negotiations.

The differentiated demand for R-LDPE pellets is critical in maintaining the momentum for continued investment in collection, sorting and recycling infrastructure with a focus on better quality recyclate.

Development of high-value added application for R-LDPE recyclate will drive the green premium associated with its pricing, ultimately leading to the development of this value chain.

| | |
|---|---|
| QUALITY | Particularity key in recycled markets due to the vast range of qualities available in the market and the lack of standardization - the better the quality of recyclate, and the more consistent the recyclate, higher is the price. |
| PRODUCTION | The recyclate value chain from collection to recycling is highy fragmented, adding up costs at each step. This is further increased by processing cost such as the washing step before recycling. In the current context, the rising energy costs have exacerbated the recyclate costs. |
| DEMAND | Legislation and ambitious sustainabily targets are starting to create a differentiated demand for LDPE recyclate for packaging application especially for stretch films, shrink films, bin-bags, etc. |
| SUPPLY | There is a structural shortage of LDPE bales in the European market currently mainly due to insufficient collection and sorting infrastructure, leading to a shortage of LDPE recyclate. Unless there is a step change, recyclate prices are expected to stay high in view of the ambitious sustainability targets. |

*Note: other factors include Sustainability, Substitution, Security of Supply, Food Contact Approval, End-use Demand, Brand Targets, etc.*

*Figure 20: Major price drivers for R-LDPE.*
*Source: ICIS Analysis.*

# INDUSTRY COMMITMENTS AND CONSUMER PRESSURE

**Demand for recyclates is expected to become more resilient because of emerging mandatory recycled content targets and packaging sector's direct exposure to end-consumer pressure. This will drive recycled content incorporation, even through periods of economic slowdown.**

Currently, packaging is a key target of regulators around the world, attributed to the high-profile plastic pollution crisis since 2016-17. That development pushed the fast-moving consumer goods (FMCG) sector to the front-line of the battle against plastic waste. Not only do brand owners have to comply with the environmental legislation, but also many decided to move forward adopting ambitious voluntary commitments. This includes industry projects and bodies focused on film recycling, stretching across the value chain.

The exposure to end-consumer pressure and emerging legislation developments have established greater resilience in demand, particularly from the packaging sector, which is likely to continue throughout the economic slowdown, but also in the attitude to costs (between virgin and recycled material) for end-users. The proposed recycled content targets in the PPWR will potentially lead to the decoupling of recycled polymers prices from virgin ones.

However, for the film sector that (to date) has had ambition rather than binding legal targets on the use of recycled content, the debate of economics versus sustainability when choosing raw material type is often a greater consideration.

This well-justified strategy exposed the packaging sector to several risks, with the structural supply-demand imbalance in the plastics recycling market being key. The supply side, mostly because of structural collection problems, was simply not ready to match the rate at which demand increased (especially for high-quality and sensitive applications), which pushed recycled polymer prices to the record-highs in H1 2022 in Europe.

# 7

# WAY FORWARD

**While legislation will be a key enabler, collaboration across the value chain will be crucial to progress towards flexible films circularity.**

Developing a robust & sustainable value chain for flexible films in Europe will require overcoming challenges related to insufficient collection and sorting, the lack of design for recycling, limited data transparency and the energy costs. Quality of film waste being fed to the recycling plants determines the quality & performance of the recyclate and the recyclers have limited to no control over it. The whole value chain, including Member States must step up to develop relevant infrastructure to better facilitate waste collection and sorting of flexibles while relevant policy-makers should focus on harmonisation of regulatory and legislative landscape.

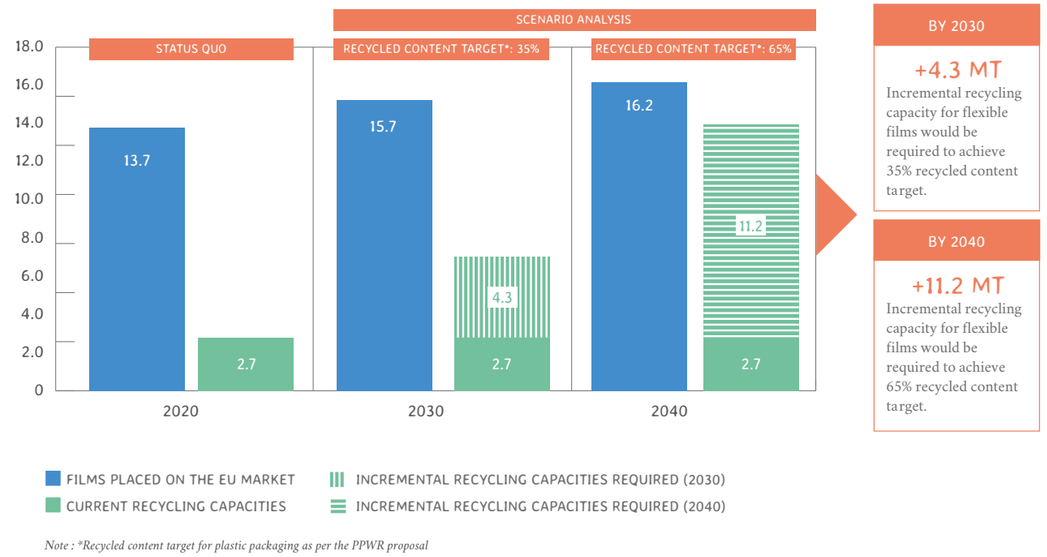
Developing recycling capabilities, in terms of both technology & scale would be a pre-requisite to ensuring stable supply & quality of recycled plastic pellets for higher end applications. Recyclers, waste collectors, converters & polymer producers would need to come together to make this happen by pooling in their respective expertise and resources. Low collection rates, inefficient sorting, high costs for producing good quality recyclate are often seen as deterrents to enhanced recovery and re-processing of flexible films in Europe. While technology & economies of scale could offer some support, legislative & regulatory incentives, paired with favourable fiscal policies would be critical to make this sector more viable for further investments.

# EUROPEAN RECYCLING CAPACITY REQUIRED TO ACHIEVE RECYCLED CONTENT TARGETS

The way forward will require significant expansion of recycling in Europe to meet the upcoming legislative targets. As mentioned in previous section, the Packaging and Packaging Waste Directive (PPWD) proposal also included targets for incorporation of recycled content in packaging (35% by 2030 and 65% by 2040) that will cover non-contact-sensitive flexible films as well as specific targets for contact-sensitive plastic packaging.

These targets are for plastic packaging in general, therefore recycled content may vary across different plastic packaging types, polymers, etc. However, for the purpose of the following estimates, a scenario where flexible films achieve the plastic recycled content targets has been considered. This has been modelled to estimate how much flexible films recycling capacity would be required to guarantee that the flexible films also meet the recycled content targets for plastic packaging waste of 35% by 2030 and 65% by 2040. The results obtained shown in Figure 21 indicate that:

- To achieve 35% recycled content target of flexible films (placed on the European market) within plastic packaging in 2030, a total of 7 million tonnes of mechanical recycling capacity for flexibles would be required.
- Similarly, by 2040, to achieve 65% recycling of flexible films (placed on the European market) within plastic packaging, a total of 13.9 million tonnes of mechanical recycling capacity for flexibles would be required.
- Considering that in 2020, films' mechanical recycling capacity was 2.7 million tonnes, this would translate to an incremental capacity of 4.3 million tonnes required by 2030 and 11.2 million tonnes required by 2040.




*Note : *Recycled content target for plastic packaging as per the PPWR proposal*

*Figure 21: European films placed on the market vs projected recycling capacity required based on the proposed recycled content targets (ppwr proposal)*
*Source: ICIS Supply & Demand Database, ICIS Analysis*

This scenario considers only mechanical recycling plants and an average recycling yield of over 75%. Other factors such as improvements to consumer awareness, collection rates, waste management and sorting technologies, end-markets, mandates, financial incentives or penalties, etc. have not been considered in the estimates, but will play a significant role in achieving the targets.

Expanding flexible recycling capacity to these levels will be quite challenging. Turning this ambition into reality would take significant effort and require more legal certainty, regulation, and collaboration across the value chain, especially around the collection and sorting systems. There would have to be a corresponding effort to significantly improve the collection rates to be able to have enough waste to process regularly.

# DEVELOPMENT AND OUTLOOK FOR RECYCLATE APPLICATIONS

Recycled PE and PP films differentiated demand for higher-end value applications would be crucial in accelerating the development of collection, sorting and recycling infrastructure in the region and will need to be driven by brand owners, retailers & packaging producers by using recycled plastic content in their packaging either voluntarily or to comply with the government mandates. This latent demand & any unmet needs could pave the way for further development of relevant applications.

While currently the application of R-LDPE for contact-sensitive packaging does not exist, there are other, bigger film applications (~75% of the films market) where the consumption of R-LDPE can be expanded. Based on the discussions with market participants and the evolving market direction, besides non-food film & foil, other markets with a growing potential of R-LDPE usage are agricultural films and building & construction films. Even though there are no policies in place for usage of recycle in non-packaging films, the industry is stepping up efforts to make their contribution towards circularity voluntarily. Use of LDPE recycle towards longer life applications such as roofing membranes, pipes, air ducts are also being explored.

Use of recycled content in flexible packaging would necessitate new design solutions for polymers, additive/adhesive systems, packaging design to achieve at par or better packaging performance. With the polymer know-how & knowledge of end-applications, polymer / packaging producers as well as adhesives/ additive suppliers have a major role to play in this necessary development. Brand owners' & polymer producers' off-take arrangements to secure volumes of recycled material would further enable sustained demand for recycled plastics as well as facilitate streamlining of recycling operations by encouraging them to maintain performance and quantity of their output.

However, there are inherent quality and yield challenges in using flexible film recycle, especially from the household and agricultural waste streams linked to lack of design for recycling, limited segregation at source, insufficient collection, high contamination, etc. In order to expand the usage of flexible film recycle towards high end value applications, the desired recycle quality and available quantity will be essential.

# RECOMMENDED INTERVENTIONS / PRACTICES

## COLLECTION

- ✓ Increase the availability and accessibility of flexible films waste collection systems to maximize the inclusion of not only households but all sectors
- ✓ Increase the investments in waste management infrastructure to facilitate the increased inflow of waste films to the recyclers
- ✓ Launch of campaigns (by municipalities, waste managers, etc.) to build consumer awareness and responsible behaviour towards source segregation to prevent film waste leakage
- ✓ Reduce dependency on exports to better manage the flexible films waste locally

## SORTING

- ✓ Improve sorting systems and integrate upcoming innovative technologies to reduce losses and produce bales with consistent specifications
- ✓ Standardise sorted bale specifications in Europe

## RECYCLING

- ✓ Expand recycling capacity for flexible films and increase the use of new technologies to improve the quality of waste film bales
- ✓ Standardise specifications for various grades of R-LDPE recycle in Europe
- ✓ Plan off-takes for recycle from recyclers to bring commitment across the value chain
- ✓ Improve recycle specifications to meet performance expectations for sophisticated applications

## LEGISLATION

- ✓ Create legal certainty and harmonised implementation of legislation for the products placed on the market across European countries
- ✓ Standardise definition of recyclability and harmonisation of packaging design with design for recycling guidelines
- ✓ Harmonise implementation of Extended Producer Responsibility (EPR) for flexibles in all countries
- ✓ Introduce legislative mandates for recycled content targets for flexible films
- ✓ Implement eco-modulated EPR fee for flexible films based on recycled content and recyclability, among other factors

# 4. COLLABORATION ACROSS THE VALUE CHAIN

Collaboration and commitment across the value chain will be fundamental in developing a robust & sustainable system for flexible films recycling in Europe since this value chain is in the midst of an ever-evolving, iterative phase of development.

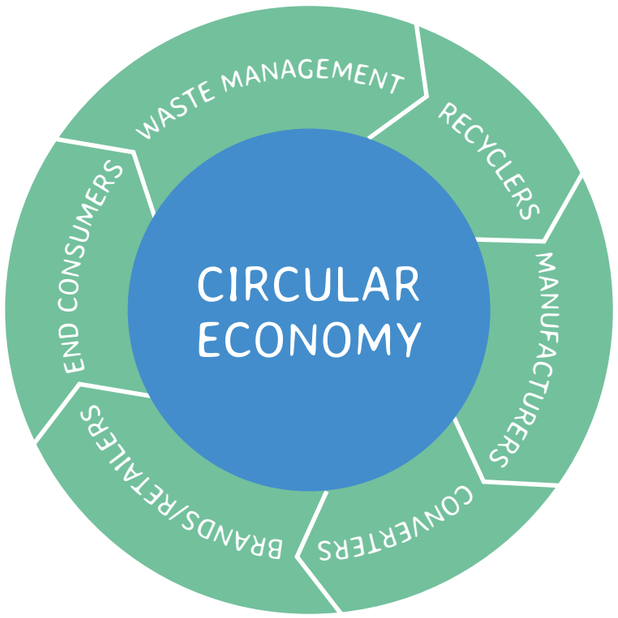



*Figure 22: Key recycling value chain stakeholders.*
*Source: ICIS Research & Analysis*

The key value chain stakeholders including brand owners, recyclers, converters, polymer producers are working persistently to meet the growing sustainability demands to meet the consumer expectations as well conform to the regulatory obligations for recycling and recycled content targets. One example mentioned above is that only 17% of the recyclates produced were consumed back on flexible films applications in 2020.

Number of projects are ongoing that are investing various aspects of the flexible films value chain including process development for recycling multilayer films, development of robust data sources, identification and scaling up of recovery processes, etc. Such projects are being led by industry consortiums, who are working diligently towards achieving the circularity goals.

# 6

# CONCLUSION

**Flexible films are lightweight and efficient materials with optimal performance that allows to do "more with less", thereby contributing towards sustainability. However, managing their end-of-life and journey thereafter will be a crucial step to progress towards circularity especially in the case of flexibles. While flexibles circularity shows a strong growth potential into the future, its growth needs to be supported by timely actions by participants across the value chain:**

## DESIGN FOR RECYCLING

Recyclability through Design for Recycling (DfR) can reduce contamination, process losses, and reject fractions, ultimately improving quality and quantity of supply.

## STEEP INCREASE IN COLLECTION RATES AND SIGNIFICANT IMPROVEMENTS IN QUALITY OF SORTING

It is evident that the key challenge for expanding flexible film circularity is to to reduce the amount of plastic waste that is neither collected nor sorted by promoting separate collection and monomaterial sorting.

## DATA TRANSPARENCY

Regular availability of consistent and reliable data on tonnages of flexible films placed on the market and collected by polymer, colour, size and source will be essential for the long-term planning and development of collection & sorting infrastructure, recycling technologies and capacities required to achieve flexibles circularity.

## CREATION OF HIGH-VALUE END-MARKETS

Improvement in recyclate specifications to meet performance expectations for sophisticated applications will lead to the creation of higher value end-markets and also improve the amount of recyclates that are put back on the market.

## GREATER HARMONISATION OF LEGISLATIVE LANDSCAPE AND TECHNOLOGY INNOVATION

Legislation can encourage recovery of film waste, ideally separately, and potentially with improved systems that produce higher quality bales. Extended Producer Responsibility (EPR) schemes though implemented could significantly vary across EU countries potentially leading to data transparency challenges particularly in countries with several competing Producer Responsibility Organisations (PROs). Adopting a universal definition, common framework and reporting obligations for EPR regulations would support harmonisation of systems across Europe.

Technology innovation and adoption especially around packaging design (design for recycling), sorting, recycling and traceability will act as key enablers to accelerate the upgradation and automation of processes required to bring about a step change in the transformation of flexible films recycling value chain. Each of these has been discussed in more detail in the full report.

## WHILE LEGISLATION WILL BE A KEY ENABLER, COLLABORATION ACROSS THE VALUE CHAIN WILL BE CRUCIAL TO PROGRESS TOWARDS FLEXIBLE FILMS CIRCULARITY

The value chain, through collaboration, has the potential to develop solutions. There are short- and long-term developments needed for flexibles circularity, but collaboration will be key to achieving that progress. Industry (recyclers, waste managers & polymer producers) and policymakers should come together to make this happen by pooling in their respective expertise and resources. Municipalities & waste managers must step up efforts to develop viable infrastructure to better facilitate waste collection and sorting of flexibles. Polymer / packaging producers with their polymer know-how & knowledge of end-applications, as well as adhesives / additive suppliers have a major role to play in the design for recycling efforts. Brand owners' commitments through off-take arrangements to secure volumes would further enable sustained demand for recycled plastics and streamline recycling operations to maintain consistent performance and quantity of their output. For policymakers, continued efforts on harmonisation of regulatory and legislative landscape in Europe should be a key priority.

# GLOSSARY OF TERMS

| | |
|---|---|
| B2B | Business-to-business |
| BOPE | Biaxially Oriented Polyethylene |
| BOPET | Biaxially Oriented Polyethylene Terephthalate |
| BOPP | Biaxially Oriented Polypropylene |
| CAGR | Compound Annual Growth Rate |
| EPR | Extended Producer Responsibility |
| EU | European Union |
| EU27+3 | EU Countries, United Kingdom, Switzerland, Norway |
| EV | Electric Vehicles |
| EVOH | Ethyl-vinyl alcohol copolymer |
| HDPE | High Density Polyethylene |
| ICE | Internal Combustion Engine |
| KT | Kilo Tonnes |
| LDPE | Low Density Polyethylene |
| LLDPE | Linear Low-Density Polyethylene |
| MFI | Melt Flow Index |
| MT | Million Metric Tonnes |
| PA | Polyamide |
| PCR | Post Consumer Recyclate |
| PE | Polyethylene |
| PET | Polyethylene Terephthalate |
| PO | Polyolefins |
| PP | Polypropylene |
| PPWD | Packaging and Packaging Waste Directive |
| PRO | Producer Responsibility Organization |
| PVC | Polyvinyl Chloride |
| PVDC | Polyvinylidene Chloride |
| R-LDPE | Recycled LDPE |
| SKU | Stock Keeping Unit |
| UK | United Kingdom |

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