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**Article**

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Article

# The Commitment of Packaging Industry in the Framework of the European Strategy for Plastics in a Circular Economy

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**Abstract:** European Commission is strongly committed into issues related to plastic materials production and plastic waste management. While the *Circular Economy Package* has set targets generally referred to recycling rates, the *European Strategy for plastics in a circular economy* (and related action plan), fosters sustainability along the entire plastic value chain: from primary producers to converters, brand owners and retailers to waste collectors and recyclers. The *Directive on the reduction of the impact of certain plastic products on the environment* (more commonly known as Directive on Single-Use-Plastics, waiting for publication in the Official Journal of the European Union) rules targets on ten plastic products most often found as littering on global beaches, directly affecting plastic industry and, consequently, market. Policy makers and industrial stakeholders are called upon to collaborate. The article aims to illustrate interactions between European Commission and all plastic value chain stakeholders on implementing measures to reach ambitious targets pursued by the recent European policy. The study shows how European Commission has robustly worked to regulate production and consumption patterns on plastic carrier bags and packaging (including food packaging) thus facilitating the achievement of specific targets provided by the recent Directive. However, additional provisions concerning market restriction have been introduced; industrial stakeholders carried on a prompt response by promoting the creation of alliances, joint venture and association, as well as a more integrated plastic value chain. On the base of this purpose, a virtuous example of a closed supply chain is presented.

**Keywords:** plastic; circular economy; European Strategy for Plastics in a Circular Economy; Single-Use-Products; environmental management; closed-loop supply chain

## 1. Introduction

The awareness on the impact of certain production and consumption systems in the environment has globally stimulated interest into the re-design of products, processes and services, pursuing raw materials sustainable utilization, waste reduction and sustainable patterns. The value and material maintenance in products and waste is stimulated by circular economy models (Di Maio and Rem 2015).

Within this context, plastics represent a key material. World plastic production is continuously increasing; it has experienced an exponential growth over the past half-century: from the 1.7 million metric tons (Mt) produced in 1950 to 348 Mt in 2017 (Ellen MacArthur Foundation 2016). Despite the recent increasing awareness on the impact of this material in different components of the eco-system (Eagle et al. 2016), plastic market seems not to be interested to a setback, growing of around 10–15 Mt every year. However, there is no alignment between the increasing of the production rate and an adequate result in waste management, that is still widely underperforming. Considering the

estimation provided by Geyer et al. (2017), 6300 Mt of plastic waste were globally generated in 2015, which around 9% was recycled, 12% was incinerated and 79% was disposed in landfills or the natural environment. Marine environment is nowadays the main hub of mismanaged plastic waste. Marine plastic pollution (MPP) has been ignored for a long time and its gravity has been only recently recognized (Stefatos et al. 1999). An estimated 8 Mt of plastic waste enters the Ocean every year, where around 60% has been rediscovered in five Asian countries: China, Indonesia, the Philippines, Thailand and Vietnam (Meng et al. 2015). The biggest plastics island, the so-called *Great Pacific garbage patch*, is located in the north central Pacific Ocean (Lebreton et al. 2018). Africa remains relatively unknown in terms of their overall contribution to the plastic waste in the Ocean (Eriksen et al. 2014). However, the Mediterranean Sea can be considered as an additional great accumulation zone of floating plastic debris at global scale (Cózar et al. 2015). Even if hydrodynamic study suggests that a proportion of the MPP may originate outside the basin, European Union gives a great contribution in terms of plastic production and consumption.

Europe is the third global plastic producer, manufacturing 60 Mt of plastic resins in 2017, with an increasing of 4.5 Mt in comparison with 2016 production (PlasticsEurope 2017, 2018). In accordance with global context, waste generation has also seen an intensification in Europe<sup>1</sup>: 27.1 Mt of post-consumer plastic waste was collected in 2016; however, less than 31.1% of collected plastic waste was recycled in 2016, while landfilling and incineration rates of plastic waste remained relatively high, respectively about 27.3% and 41.6% (PlasticsEurope 2017). At manufacturing level, the European plastic demand was 51.2 Mt in 2017. The main plastic demanders were packaging, automotive and building and construction (B&C) industries, covering respectively 39.7%, 19.8% and 10.1% of the total demand (PlasticsEurope 2018). About waste management, packaging composition, functionalities and purpose allow to better track this type of plastic waste: 16.7 Mt European plastic packaging waste was collected in 2016 but only 40.8% was recycled (PlasticsEurope 2017). Owing to long-term service life and its present as constituents in multi-material products, plastic coming from B&C and automotive are not directly related to production items, triggering data disaggregation and fragmentation.

The European Commission is strongly working on waste traceability and consequently, MPP reduction. Accounting for 60% of post-consumer plastic waste, among European measures, plastic packaging covers a priority role: the recent *Strategy for Plastics in a Circular Economy* has set very ambitious goal for plastic packaging sustainability. In fact, the European Commission aims to achieve 100% of reusable or easily recyclable plastic packaging placed on the market by 2030 (European Commission 2018a). It follows that packaging industry become the cornerstone for a broader vision of sustainable plastic value chain. In this context, the paper would illustrate policy effort and packaging industry commitment towards the implementation of measures and the achievement of European targets in the plastic field.

## 2. The European Strategy for Plastics in a Circular Economy Perspective

Work plan on plastics was identified as a priority in the *Closing the loop Action Plan for the Circular Economy* (European Commission 2015; Bourguignon 2016). In fact, while the Circular economy package had set general targets on recycling and landfilling rate, the European Plastic Strategy has strongly contextualized into the packaging industry (European Commission 2018a). The European targets, established by the European Commission within the Strategy, are here listed:

- *By 2030, all plastics packaging placed on the European market will be either reusable or can be recycled in a cost-effective manner.*
- *By 2030, more than half of plastics waste generated in Europe will be recycled.*

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<sup>1</sup> EU28+NO/CH.

- *By 2030, sorting and recycling capacity will increase fourfold since 2015, leading to the creation of 200 000 new jobs, spread all across Europe.*
- *By 2030, secondary plastic market will increase fourfold since 2015.*

The Plastic Strategy seems to encourage measures on recyclable and recycled plastics. Design and innovation become the main tools that industrial stakeholders should implement to reach targets. However, a better collaboration between actors involved in plastic value chain is necessary to improve the separate collection of plastic waste, to ensure high quality standards for recycling industry and foster a well-functioning market of recycled polymers. Industrial ecology principles should be implemented to make raw material producers, compounders, plastic converters and recyclers more collaborative. Market Based Instruments (MBIs),<sup>2</sup> including Extended Producer Responsibility (EPR),<sup>3</sup> could be the means by which better pursue collaboration between plastic producers and waste managers, thus making the plastic supply chain responsible for its un-sustainable production impact. However, being it applicable only on specific products, synergies, in terms of alliance, joint venture and association, must become the strategic solution to make plastic value chain more sustainable.

#### *Directive on the Reduction of the Impact of Certain Plastic Products on the Environment*

The Plastic Strategy includes key commitments that will transform the way in which plastic products can be designed, produced and recycled. However, considering the pressure of certain plastic products in the environment, a more impactful set of measures has been undertaken by the European Commission. In fact, taking into account that plastic makes up 80–85% of the total number of marine litter items (Jambeck et al. 2015) and that Single-Use-Plastics (SUPs) items represent about half of MPP, many variegated measures will be forced to the ten main SUPs responsible for the marine litter.

The list of actions is shown in Table 1.

Entering into details, measures are referred to design, market, consumer behaviour and waste management. While European Commission has already worked very intensively to facilitate sustainable production and consumption, additional measures have been included to innovate plastic market. In particular:

- *If readily available alternatives are present, market restriction must be set;*
- *If available alternatives are not available yet, general reduction targets must be fixed, allowing Member States to adopt their own measures to achieve the reduction which should be at least of 25% by 2025 (European Commission 2018b).*

Market restriction are imposed for cotton bud sticks, stick for balloons, cutlery, plates, stirrers, straws and oxo-degradable plastic food container. Reduction in consumption has forced for food containers and cups for beverage.

It follows that, packaging products, such as food and beverage containers, cups for beverages, cutlery, plates, stirrers, straws, packets and lightweight plastic carrier bags are under the microscope of Europe. While a great deal of work has been done to regulate plastic carrier bags and packaging, including food packaging, other products have been investigated for the first time.

The following paragraphs are going to provide a discussion on the effort carried on by the European Commission on these products than the main actions and measures established by the Directive on SUPs. The study is carried on by a legislative review of the current European policy regarding the field of interest.

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<sup>2</sup> MBIs are tools to address the market failure of environmental externalities either by incorporating the external cost of production or consumption activities through taxes or charges on processes or products.

<sup>3</sup> EPR is an economic instrument for making the producers financially responsible of the consequences on the environment.

**Table 1.** Actions for single-use plastic items and fishing gear– Source: European Commission, Proposal Directive on the reduction of the impact of certain plastic products on the environment (2018).

|  | Consumption Reduction | Market Restriction | Product Design Requirement | Marking Requirements | Extended Producer Responsibility | Separate Collection Objective | Awareness Raising Measures |
|--|-----------------------|--------------------|----------------------------|----------------------|----------------------------------|-------------------------------|----------------------------|
| Food containers                        | ■                     |                    |                            |                      | ■                                |                               | ■                          |
| Cups of beverages                      | ■                     |                    |                            |                      | ■                                |                               | ■                          |
| Cotton bud sticks                      |                       | ■                  |                            |                      |                                  |                               |                            |
| Cutlery, plates, stirrers, straws      |                       | ■                  |                            |                      |                                  |                               |                            |
| Stick for balloons                     |                       | ■                  |                            |                      |                                  |                               |                            |
| Balloons                               |                       |                    |                            | ■                    | ■                                |                               | ■                          |
| Packets & wrappers                     |                       |                    |                            |                      | ■                                |                               | ■                          |
| Beverage containers, their caps & lids |                       |                    | ■                          |                      | ■                                |                               | ■                          |
| Beverage bottles                       |                       |                    | ■                          |                      | ■                                | ■                             | ■                          |
| Tobacco product filters                |                       |                    |                            |                      | ■                                |                               | ■                          |
| Wet wipes                              |                       |                    |                            | ■                    | ■                                |                               | ■                          |
| Sanitary towels                        |                       |                    |                            | ■                    | ■                                |                               | ■                          |
| Lightweight plastic carrier bags       |                       |                    |                            |                      | ■                                |                               | ■                          |
| Fishing gear                           |                       |                    |                            |                      | ■                                |                               | ■                          |

### 3. Policy effort on Single-Use-Plastics

The short lifetime and, at the meantime, the huge environmental impact of SUPs, suggest rethinking each phase of the life cycle by introducing a set of measures affecting design, manufacturing, trade, consumption and disposal. As described below, a step-by-step effort has been pursuing by policy and industry since 2015.

#### 3.1. Lightweight Plastic Carrier Bags

The consumption of plastic carrier bags has quickly increased in the last years: 98.6 billion plastic carrier bags have been used in 2010 (European Commission 2013). The volume of plastic carrier bags is estimated to rise from 0.75Mt in 2010 to 0.84 Mt in 2020 (BIO Intelligence Service 2011). Many measures had been forced by the European Commission for the regulation of plastic carrier bags before 2018. The Directive 2015/720 EC (European Parliament and the Council of the European Union 2015) has already paid attention to the consumption of lightweight plastic carrier bag, resulting the first European instrument of that nature. Measures taken by Member States substantially included:

- consumption reduction of lightweight bags (ensuring that the annual consumption level does not exceed 90 lightweight plastic carrier bags per person by 31 December 2019 and 40 lightweight plastic carrier bags per person by 31 December 2025 or equivalent targets set in weight) by the application of Market-Based-Instruments (MBIs).
- elimination of very lightweight plastic carrier bags (categorized as illegal, today)

Even if provisions have been positively accepted and brought about a rapid shift in consumer behaviour, less performances have been registered at disposal stage. Despite the application of EPR scheme (by the Directive 2004/12/EC on packaging and packaging waste), the lack of training and information about proper disposal of biodegradable and bio-compostable plastic carrier bags, has negatively influenced the cost analysis of waste management among public authorities (da Cruz et al. 2014). It is particularly evident in marine environments where plastic bags are the most found items of European beaches (O'Brine and Thompson 2010). For a good understanding of biodegradation, composting and oxo-degradation process, a study was published by the European Commission in 2018 (European Commission 2018c). The absence of certain evidence of positive impact and beneficial effects of oxo-degradable plastic on the environment has led the Commission to insert process regarding the restriction of oxo-degradable plastic bags and EPR scheme for other plastic carrier bags in the Plastic Strategy Action plan. The European Commission has also started to define new harmonised rules for defining and labelling compostable and biodegradable plastics to empower consumers to make the proper disposal.

Legislative efforts to regulate lightweight plastic carrier bags are summarized in Table 2.

**Table 2.** Actions for lightweight plastic carrier bags.

|                                  | Consumption Reduction | Market Restriction | EPR                  | Awareness Raising Measures | Marking Requirements |
|----------------------------------|-----------------------|--------------------|----------------------|----------------------------|----------------------|
|                                  | Directive 2015/720 EC |                    |                      |                            |                      |
| LIGHTWEIGHT PLASTIC CARRIER BAGS |                       |                    | Directive 2004/12/EC |                            |                      |
|                                  |                       |                    | Directive on SUPs    |                            |                      |
|                                  | Further step          |                    |                      |                            |                      |

The transposition of European Regulation among Member States has positively affected the reduction of single use plastic carrier bags production and consumption. Each Member State has adopted different approach to deal with the problems. Denmark, has first chosen to tax plastic bag production reducing the consumption to 4 single use plastic bags a year (Larsen and Venkova 2014);

Poland has introduced a tax based on weight of plastic bags, while Ireland and England have introduced a fee for plastic shopping bags, contributing to a 90% reduction in consumption (UNEP 2018). France and Italy have banned non-biodegradable and non-compostable lightweight plastic carrier bags. The fossil plastic carrier bags market has reacted by biodegradable and bio-compostable plastic carrier bags that, nowadays dominate European market of biodegradable plastic products, accounting about two thirds of the total market of 100,000 t sold in 2015 (Nova Institute 2016).

### 3.2. Plastic food packaging

Plastic is one of the most common food contact materials (FCM)<sup>4</sup> in Europe. It is mainly used to package and contain food, but cutlery and dishes can be also included.

One of the main group of products, in which the SUPs Directive has been planned activities, deals with food and beverage packaging. In opposite to plastic bags, no previous actions on market restrictions and consumption reduction had been undertaken by the European Commission before 2018 (see Table 3). About waste management, Directive on SUPs introduces bottle collection scheme to improve the cost-effectiveness of Polyethylene Terephthalate (PET) recycling process. In particular, the Commission has established a separate collection target for beverage bottles of 77% by 2015 and 90% by 2029, resulting the first target established for a specific packaging waste (European Commission 2018b). Nevertheless, Directive 1994/62/EC on packaging and packaging waste (PPWD) had promoted recycling, reuse and other forms of waste prevention and recovery, establishing targets in 2004, then changed by the Directive 2018/852/EC (European Parliament and the Council of the European Union 1994, 2004a, 2018) setting targets for 55% of plastic packaging waste prepared for reuse and recycling to be met by 2025. Although, no 2030 target has been proposed for plastic packaging waste, many design requirements and MBIs implementation have been introduced. EPR optimization has also been suggested by the Directive as a measure for regulating the quantity and quality of packaging.

Considering legislative framework about Food-Contact-Material (FCM), general requirements were laid down in the Framework Regulation (EC) No 1935/2004 in the same year of the PPWD (European Parliament and the Council of the European Union 2004b). Good Manufacturing Practice (GMP) for materials and articles intended to come in contact with food were described in the Regulation (EC) No 2023/2006 (Commission Regulation 2006). All have been summarized and consolidated within the Regulation (EC) No 10/2011 setting rules for the composition of FCM plastic and detailing the list of authorized and not authorized substances (European Commission 2011). Thanks to the Regulation (EC) No 282/2008, that establishes rules for the authorization of processes used to recycle such materials, measures on sustainability and circularity were integrated in FCM Framework Directive for the first time (Commission Regulation 2008). The Regulation, resulting from a strong cooperation between European Food Safety Authority (EFSA)—that releases scientific opinion on process and European Commission—that give final authorization to manufacture food packaging made of recycled plastic, has positively affected industry. In order to quickly implement that innovation, firms have widely invested in R&D such a point that 127 recycling processes have been registered and partially evaluated by EFSA in 2014 in Europe (Food Packaging Forum 2014). More and more food packaging companies are today investing in recycling plant, especially chemical depolymerization (Aguado et al. 2007) to meet high quality standards for FCM.

On the base of the regulation for plastic carrier bags, a similar approach has been implemented for specific packaging products within SUPs Directive: the market restriction of cutlery and dishes is shifting manufacturing from virgin plastic to recycled, biodegradable and compostable plastic and alternative materials. As seen in the Table 3, innovation on product is also stimulated for additional packaging: beverage bottles are mentioned by ensuring 30% of recycled content by 2030.

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<sup>4</sup> Food contact materials (FCMs) are either intended to be brought into contact with food, are already in contact with food, or can reasonably be brought into contact with food or transfer their constituents to the food under normal or foreseeable use.

**Table 3.** Actions for food packaging.

|   | <b>Consumption Reduction</b> | <b>Market Restrictions</b> | <b>Product Design Requirements</b>  | <b>EPR</b>  | <b>Separate Collection Objectives</b> | <b>Awareness Raising Measures</b>           |
|---|------------------------------|----------------------------|---|---|---------------------------------------|---|
| <b>FOOD CONTAINERS</b>                      | SUPs Directive               |                            | Regulation (EC) No 1935/2004 + Regulation (EC) No 2023/2006 + Regulation (EU) No 10/2011 + Directive 2018/852 EC                  | Directive 2004/12/EC + SUPs Directive + Directive 2018/852 EC |                                       | Regulation (EC) No 66/2010 + SUPs Directive |
| <b>CUPS FOR BEVERAGE</b>                    | SUPs Directive               |                            | Regulation (EC) No 1935/2004 + Regulation (EC) No 2023/2006 + Regulation (EU) No 10/2011 + Directive 2018/852 EC                  | Directive 2004/12/EC + SUPs Directive + Directive 2018/852 EC |                                       | Regulation (EC) No 66/2010 + SUPs Directive |
| <b>CUTLERY, PLATES, STIRRERS, STRAWS</b>    |                              | SUPs Directive             | Regulation (EC) No 1935/2004 + Regulation (EC) No 2023/2006 + Regulation (EU) No 10/2011  |   |                                       | Regulation (EC) No 66/2010                  |
| <b>PACKETS &amp; WRAPPERS</b>               |                              |                            | Regulation (EC) No 1935/2004 + Regulation (EC) No 2023/2006 + Regulation (EU) No 10/2011  | Directive 2004/12/EC + SUPs Directive                         |                                       | Regulation (EC) No 66/2010 + SUPs Directive |
| <b>BEVERAGE CONTAINERS (AND COMPONENTS)</b> |                              |                            | Regulation (EC) No 1935/2004 + Regulation (EC) No 2023/2006 + Regulation (EU) No 10/2011 + Directive 2018/852 EC + SUPs Directive | Directive 2004/12/EC + SUPs Directive                         |                                       | Regulation (EC) No 66/2010 + SUPs Directive |
| <b>BEVERAGE BOTTLES</b>                     |                              |                            | Regulation (EC) No 1935/2004 + Regulation (EC) No 2023/2006 + SUPs Directive  | Directive 2004/12/EC + SUPs Directive                         | SUPs Directive                        | Regulation (EC) No 66/2010 + SUPs Directive |



Many other requirements have been forced to prevent marine littering. Citizens awareness covers an important part in encouraging responsible behaviour. Awareness raising measures have been pushed by the legislative framework on labelling activity, deeply described in European Standards ISO. Information about the environmental impact have been included by the Regulation (EC) No 66/2010 on the Ecolabel (European Parliament and the Council of the European Union 2010). However, more labelling activity on the plastic content and the appropriate waste disposal operations is pursued by the SUPs Directive.

#### 4. Industry Commitment towards EU Plastic Strategy

The recent European benchmark has upset the industrial environment. A positive feedback on SUPs Directive has been received from 65 industrial stakeholders (including Barilla, Borealis, Coca-Cola, PepsiCo, PlasticRecyclersEurope, Danone, Whirlpool, Vinylplus etc.) that, participating to the European campaign related to the Plastic Strategy, have submitted voluntary pledges to reach targets about having 10 Mt of recycled plastics in a closed loop system by 2025. Other 73 stakeholders (including CPME, Elipso, epro, EuPC, European Bioplastics, Europen, Federazione Gomma Plastica, Flexible Packaging Europe, IK, pack2go, Petcore Europe, PlasticsEurope, Pro.mo e Styrenics Circular Solutions) have appealed to the European legislators to ensure the safeguarding of competitive packaging market. Considering that all measures provided by the SUPs Directive also includes bio-based and biodegradable plastics, the assurance of that market has been proposed by the European Bioplastics association (EUBP).

It is well known that uncoordinated manner, differing in ambition and purpose, could deliver a fragmentation in the market. Many initiatives have been diffused to establish a proactive attitude at plastic value chain and prevent plastic market crisis. The engagement and work in partnership with a wide range of stakeholders (NGOs, customers, consumers, suppliers, regulators, trade and research entities and associations) has allowed the creation of a multitude of alliances. Ellen MacArthur foundation, in collaboration with UN Environment, has launched the *New Plastics Economy Global Commitment*, uniting over 290 organizations (including, Amcor, Ecover, Evian, L'Oréal, Mars, M&S, PepsiCo, Coca-Cola Company, Unilever, Walmart and Werner & Mertz (together representing more than 6 Mt of plastic packaging per year) on sharing a harmonized 2025 vision of 100% reusable, recyclable or compostable packaging.

Governmental organizations can stimulate cooperation between corporations in product chains. (Boons and Baas 1997; Lambert and Boons 2002). This principle is pursued by the European Commission that has launched the *Circular Plastic Alliance* to foster well-functioning market of recycled plastics. The *Alliance to End of Plastic Waste* has been created by the main plastic producers (Chevron Phillips Chemical Company, Dow Chemical, ExxonMobil, Formosa Plastics Corporation, Procter & Gamble, Reliance Industries and Shell, among other oil, chemical and waste management companies) with the aim to dedicate a combined total of \$1 billion over the next five years to develop and scale solutions to minimize and manage plastic waste. In spite of the lack of coordination, the network of alliances has been unable to separately make effort on design, waste management and recycling thus covering the main challenges of the current pattern.

Other effects of high-effort on plastic responsible industries is the diffusion of inter-firm alliances, recognized by Hagedoorn (2002) as an important organization form of innovative activities able to lead to a new view of industry structure. In addition to inter-firm alliances, industrial networking is pursued by technology-based joint ventures (Metcalf and Coombs 2000), basically aimed to reinforce experimentation on bio plastic and recycled plastic applications. Smart packaging and recycling programs become the main sustainability strategy of the main packaging brands. Just to mention some good practices, among the main plastic converters, Coca Cola and BASF have invested on chemical recycling, while Bio-On and Nestlé has created a partnership with Danimer Scientific to substitute PET with PHA in bottle manufacturing. Unilever has started a collaboration with Bio-on on PHA microplastic in bio cosmetics. Last but not least, Procter and Gamble has launched a limited-edition

bottle made of 100% recycled plastic, including bottles sourced from beach plastic. However, European companies who have already invested on eco-design and implemented new business models could have more opportunities to gain a substantial foothold in the current marketplace. As described in the following example, environmental management (EM) covers a strategic role.

### 5. Virtuous Example of Closed Loop Supply Chain

Cooperative relations between producers and suppliers can become more impactful when mergers and acquisitions activity (M&A) are implemented. The internalization of specialization can generate more value in EM (Murty et al. 2006), especially in plastic industry where only a strong control and supervision on recycling can produce high quality of secondary plastics such to fulfil requirements for following applications.

The article presents the example of ILPA Group, an Italian company located in the so-called Packaging valley in Emilia Romagna region. The packaging valley includes 339 companies working on packaging machinery manufacturing and 193 companies active in metal, paper and plastic packaging manufacturing. Among them, ILPA Spa is the main plastic packaging company of the Region. The peak has been registered when ILPA Spa, consisting of MP3 Srl—operating in the supply of finished products and ILIP Srl—working on thermoformed and semi-finished plastic food, acquired AMP Recycling, specialized on thermoforming and extrusion processes in one side and PET recycling in another side. With its three divisions (ILIP Srl, AMP Srl and MP3 Srl) ILPA Spa has reinforced its position on a European-wide scale in the segment of thermoformed plastic food packaging, as well as in the segment of semi-finished products for food applications. In particular, the implementation of the “Closed loop” system about the re-processing of PET, has led to a complete control system on recycling process (see Figure 1).

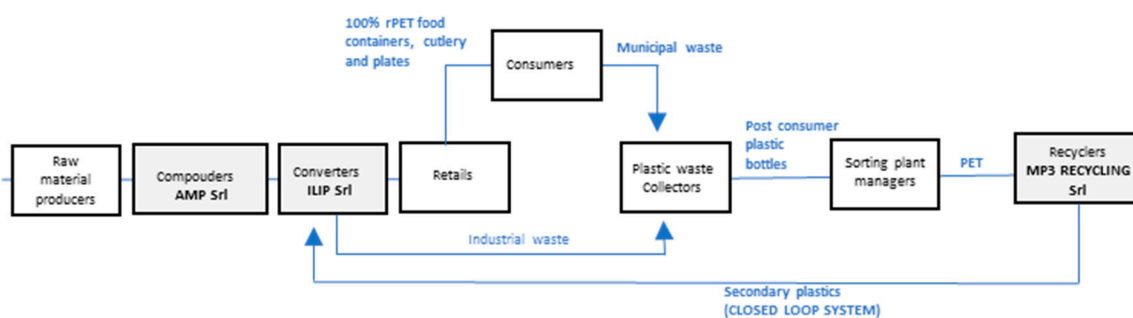


Figure 1. Closed loop supply chain–ILPA Group.

The “Closed loop” system is based on internal post-consumer bottle recycling process to produce high quality food grade rPET. While the recycling plant works on bottles sorting and washing, other departments of the group are devoted to grind, extrude and thermoform the recycled PET to produce secondary plastic materials for punnets and trays manufacturing. The meeting of high standards for secondary plastics has allowed the Group to receive the authorization to innovate packaging by 100% rPET mono-layer sheet so much that rPET has become the main input resource to manufacture foodstuffs, boasting a remarkable increase accounting for 18,000 tons in 2012 and 30,000 tons in 2016. In addition to high profit, and consequently return in investment, the Sustainability Strategy of the Group has anticipated the provisions established by the European Plastics Strategy, coming ready to implement measure imposed by the Directive on SUPs. In particular, ILIP’s business has experimented a wide range of food containers, cutlery and pledges made of alternative and sustainable materials, complying with the market restriction of the Directive (see Table 4).

Table 4. ILIP commitment towards SUPs Directive.

|  | r PET Food<br>Grave | PLA      | PLA/MATERBI | Polypropylene<br>(PP)—Reusable | Cellulose |
|--|---------------------|----------|-------------|--------------------------------|-----------|
| <b>FOOD<br/>CONTAINERS</b>             | ×                   |          |             |                                |           |
| <b>DISHES: Beverage<br/>containers</b> | × (100%)            | × (100%) | × (60%)     |                                |           |
| <b>Plates</b>                          |                     | × (98%)  | × (60%)     | ×                              | × (100%)  |

## 6. Conclusions

Plastic has become the key material to push transition towards circular economy models. *A European Strategy for plastics in a circular economy* requires huge efforts from plastic industry to shift unsustainable patterns with more one, thus preventing environmental externalities produced by fossil-based product manufacturing and disposal. Even if the current legislation on packaging has facilitated the transition to a more sustainable production and consumption pattern, the recent *Directive on the Reduction of the Impact of Certain Plastic Products on the Environment* (waiting for publication in the Official Journal of the European Union) fosters collaboration among policy makers, industrial stakeholders, trade associations and consumers. Even if Member States will have two years to transpose the Directive into national laws, many initiatives have been strengthened and disseminated at industrial context in a large European scale. The main brands, responsible for the sizeable proportion of plastic pollution, have started numerous activities based on alliance, joint-venture and association creation. However, coordination does not mean cooperation. The main challenge deals with the improvement of internal management to better meet European expectation. The modification of internal management could intensely affect supply chain, process, marketing services and waste operation. Integrated skills and expertise are indispensable to be innovative and remain in the competitive market. The sustainable strategy implemented by ILPA Group is a clear example of added value creation: the packaging company has decided to maintain its core business changing the overall supply chain, resulting on the application of circular economy principles where waste become a new resource in a closed loop system. The decoupling between value creation and purely economic growth has allowed ILPA Spa to create a valid competition by building a “differentiating dimension” in the short term. The ability to switch manufacturing sustainable packaging, has allowed the Group to be ready at tackling the European plastic challenge, thus covering a primary role on current green marketing chain. SMEs, are called upon to prioritize investment in sustainability in order to enhance trade innovations and opportunities and reinforce European leadership on sustainable market.

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## References

- Aguado, José, D. Serrano, and G. San Miguel. 2007. European trends in the feedstock recycling of plastic wastes. *Global NEST Journal* 9: 12–19.
- BIO Intelligence Service. 2011. Assessment of Impacts of Options to Reduce the Use of Single-Use Plastics Bags. Final Report Prepared for the European Commission—DG Environment 2011. Available online: [http://ec.europa.eu/environment/waste/packaging/pdf/report\\_options.pdf](http://ec.europa.eu/environment/waste/packaging/pdf/report_options.pdf) (accessed on 12 February 2019).

- Boons, F., and Leo W. Baas. 1997. Types of Industrial Ecology: The Problem of coordination. *Journal of Cleaner Production*. [CrossRef]
- Bourguignon, Didier. 2016. Closing the loop New circular economy package. *European Parliamentary Research Service*. [CrossRef]
- Commission Regulation. 2006. Regulation (EC) No 2023/2006 of 22 December 2006 on Good Manufacturing Practice for Materials and Articles Intended to Come into Contact with Food (Text with EEA Relevance). Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R2023&from=EN> (accessed on 27 December 2018).
- Commission Regulation. 2008. Regulation (EC) No 282/2008 of 27 March 2008 on Recycled Plastic Materials and Articles Intended to Come into Contact with Foods and Amending Regulation (EC) No 2023/2006 (Text with EEA Relevance). Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0282&from=EN> (accessed on 27 December 2018).
- Cózar, Andrés, Marina Sanz-Martín, Elisa Martí, J. Ignacio González-Gordillo, Bárbara Ubeda, José Á. Gálvez, Xabier Irigoien, and Carlos M. Duarte. 2015. Plastic accumulation in the mediterranean sea. *PLoS ONE*. [CrossRef]
- da Cruz, Nuno Ferreira, Sandra Ferreira, Marta Cabral, Pedro Simões, and Rui Cunha Marques. 2014. Packaging waste recycling in Europe: Is the industry paying for it? *Waste Management* 34: 298–308. [CrossRef] [PubMed]
- Di Maio, Francesco, and Peter Carlo Rem. 2015. A Robust Indicator for Promoting Circular Economy through Recycling. *Journal of Environmental Protection* 6: 1095–104. [CrossRef]
- Eagle, Lynne, Mark Hamann, and David R. Low. 2016. The role of social marketing, marine turtles and sustainable tourism in reducing plastic pollution. *Marine Pollution Bulletin* 107: 324–32. [CrossRef] [PubMed]
- Ellen MacArthur Foundation. 2016. *The New Plastics Economy: Rethinking the Future of Plastics*. Cologne: World Economic Forum. [CrossRef]
- Eriksen, Marcus, Laurent C. M. Lebreton, Henry S. Carson, Martin Thiel, C. J. Moore, Jose C. Borro, Francois Galgani, Peter G. Ryan, and Julia Reisser. 2014. Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea. *PLoS ONE*. [CrossRef] [PubMed]
- European Commission. 2011. Commission Regulation (EU) No 10/2011 of 14 January 2011 on Plastic Materials and Articles Intended to Come into Contact with Food. *Official Journal of the European Union*. Available online: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32011R0010> (accessed on 15 December 2018).
- European Commission. 2013. Press Release. Environment: Commission Proposes to Reduce the Use of Plastic Bags. Available online: [http://europa.eu/rapid/press-release\\_IP-18-3927\\_en.htm](http://europa.eu/rapid/press-release_IP-18-3927_en.htm) (accessed on 15 December 2018).
- European Commission. 2015. An EU Action Plan for the Circular Economy. COM (2015) 614. Available online: <https://www.eea.europa.eu/policy-documents/com-2015-0614-final> (accessed on 15 December 2018).
- European Commission. 2018a. A European Strategy for Plastics in a Circular Economy. Available online: <https://publications.europa.eu/en/publication-detail/-/publication/e7904416-72a2-11e8-9483-01aa75ed71a1> (accessed on 15 December 2018).
- European Commission. 2018b. Proposal for a Directive of the Impact of Certain Plastic Products on the Environment. 2018/0172 (COD). Available online: [https://eur-lex.europa.eu/resource.html?uri=cellar:fc5c74e0-6255-11e8-ab9c-01aa75ed71a1.0002.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:fc5c74e0-6255-11e8-ab9c-01aa75ed71a1.0002.02/DOC_1&format=PDF) (accessed on 15 December 2018).
- European Commission. 2018c. Report on the Impact of the Use of Oxo-Degradable Plastic, Including Oxo-Degradable Plastic Carrier Bags, on the Environment. COM (2018) 35 Final. Available online: <http://ec.europa.eu/environment/circular-economy/pdf/oxo-plastics.pdf> (accessed on 27 December 2018).
- European Parliament and the Council of the European Union. 1994. European Parliament and Council Directive 94/62/EC of 20 December 1994 on Packaging and Packaging Waste. *Official Journal of the European Communities*. Available online: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:31994L0062> (accessed on 15 December 2018).
- European Parliament and the Council of the European Union. 2004a. Directive 2004/12/EC of the European Parliament and of the Council of 11 February 2004 amending Directive 94/62/EC on Packaging and Packaging Waste—Statement by the Council, the Commission and the European Parliament. Available online: [https://eur-lex.europa.eu/resource.html?uri=cellar:f8128bcf-ee21-4b9c-b506-e0eaf56868e6.0004.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:f8128bcf-ee21-4b9c-b506-e0eaf56868e6.0004.02/DOC_1&format=PDF) (accessed on 15 December 2018).

- European Parliament and the Council of the European Union. 2004b. REGULATION (EC) No 1935/2004 of the European Parliament and of the Council of 27 October 2004 on Materials and Articles Intended to Come into Contact with Food and Repealing Directives 80/590/EEC and 89/109/EEC. Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004R1935&from=SL> (accessed on 27 December 2018).
- European Parliament and the Council of the European Union. 2010. REGULATION (EC) No. 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel (Text with EEA Relevance). Available online: <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:027:0001:0019:en:PDF> (accessed on 12 February 2019).
- European Parliament and the Council of the European Union. 2015. Directive (EU) 2015/720 of 29 April 2015 amending Directive 94/62/EC as Regards Reducing the Consumption of Lightweight Plastic Carrier Bags. *Official Journal of the European Union*. Available online: <https://publications.europa.eu/en/publication-detail/-/publication/58d93aee-f3bc-11e4-a3bf-01aa75ed71a1/language-en> (accessed on 15 December 2018).
- European Parliament and the Council of the European Union. 2018. Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 Amending Directive 94/62/EC on Packaging and Packaging Waste (Text with EEA Relevance). Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0852&from=EN> (accessed on 15 December 2018).
- Food Packaging Forum. 2014. Plastic Recycling Dossier. Available online: [https://www.foodpackagingforum.org/fpf-2016/wp-content/uploads/2015/11/FPF\\_Dossier08\\_Plastic-recycling.pdf](https://www.foodpackagingforum.org/fpf-2016/wp-content/uploads/2015/11/FPF_Dossier08_Plastic-recycling.pdf) (accessed on 15 December 2018).
- Geyer, Roland, Jenna R. Jambeck, and Kara Lavender Law. 2017. Production, use and fate of all plastics ever made. *Science Advances* 3: e1700782. [CrossRef] [PubMed]
- Hagedoorn, John. 2002. Inter-firm R&D partnerships: An overview of major trends and patterns since 1960. *Research Policy* 31: 477–92.
- Jambeck, Jenna R., Roland Geyer, Chris Wilcox, Theodore R. Siegler, Miriam Perryman, Anthony Andrady, Ramani Narayan, and Kara Lavender Law. 2015. Plastic waste inputs from land into the ocean. *Science* 347: 768–71. [CrossRef] [PubMed]
- Lambert, A. J. D., and Frank A. Boons. 2002. Eco-industrial parks: Stimulating sustainable development in mixed industrial parks. *Technovation* 22: 471–84. [CrossRef]
- Larsen, Janet, and Savina Venkova. 2014. The Downfall of the Plastic Bag: A Global Picture. Plan B. Updates: Earth Policy Inst. (May 1). Available online: [www.earth-policy.org](http://www.earth-policy.org) (accessed on 12 February 2019).
- Lebreton, L., B. Slat, F. Ferrari, B. Sainte-Rose, J. Aitken, R. Marthouse, S. Hajbane, S. Cunsolo, A. Schwarz, A. Levivier, and et al. 2018. Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. *Scientific Reports* 8: 4666. [CrossRef] [PubMed]
- Meng, Qing-Jin, Qiang Ji, Yu-Guang Zhang, Di Liu, David M. Grossnickle, and Zhe-Xi Luo. 2015. An arboreal docodont from the Jurassic and mammaliaform ecological diversification. *Science* 347: 764–68. [CrossRef] [PubMed]
- Metcalfe, J. Stan, and Rod W. Coombs. 2000. Organizing for Innovation: Co-Ordinating Distributed Innovation Capabilities. In *Competence, Governance and Entrepreneurship*. Oxford: Oxford University Press.
- Murty, M. N., Surender Kumarc, and Mahua Paul. 2006. Environmental regulation, productive efficiency and cost of pollution abatement: A case study of the sugar industry in India. *Journal of Environmental Management* 79: 1–9. [CrossRef] [PubMed]
- Nova Institute. 2016. Market Study on the Consumption of Biodegradable and Compostable Plastic Products in Europe 2015 and 2020. Available online: [http://www.bio-based.eu/biodegradable\\_market\\_study/media/biodegradable%20market%20study/16-04-Biodegradable-and-compostable-plastic-products-in-EU-short-version.pdf](http://www.bio-based.eu/biodegradable_market_study/media/biodegradable%20market%20study/16-04-Biodegradable-and-compostable-plastic-products-in-EU-short-version.pdf) (accessed on 30 January 2019).
- O’Brine, Tim, and Richard C. Thompson. 2010. Degradation of plastic carrier bags in the marine environment. *Marine Pollution Bulletin* 60: 2297–83. [CrossRef] [PubMed]
- PlasticsEurope. 2017. *Plastic—The Facts 2017*. Brussels: Plastics Europe. Available online: [https://www.plasticseurope.org/application/files/5715/1717/4180/Plastics\\_the\\_facts\\_2017\\_FINAL\\_for\\_website\\_one\\_page.pdf](https://www.plasticseurope.org/application/files/5715/1717/4180/Plastics_the_facts_2017_FINAL_for_website_one_page.pdf) (accessed on 15 December 2018).

- PlasticsEurope. 2018. *Plastic—The Facts 2018*. Brussels: Plastics Europe. Available online: [https://www.plasticseurope.org/application/files/6315/4510/9658/Plastics\\_the\\_facts\\_2018\\_AF\\_web.pdf](https://www.plasticseurope.org/application/files/6315/4510/9658/Plastics_the_facts_2018_AF_web.pdf) (accessed on 30 December 2018).
- Stefatos, Aristofanis, Marinos Charalampakis, George Papatheodorou, and George Ferentinos. 1999. Marine debris on the seafloor of the Mediterranean Sea: Examples from two enclosed gulfs in western Greece. *Marine Pollution Bulletin* 38: 389–93. [CrossRef]
- UNEP. 2018. Single-Use Plastics—A Roadmap for Sustainability. UNEP. Available online: [https://wedocs.unep.org/bitstream/handle/20.500.11822/25496/singleUsePlastic\\_sustainability.pdf?sequence=1&isAllowed=y](https://wedocs.unep.org/bitstream/handle/20.500.11822/25496/singleUsePlastic_sustainability.pdf?sequence=1&isAllowed=y) (accessed on 27 December 2018).



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