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Bioplastics For Packaging In Cosmetic Sector Towards A Circular Bioeconomy Model

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ABSTRACT

The Italian cosmetic industry is experiencing a period of constant growth. The materials used for industrial packaging are often produced in compliance with the hygiene standards imposed by the rules of the sector but without looking at the environmental aspect, how they are produced and how these packaging will be disposed of. In recent years, consumers' environmental awareness has increased thanks to fast and accessible media, like the internet, and to a greater consciousness of the institutions. The average consumer is no longer satisfied with the generic product found at the point of sale, but he informs himself, evaluates, and relies on companies that embrace the culture of sustainability. The aim of this paper is the analysis of the technological and environmental advantages coming from the benefit of Bio-based polymers applied to the sector of cosmetic packaging, through a project of a new start up based on production of bioplastics for that sector. Highlights: Cosmetic packaging and different kinds of materials; cosmetics market; green marketing and investments.

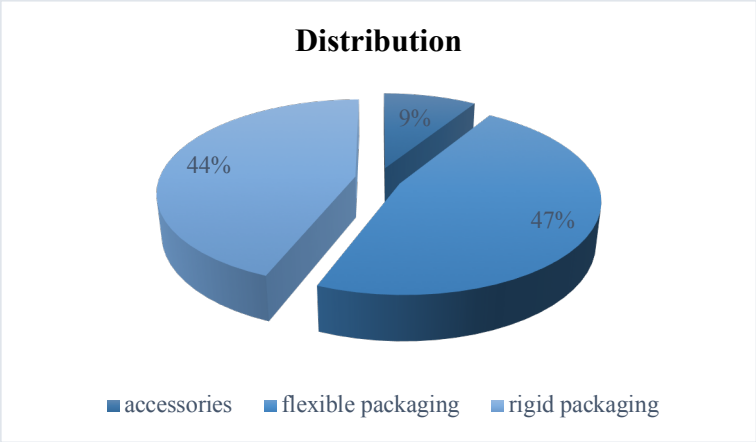
Keywords: Bio-based polymers; start up; SWOT analysis; packaging; circular economy; cosmetic sector.

INTRODUCTION

Birth and evolution of packaging are configured as a path in which different needs are woven together, influenced by production processes of materials, by new technologies, by needs of the production and distribution system. Although to contain and protect products some forms of packaging were always used, significant developments have taken place over the last two centuries. In the first industrial production of the last century, the packaging met the need for protection and preservation of the product. In contrast, at the beginning of the twentieth century, the packaging began to become an increasingly sophisticated device, whose characteristics were

fundamentally oriented to spreading of massive goods' consumption [1]. The evolution of industrial packaging has continued until the present day; now, packaging evolved in terms of both aesthetics and technology requirements, and becomes a real object of communication.

First in terms of production volumes, *plastic* is the most used material in the cosmetic packaging sector. Plastics are entirely or partially synthetic organic substances, formed by a molecular chain called polymer. Synthetic plastics have a relatively recent history (the industrial production of the main resins dates back to the decade 1930-1940). What plastics have brought is the ability to offer alternatives, and brand owners have seized these opportunities to differentiate their product offering. Prominently they have also brought reductions in pack weight. Often with associated decreases in the total cost of the packed product and, not surprisingly, product manufacturers have welcomed such changes [2]. In Italy plastics are widely involved in the production of packaging; in the graphic behind it is possible to see the distribution of these main materials for packaging in different sectors (Graph 1).



Graph 1 Percentage distribution of the Italian production of plastic materials for packaging
Source: Data from the Italian Packaging Institute, 2008

Over the past 50 years, the role and importance of plastics in our economy have consistently grown. Indeed, since 1980, the plastic industry has had a growth rate of 3.4% a year? [3]. Global production of plastics has increased twentyfold since the 1960s, reaching 322 million tons in 2015. It is expected to double again over the next 20 years [4].

Significant *environmental impacts* from non-renewable fossil-derived thermo-plastics include:

- Use of non-renewable resources as raw materials
- Emissions during the refining and cracking processes
- Some by-products or emissions are carcinogenic.

All of these impacts have an essential role in the world environment. Nowadays, there are real problems caused by the incorrect disposal of plastic waste that is polluting every ecosystem; for this reason, it was essential to introduce methods for disposing of them.

There are some recycling technologies for this kind of fossil-derived plastics, which includes:

- Mechanical recycling: plastics are shredded, washed, and extruded to form pellets; this process is well established in most developed economies.

- Feedstock recycling: plastics are converted. Back into a monomer or a new raw material by changing their chemical structure.
- Energy recycling: plastics are processed through controlled combustion to generate electricity or steam [5].

Plastic packaging waste can be recycled or subjected to energy recovery [6]. Plastics are an excellent fuel, on average higher than naphtha, and can be burned mixed with urban solid waste. Modern waste combustion plants ensure containment of atmospheric emissions, and the combustion of plastics does not increase emissions of harmful substances. In many cases, waste-to-energy is more convenient than other methods of disposal, both economically and in terms of eco-balance. The recycling can be defined as a "down cycling," as the properties of the material tend to decrease after each processing cycle [7]. It was estimated that plastics production and the incineration of plastic waste give rise globally to approximately 400 million tons of CO_2 a year. Using more recycled plastics can reduce dependence on the extraction of fossil fuels for plastics production and curb CO_2 emissions. Another problem resulting from the mismanagement of plastic waste is that of micro plastics released in nature [8].

In this paper, we analyze bio-polymer sector and propose it as packaging input in cosmetics sector.

BIOPLASTIC SECTOR

Starting from the 80s bioplastic sector was the first polymer introduced in trade; indeed, besides having characteristics similar to the traditional plastic materials, bioplastic was discovered to be biodegradable and therefore admissible to the flow of compound waste. Bioplastics are highly technological materials, placed today under the attention of the scientific community, which has developed new methods of production and in various studies is researching new techniques for extraction; however, they originated from the mid-nineteenth century, when a British chemist created plastic materials from cellulose, a derivative of wood pulp [9]. The prefix “bio” comes from the Greek “bios”, meaning “human life”.

Nevertheless in the polymer, packaging and composite areas, several definitions are used, and misunderstandings are very common. Sometimes “bio” is used to designate a biodegradable material, but it is also used to designate materials from renewable resources that are not biodegradable. The distinction, however, is very important, even from a normative point of view; actually, the distinction is very much in evidence since the treatment of these materials at the end of life will be different.

Bioplastic is a type of plastic that can be biodegradable or bio-based or possess both features. A bioplastic can be defined as "bio-based" when it is biodegradable and consists wholly or in part of annually renewable plant raw materials. A bioplastic can be biodegradable, even if it is derived from fossil oil.

From a practical point of view, biopolymers offer two main *advantages* when compared with synthetic plastics:

- biodegradability/compostability,
- eco-friendly,
- availability from renewable resources.

Currently, the only European standard that specifies the meaning of "biodegradable plastic material" is UNI EN 13432 of 2002 [10], dedicated to compostable packaging, adopted in Italy as UNI EN 13432: 2002. This determines the compostability criteria of a certain bioplastic in an industrial composting plant: high temperatures (55-60 °C), at a given humidity level, in the presence of oxygen: conditions more suitable for biodegradation than the natural conditions of biodegradation in the soil, in a marine environment or in freshwater. Moreover, we can have nano-cellulosic materials, which are based on renewable matrices and fillers for applications in packaging markets thanks to the great variety of polymers that can be extracted and or synthesized from bio-based sources; the most widely used biopolymer in packaging is the polylactides (PLAs).

Even though biodegradable plastics are anticipated to be suitable for the environment, they can damage nature in certain ways. The emanation of greenhouse gases like methane and carbon dioxide, while they are degrading, is huge at landfill sites. This material can be controlled by designing plastics so that they can disintegrate and break down slowly, or by accumulating the methane released and use it elsewhere as fuel. Some bioplastics require specific conditions to degrade; these requirements may not be available at all landfills or consumers may not have access to landfills. In such cases, it is essential to design bioplastics that are biodegradable in ordinary soil composting conditions [11].

Bioplastics can be classified in many ways based, for example, on their origins, chemical compositions, synthesis methods, and applications (table 1), such as:

- Bioplastics directly extracted from biomass: starch, cellulose, others, animal or vegetal proteins.
- Bioplastics synthesized from bio-derived monomers.
- Biodegradable polymers from petrochemicals.
- Polyesters directly produced from natural organisms.

The European Bioplastics Association has a broader definition, which refers to three types of bioplastics:

- bio-derived and biodegradable/compostable
- fossil fuel-derived and biodegradable
- bio-derived and non-biodegradable

Table 1 Classification of different kinds of plastics

	Petrochemical	**Partly Bio-Based**	**Bio-Based**
Non-biodegradable	PE, PP, PET, PVC, PS	Bio-PET, PTT	Bio-PE
Biodegradable	PBAT, PBS(A), PCL	Starch blends	PLA, PHA, Cellophane

Source: Chemical Market Resources

Current European legislation regulates bioplastics based on their ability to decompose in a natural environment, not controlled by human activity. The European standard EN 13432: 2002 "Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for final acceptance of packaging", recently adopted also in Italy under the designation EN 13432: 2002 [10], solves this problem by defining the characteristics that a

material must possess in order to be called compostable. This standard is a reference point for material producers, public authorities, composters, and consumers. According to EN 13432: 2002, the characteristics that a compostable material must have are the following:

- Biodegradability, determined by measuring the actual metabolic conversion of the compostable material into carbon dioxide. This property is quantitatively evaluated with a standard test method: EN 14046 (also published as ISO 14855: biodegradability under controlled composting conditions) [12]. The acceptance level is 90% to be reached in less than 6 months.
- Disintegration, fragmentation and loss of visibility in the final compost (absence of visual contamination). Measured with a composting test on a pilot scale (EN 14045).
- Absence of negative effects on the composting process. Requirement verified with a composting test on a pilot scale.
- Low levels of heavy metals (below predefined maximum values) and absence of negative effects on compost quality (example: reduction in agronomic value and presence of ecotoxicological effects on plant growth).

Other chemical-physical parameters that need not differing from the control compost after biodegradation are: pH; salt content; volatile solids; N; P; Mg; K. Each of these points is necessary for the definition of compostability but alone is not sufficient.

In the Table 2 there is a comparison between bioplastic and oil-based plastic in order to highlight some their properties.

Table 2 Comparison between bio-plastic and traditional plastic.

Property	Bio-based plastic	Oil-based plastic
Renewable	Yes	Partially No
Break down in the environment	Biodegradable And/or compostable	Some degradable by polymer oxidation
GHG emissions	Usually low	Relatively high
Fossil fuel usage	Usually low	Relatively high

Source: Wageningen Food & Biobased Research.

Biodegradation can be defined as “the breakdown of chemical bonds of organic compounds into smaller organic and inorganic compounds performed by microorganisms”.
The harmful environmental impact of a cosmetic can take place in different phases:

- production process of the ingredients: an ingredient deriving from the extraction of oil will pollute much more than a vegetable ingredient produced, for example, by an organic farm;
- production process of the finished product: in the same way, a chemical ingredient will involve the disposal of a certain amount of non-biodegradable waste, which in most cases will be thrown into the sea;
- packaging: a cosmetic product whose packaging, after the product has run out, cannot be reused;
- transport: a cosmetic made in Italy will involve energy and fuel consumption, and therefore the production of polluting material, less than a cosmetic coming from the United States or foreign countries in general;

- daily use and elimination of residues: throw the foam of a shampoo containing oil substances into the drains (or throw a certain amount of expired cream into the garbage) and therefore not biodegradable, causes greater pollution than the same amount of shampoo produced with vegetable ingredients [14].

Technological innovation

Bioplastics can be made from many different sources and materials. They include - Plant Oil, Cellulose, Corn Starch, Potato Starch, Sugarcane, Weeds, Hemp, etc. The whole process is very complicated; however, the leftover potatoes waste is crushed into a pulp in a big grinding machine [15]. The starch obtained from this pulp is converted into glucose, which is mixed with a huge quantity of lactic acid. Then, by subjecting this mixture to an electrically charged refinement process and thereafter passing it through carbon filters, a powder-like substance is obtained from which bioplastic is made [16]. Thanks to the natural property of being biodegradable, the bioplastic obtained by this method is environment-friendly, unlike conventional plastics); it will not pollute the environment remaining there for a long time and will not fragment into highly polluting micro particles [17]. Plastics recycling falls into two categories: pre-consumer and post-consumer. Pre-consumer one involves recycling of waste generated while manufacturing the product, such as trim wastes after thermoforming or runner and sprue waste from post-injection molding. Most manufacturers are focused on recycling pre-consumer waste at the source itself.

The problem arises with the *post-consumer recycling* of bioplastics after their end-use. Recycling post-consumer waste is a tedious and expensive process, as it involves a considerable amount of cleaning and sorting activities. Within the petroleum-based plastics, it is not easy to determine the difference between similar plastics such as PE or PP. One of the major hurdles in recycling is that these different polymers are not mixable. Mixing of bioplastics with petroleum-based plastics could contaminate the oil-based plastic feed generated from recycling. A mixture could result in inferior properties, leading to unusable recycled plastic for many processes. This is very likely to happen, as the consumers may not differentiate between different plastic types. Therefore, bioplastics should be identify from discernable sources that will allow for sorting [18].

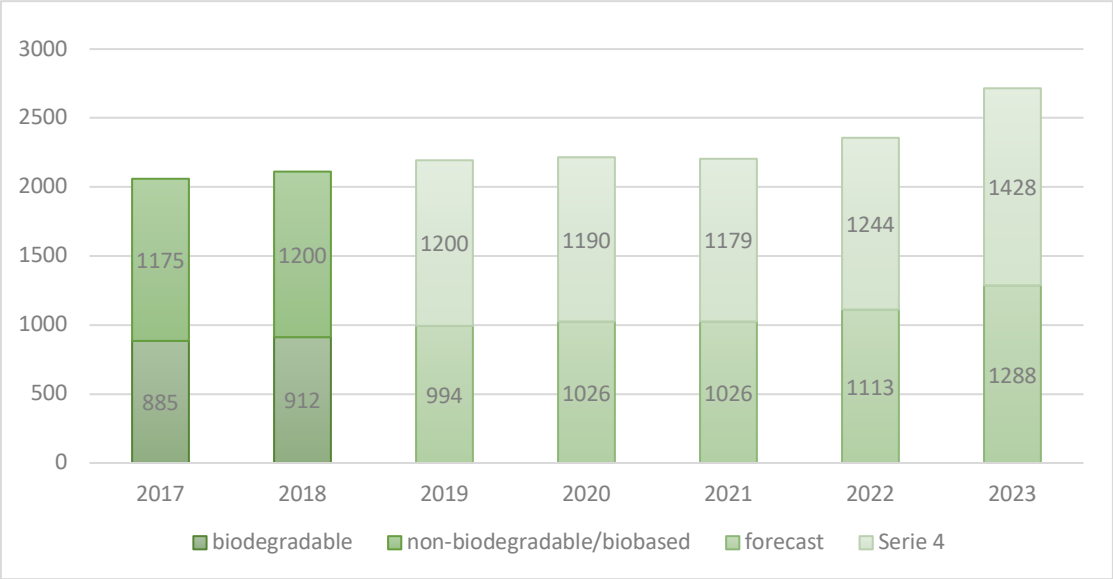
Another option of dealing with post-consumer plastics is composting. It should be noted that one of the biggest myths about landfills is that they are giant compost pits, but it is not truth. Nothing that goes into a landfill (bioplastics or oil-based plastics) will decompose properly, because of the lack of sunlight and air. For that reason, composting bioplastics needs additional infrastructure and set to handle the volume. Commercial bioplastics such as PLA would compost only in municipal and industrial compost settings. Therefore, the composting sector has to expand to accommodate the growing waste generated from bioplastics [19].

Table 3: Comparisons between bioplastics and conventional plastics

	Positive features	Negative features
Conventional Plastics	-low cost -good and excellent technical properties -easy processability -can save energy and resources compared with other materials, depending on application -thermal recycling possible	-based on petrochemicals. -difficult to recycle -mostly not biodegradable -uncontrolled combustion -can release toxic substances -ecotoxicity, particularly microplastics in the marine environment -partly toxic raw materials an additives.
Bioplastics	-(partly) biodegradable -(partly) based on natural feedstock, hence reducing the -emission of GHG and dependence on crude oil -interesting properties -generally, standard manufacturing processes and plants can be used for biobased -feedstock, and standard rocessing machines can be used for biobased plastics -positive image among consumers	-Costly (expensive) -(partly) use of genetically modified organism modified organisms -use of land, fertilizers, and pesticides for crops, potential food competition pesticides for crops, potential food competition pesticides for crops, potential food competition -narrow processing window (lower melting temperature) -brittleness -thermal degradation

Source: Kirk-Othmer Encyclopedia of Chemical Technology

The *benefits* of bioplastics, materials that are bio-based, biodegradable, or both, are clear: they contribute positively to our economy, our society, and our environment (table 3). With a current share of almost one percent of the global plastics market, they represent an economically innovative sector growing between 20% and 100% per year. [20] The bioplastics industry demand is expected to hit annual production of 2% of global thermoplastics production, which is approximated at 250 million tons annually. Major manufacturers and even governments are focusing on the renewability of the plastics. For example, the Japanese government has set a target that by the year 2020, 20% of their plastic production will be from renewable sources. According to the European bioplastics organization, currently bioplastics represent about 1% of the about 335 million tons of plastic produced annually (graph 2). However, as demand is rising and with more sophisticated biopolymers, applications, and products emerging, the market is continuously growing.



Graph 2 Global production capacities of bioplastics

Source: European Bioplastics, nova-institute (2018)

CASE STUDY

We now (In this Section) investigate a really forthcoming company operating in cosmetics sector, its projects, plans and objectives pursued, its main management problems, particularly with respect to economic and environmental aspects.

The company studied is a new startup, called Perpetual Product; born from the commitment and dedication of its founders; it is located in Rotterdam, where it operates. In order to proceed with the analysis of this company in the framework of the considered sector, a fruitful collaboration was carried out with its management.

Cosmetics and logistics

As for any production process, the harmful environmental impact of cosmetics can take place with different severity degree and in different phases:

- production process of the ingredients: an ingredient deriving from the extraction of oil will pollute much more than a vegetable ingredient produced, for example, by an organic farm;
- production process of the finished product: in the same way, a chemical ingredient will involve the disposal of a certain amount of non-biodegradable waste, which in most cases will be thrown into the sea;
- packaging: a cosmetic product whose packaging, after the product has run out, cannot be reused;
- transport: a cosmetic produced and distributed, for example, in Italy will involve energy and fuel consumption, and therefore the production of polluting material, however less than a cosmetic coming from the United States or foreign countries in general;
- daily use and elimination of residues: throw the foam of a shampoo containing oil substances into the drains (or throw a certain amount of expired cream into the garbage) and therefore not biodegradable, causes greater pollution than the same amount of shampoo produced with vegetable ingredients [21].

The general growth of demand for goods and services, the increase of competition in global markets, the introduction of short-life goods, new communication and transportation technologies, and new sales techniques lead companies to rethink their production methods and goods and / or services supplying processes that require investing also in management of logistics activities. Much has been done for the reorganization of production processes; much more can be achieved thanks to an efficient organization of the flows of goods or services and the information related to these. All this involves new logistical needs and the adoption of efficient logistic management policies, related also to different intrinsic value of goods.

Today, there are new "green" technologies on the market that offer both environmental and economic benefits. That is why the world of *logistics* is looking at the green with great attention. The term logistics was born in a military environment as it was originally employed to describe the movement of men and materials in battlefields. Today, this term is used to refer to the organization of the movement of goods and provision of services with industrial and commercial objectives. Logistics, therefore, can be seen as the ability to manage the flow of materials and products from the raw material supplier to the end-user of the goods or service, within the so-called logistics system.

The green logistics sector, in such a vast and globalized market, plays a decisive role in preserving the environment; greater attention to the distribution of logistic services can lead to a much lower impact of CO_2, less use in non-recyclable packaging, etc. For this reason, in recent years this sector has attracted the attention of many investors, but also of innovators who are carrying out projects that see green logistics as a competitive sector.

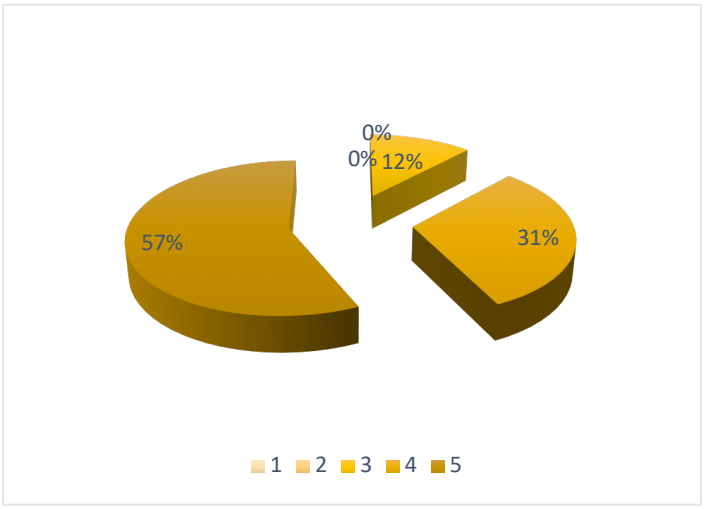
The case study has been developed to understand how the use of recyclable and biodegradable materials can lead to a reduction in management costs and a lower environmental impact.

Perpetual Product is an innovative start-up with a strong green soul that wants to make in particular a difference in the packaging and logistic of the cosmetics sector, as previously recalled, through a reorganization of the old process. The startup wants to promote the use of biodegradable bioplastics; in fact, management takes care of offering containers alternative to those supplied by the producers that can contain perishable products such as cosmetics. The service offered consists of a circular relationship with the customer, who will purchase the products of his interest on the Perpetual Product's website; later delivered their homes using green electric footprint vehicles. Once the product is ended, the customer can reorder the product by delivering the old packaging to the operator, based upon delivery of the new one.

Perpetual Products will take care of packaging disposing in the most suitable way, with a view to continuous improvement is looking and working for voluntary certifications; iso 14001 [22] would be a great way to grow and enter the market as a pioneer company in a new way to market goods with low unit value. In this initial phase, the Perpetual Product's team is trying to test the methods designed and establish relationships with providers and customers. The chosen suppliers are producers operating with great attention to materials and production methods; many of them are certified for organic production and, on the other side, reference customers are more sensitive to the footprint they leave on the environment.

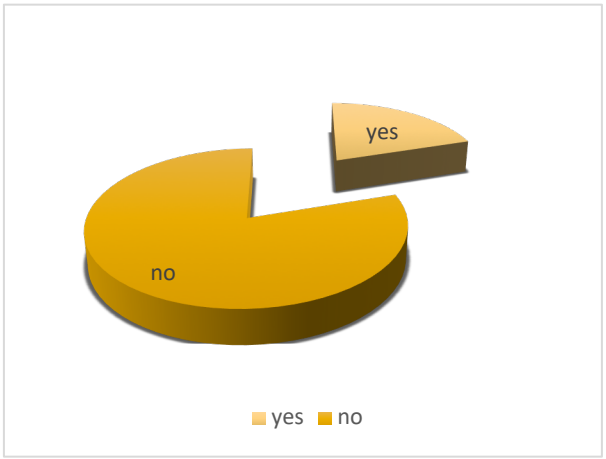
Questionnaire

During the first step of idea development and testing, the start-up collaborators proceed to provide questionnaires to sample of o customers of various ages. Through the questionnaire, it was possible to highlight their opinion concerning the pollution issue and, more specifically, that deriving from the use of non-biodegradable plastic.



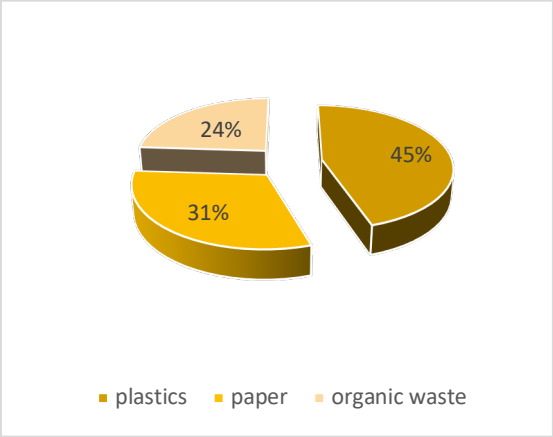
Graph 3 Sensitivity of the subjects subjected to the questionnaire, through the use of a scale of values from 1 to 5, in which 1 indicates not interested and 5 very interested.
Source: Perpetual Product Team's Survey

The first question asked in the survey was: How important is it for you to preserve the natural ecosystem? Do you feel sensitive about the environmental situation? The data obtained from the questionnaires allowed us to observe more than half of the sample have a very high sensitivity to the topic in question, while only a small percentage showed a neutral interest. Moreover, no person has expressed a value from 1 to 2 (graph 3).



Graph 4 Percentage of subjects interested in the use of biodegradable or recycled products.
Source: Perpetual Product Team's Survey.

The second question asked was: Are you interested in trying different kinds of plastics that do not damage the environment? This survey gave us results in line with the analysis carried out in the previous question, demonstrating that the subjects not only know or are sensitive to the topic, but also are really willing to change their habits to decrease the environmental impact (graph 4).



Graph 5 Percentage of materials presents in domestic waste.
Source: Perpetual Products Team's Survey.

Finally, the last question was: Which materials represent the most significant part of your domestic waste generally? From this survey, it was possible to highlight that not only plastics are regularly present in waste, but also other impacting materials, such as paper and organic waste (graph 5); however, it is clear that plastic represents the largest slice [23].

RESULT AND DISCUSSION

The case study has been developed to deeply understand how the use of recyclable and biodegradable materials can lead to a reduction in operational costs and are able to mitigate the environmental impact.

In the Perpetual Product's E-commerce, it is possible to see how services work. The main principles driving the firm are the following:

> *"Order and receive the products". In e-commerce, customers can only found sustainable products produced by the local manufacturer, which collaborates with the Perpetual Product.*
>
> *"Once finished, order a refill". The team promotes the use of a refill, because in this way customers will receive a smaller kind of packaging, which has a low cost, and the supplier can analyze the retention.*

"We delivery by bike within 48 hours", since the company operates a local to local business in Netherlands, the product can be delivered by bike. Once the product is delivered, the old packaging can be picked up and then disposed of most appropriately (graph 6).

Graph 6 Service explained in Perpetual Product site
Source: www.productsperpetual.com

The company intends to modify the internal management process by relying on logistics that are more efficient, since it allows us to use green vehicles to obtain a saving of internal costs, as well as a reduction in CO_2. The objective of the company is to create a business, starting from the fast delivery systems that in the field of food and beverage have been widely spread in recent years; the company wants to enter the market through the delivery of body care products, for which this delivery method has not yet been applied. The start-up wants to approach the cosmetic's market with a new kind of logistics system. One of the goals set is to create this almost zero-impact business that can actually help alleviate the scourge of single-use packaging pollution, and thus pursuing social and environmental protection objectives.

Objectives

It is possible to resume the main *objectives* of the company and the way to achieve them:

- Green vehicles;
- Volunteer certification;
- Supply-chain optimization;
- Biodegradable packaging.

In terms of strategic objectives, a series of investments will be implemented first in marketing to make the company brand well known, and in vehicles to acquire new *vehicles* with *zero impact*, such as electric bikes and other two-wheeled vehicles more innovative. The distribution of products by electric or emission-free vehicles allows a reduction in delivery time as well as a lower impact on the environment. In the future, the company will intend to obtain *certifications*, in particular, the ISO 14001 regarding the environment to reach a benefit and to become more attractive towards competitors.

The third objective is the *supply-chain optimization*; the company wants to achieve this goal through a series of both social and environmental actions:

- Reusing local products to avoid further waste. For the founders, the local business issue is very important, to favor local market, but also to reduce the use of fossil fuels, otherwise used for long distance delivering. This is one of the innovative logistics solutions chosen and pursued by the team. With the delivery of high-quality products and the collect of empty packaging, the company achieves better results.
- In addition, the company performs an important intermediary function as it arises between manufacturer and end customers by acting as a go-between in the supply-chain. Moreover, among the strategic objectives posed by the start-up, there is greater attention to *customer relationships*. Customers who request delivery of the various products are loyal and, even if they pay an additional price, are aware of the impact of the almost zero cost activity carried out by the company. This allows making consumers more satisfied, company producing only what they actually need.

The last point concerns the use of *biodegradable packaging*, intending to minimize its carbon footprint, and it is a distinctive element compared to other cosmetic e-commerce companies. The material chosen for packaging with the Perpetual Product logo is PLA (polylactic acid) due to its stability and durability, but also for its easy degradation in natural environments. PLA is a clean, nature-based green option that is entirely produced by corn or sugarcane. Among the reasons for

the choice of this material there is also its low cost, compared to the other bioplastics, thanks to its characteristic of being produced by the discarded glycerol during the biodiesel production process. The major producers of biodiesel PLA are present in the United States, but since biodiesel glycerol is an easily available material, in the future years more and more production companies will settle in Europe. Despite these evident advantages, Perpetual Product is also looking for packaging made in PHA (polyhydroxyalkanoate). PHA is biodegradable in a wider range of natural environments such as soil, home cold compost, marine environments, and common waste treatment facilities. This kind of resin is durable and has an excellent resistance, and at the same time, it provides greater environmental benefits than other biodegradable materials.

As we can see from the different steps represented, the cosmetic case made from PHA, despite low and cold temperatures, which are characteristic of marine environments, degrades in a relatively short period. Anyway, PLA is still a popular choice for beauty firms that are looking for entirely plant-based alternatives to traditional petroleum-based polymers [24].

Costs

The firm business plan will be difficult to evaluate, because any forecast or budget for innovative startups will always be unpredictability and unreliable, due to the nature of any pioneering young company. In this phase, the evaluable business *costs* are the following:

- A host for its site; it is the startup's first investment to make set goals noticeable.
- Marketing costs. In particular, social media marketing (SEM) and a bit of community management to benefit of the first trust of the market and costumers attraction; marketing costs are used to make Perpetual Product visible even on major social networks, such as Facebook and Instagram.
- Paid tools, such as “Elementor” for the company’s web sites.
- Costs for legal advice, to draw up agreements between the partners and so on.
- Costs for supported travels to participate in pitches or events that can be useful later, for example contest and startup competitions.
- Costs for any co-working stations.
- Costs for a bank account.

About the cost of the innovation implementation, it is already known that bioplastics have a higher price than the petroleum-based one for many reasons. One reason could be raw materials suppliers; they can be driven by the desire to increase in the value of their feedstock, since the farmers may demand higher price for their crops to manufacturers of bio-based packaging.

Table 4 Budget Forecast per month and year.

Costs	Price per month	Price per year
-Hosting	8 €	96 €
-Marketing Cost	100 €	1200 €
-Paid tools (Elementor)	4,5 €	49 €
-Legal advice	208,5 €	2500 €
-Supported travels	250 €	3000 € (budget)
-Co-working station	500 €	6000 €
-Bank account	250 €	3000 €
Total	1321 €	15852 €

Source: Forecasts by the Perpetual Product team. Based on Netherlnds average prices.

Environmental issues (certification)

One of the main objectives, as above recalled, is to offer an efficient service both from the social point of view, creating virtuous relationship with suppliers and customers, and from the environmental point of view, through the control of CO_2 emissions (in the future, we could analyze the exactly quantification thought carbon foot print analysis)and the use of materials not impacting. These are all virtuous goals, but could require a lot of effort for a startup, that is still a young company that has to check and well plan every effort. For this reason, a company that is still in an initial phase of activity, such as Perpetual Product, could find in an *Environmental Management Standard* (EMS), like ISO 14001, a guideline to establish and implement a good EMS [25].

ISO 14001 is an International Standard of worldwide acceptance based on the concept that better environmental performance can be achieved when environmental aspects are systematically identified and managed, giving a major contribution to sustainability, through pollution prevention, improved environmental performance and complying with applicable laws [26]. The ISO 14001 standard does not serve to demonstrate a certain environmental performance, but is a tool that can be used by a company focused on continuous improvement. ISO 14001 provides a framework for environmental management best practice to aid organizations to prevent pollution, minimize the environmental footprint, conform to environmental legislation, and develop their business in a sustainable manner. Applicable to all sectors of industry, ISO 14001 helps organizations review their supply chain to mitigate against environmental risk and ensure sustainability. The requirements of the standard are wholly generic, applicable to different types of companies.

To implement an EMS some steps are required. It is possible to summarize ten main steps:

1. Step 1: Initial checkup.
2. Step 2: Environmental Management System Design.
3. Step 3: Preparation of the Environmental Management System documents organizations.
4. Step 4: Development and implementation of the Environmental Management System.
5. Step 5: Internal audits.
6. Step 6: Review and validation of the implemented system.
7. Step 7: Staff training and awareness.
8. Step 8: Certification assistance according to UNI EN ISO 14001:2004.
9. Step 9: Management of relations with the Certification Body.
10. Step 10: Development of the Environmental Management System and improvement project.

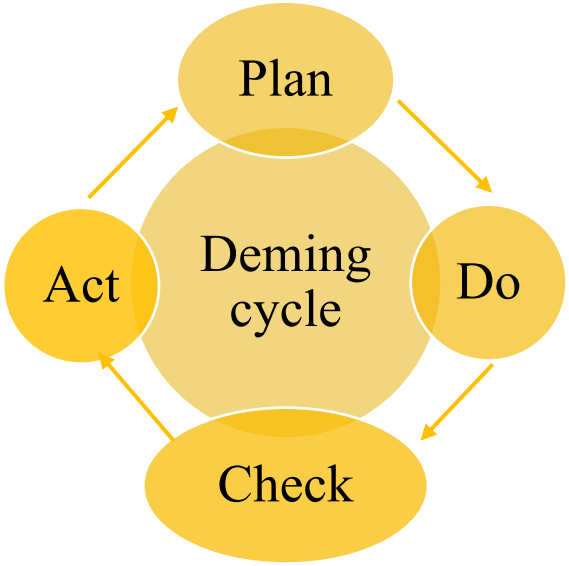
After the implementation, the EMS will be applied in every aspect of the company, especially in projects. The application to projects is based on the PDCA model, defined by Deming (*Plan-Do-Check-Act*). The PDCA cycle was designed to establish a continuous model for uninterrupted improvement of processes and to guarantee efficient and continuous quality. The model can be used in many contexts, especially through Deming extensions. Thanks to the implementation of the PDCA cycle, process integration is achieved at all levels of the company.
The constituent elements are therefore (graph 7):

- Plan: establish the environmental objectives and necessary processes, in accordance with environmental policy.
- Do: implement the processes as planned.

- Check: monitor and measure processes, the achievement of environmental objectives and report their results.
- Act: take actions for uninterrupted improvement.

The *benefits* that came from the application of ISO 14001 are not all about the environmental aspects, but they helps company in many aspects:

1. Helps getting a better corporate image: it is easy to understand how much important ISO 14001 is for public procurements, but it is also important for customers. Indeed, in the last few years customers are more and more interested about how companies are related to the environment.
2. Promote compliance with legal requirements: The ISO 14001 provide also some guide lines to monitor, follow and comply with environmental regulation.
3. Improve monitoring of costs: allow you to take advantage of the aspect of improving the environmental management system to reduce operational costs for energy saving and external materials required by the business processes.
4. Improve processes quicker: continuous improvement is the main focusing of ISO 14001, for that reason it's helpful to reach important objective to continuous improvement.



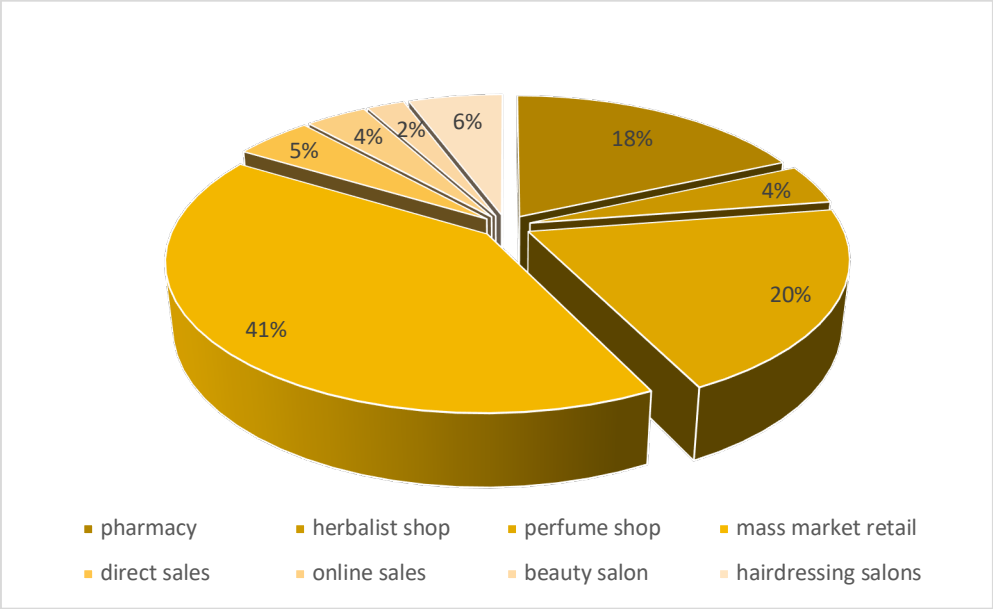
Graph. 7 Deming cycle, PDCA.
Source: Plan-Do-Check-Act in ISO 14001

Cosmetic market perspective

The global *cosmetics market*, estimated already $460 billion in 2014, is still growing and is expected to reach $675 billion in 2020, thus showing a 6.4% growth rate per year. There is an evident, strong trend towards the use of sustainably raw materials in the cosmetics field, both as active components in formulations and as packaging elements. The market intelligence firm Pike Research expects a very fast growth of the sustainable packaging sector, even more that the overall packaging industry itself, and it forecasts that eco-friendly packaging will almost double in revenues. Especially eco-friendly plastic-based packaging will be the most growing and productive sector, as plastic represents more than a third of the total global packaging industry, second only to paper packaging [27].

Indeed, cosmetics marketing emphasize that the use of green, possibly compostable or biodegradable packaging, is a benefit to the cosmetics product in itself, since it witnesses customers' and producers' *environmental attitude* and *care*. In this way, what once represented a market slice, as a niche, today represents a widespread buying attitude and consequently a successful sales strategy.

A real phenomenon in the cosmetics market is *online sales*. This sector enjoyed vigorous growth in 2018, achieving a value of nearly €390 million, up by 22% compared to the previous year, and a 3.7% degree of coverage of consumption. This phenomenon fits neatly into a broader evaluation that tends to explain the more radical changes taking place in individual channels, which are oriented increasingly towards a mixture of sales through points of sale and via digital platforms (graph 8).



Graph 8 The cosmetic products market in 2018: value and trend of distribution channels
Source: Cosmetica Italia Statistics Dept.

In such a large space, such as internet, competition is very high, the offer for consumers is varied and massive, and for a start-up as a Perpetual Product some difficulties may arise. From the analyses carried out by the "Italy cosmetic study center", emerges the online cosmetics market is growing rapidly, opening the doors to new business.

Furthermore, the in-depth analysis of the sector has allowed new knowledge in the last few years: among these, we recall the forecast of the production of goods with a natural connotation that reached 1,100 million euros, with an increase of approximately five percentage points per year [28]. These factors find a meeting point with the objectives and the corporate vision of Perpetual Product. In order to analyze the market in which Perpetual Product will find himself, a SWOT analysis was performed, trying to put in evidence a key for reading the context.

Table 5. SWOT Analysis

Strengths	**Weakness**
Effective element to reduce waste. Effective contributor towards brand equity Effective contributor towards reducing CO2 emissions Alternative source of raw material.	Higher price is a key barrier for adoption Customers unwillingness to pay premium price Delivery time Competition from the major distribution brands.
Opportunities	**Threats**
Consumer awareness Economies of scale can resolve cost issues Niche Market The growth of the shipping market. Easy targeting via social media.	Packaging is not part of core business model Constant changes in legislation Initial investment Greenwashing.

Source: SWOT analysis built in collaboration with the Perpetual Product team.

The health and beauty industry is investing more and more on social and environmental responsibility initiatives, especially about carbon footprint reduction and sustainable packaging. A trend that negatively influences the green cosmetics market is that of the so-called "Greenwashing". Greenwashing is a neologism indicating the communication strategy of some companies, organizations or political institutions aimed at building a deceptively positive self-image in terms of environmental impact [29]. Since the negative effects of this trend not only fall on the companies that operate respecting the environment, but also on the customers misled by false declarations, modifying their purchasing choices, and veering towards products that hurt the environment. In recent years, beauty brands are investing a lot in correct marketing communication in order to drive product sales toward environmental protective consumption.

That kind of marketing communication is called "Green Marketing." *Green marketing*, therefore, means acting on the product and on production processes, intervening on choice of raw materials, on design of the products, and on packaging; above all, proving it with true and precise communication. Recently, one of its most important resource is represented by environmental certifications, which guarantees the correct implementation and compliance of all the established rules that therefore allows attaching the main ecological labels on products.

CONCLUSIONS

The demand for recycled plastic represents only 6% of the global demand for plastics in Europe. In recent years, the plastics recycling sector in the EU has suffered from alternative raw material low prices and uncertainties about market outlets. Investments in new tools for the plastic recycling sector were held back by the prospect of low profitability. These data, combined with the growing demand, production, and consumption of plastic materials, have a significant impact on the environment. All such methods have their limitations and can only address the solid waste generation to an extent. It is easy to understand that the recycling of fossil plastics is not today a solution to the problem of pollution from plastic waste.

The bio-based materials provide many environmental advantages as their use can significantly reduce greenhouse gases emissions, shorten the carbon cycle, save fossil fuels without compromising on performance, quality and suitability of the package. The green plastics industry is still in its infancy and may not be ready to replace the petrochemical-based plastics. At the same

time, this sector is preparing for growth and getting ready to meet increased demand. Still, there are processing, material properties and recycling challenges faced while attempting to replace the petrochemical-based plastics. Most of the bioplastics currently are utilized for nondurable goods such as packaging. Green plastics, possessing a wide range of properties that could allow them to be processed like conventional plastics, need to be developed.

One of the real problems that exist is in defining and identifying green plastics. It is needed a better recognizing and understanding about what constitutes greenness. Standardizations and certifications of sustainability should be publicized extensively, showing their benefits in economic and environmental terms. Cosmetic packaging is hardly collected and recycled, thus restricting its use for sustainable compostable or opportunity for sustainability. Innovative bio-based and compostable materials are already developed. Environmentally biodegradable materials for packaging are an important challenge and suitable for the production of cosmetic packaging too, while others are constantly developing with great opportunity for sustainability. Innovative bio-based and compostable materials are now promising properties and perspectives. Consumer and policy awareness is important to support their development, and suitable for developing production of cosmetic packaging, which represents an important step towards environment preservation.

In the last ten years, the bioplastics industry has flourished and developed in a fast-growing innovative sector. We are seeing an increasing number of major brands moving from fossil raw materials to bio-based materials, or offering biodegradable solutions for their products, in response to the growing consumer demand for more sustainable products and to a generalized change in awareness of the impact of consumer choices on the environment. The bioplastics industry is able to meet the increase in demand, thanks to the strong investments in research and development made by many small and large innovative companies that focus their strength on the creation of bio-based products founded on an idea of circular economy.

This case study shows how important it is to pay attention to the factors influencing climate change and pollution of our planet, such as emissions into the atmosphere and the use of environmentally friendly materials, recyclable products and services. Many domestic entrepreneurs, who thanks to their business activity focus on process innovations, allowing cost savings and environmental preservation, have felt this increased sensitivity to environmental issues. The considered start-up has implemented, and in the future will further develop many sustainable investments; for examples, electric transport aiming to zero CO_2 emissions, used to perform its business for free home delivery service to customers purchasing various products [30]. Other important investments will be in the green marketing, essential to obtain a good positioning in the cosmetic market. The objective of the considered company is becoming itself more and more well known, to increase consumer awareness on those issues, in particular with respect to less environment impact as result of use of bioplastics.

The start-up will be able to keep pace with innovation, combining consumer satisfaction and the need to struggle environmental pollution with widespread use of biodegradable plastic and new logistics management. So, making step by step the consumers aware of the need to protect environment, preventing plastic, already in use, from ending up in the landfill.

The idea for carrying out this study was to conduct a comparative study bringing up the pros and cons of the conventional traditional plastics as opposed to the new-age degradable bio-derived plastics in the cosmetic sector. Bioplastics have recently come up as an integrated sustainable alternative to plastic management in order to reduce petroleum dependency as well as better plastic disposal means. Consumers have played an essential role in achieving this awareness; changing their demand behavior has actually transformed the supply. The sold production is more and more compatible with environmental and social needs, and for this reason, the institutions, and standardization and research bodies have adapted to this trend. It is undeniable that sustainability is a new way of doing business. To get practical outcomes, companies have to invest a lot in innovation and research.

The main point at the base of sustainable development is the awareness that sustainability must constitute the central part of each company's strategy. This is still something challenging to take place as complex feature and important issue in the considered cosmetic industry. Responsible consumption of cosmetic products is fundamental to promote sustainability and reduce environmental impacts, not only for the intrinsic consumption in itself and the communication that peculiar packing of this kind of niche products can disclose, but also for the meaning and the message that this important sector can disseminate over the entire world.

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