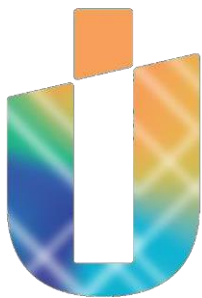


# Managing and recovering bioplastics



UTILITALIA

Utilitalia Position Paper adopted on January 21 2020  
by the Environment Board



## FOREWORD

«Bioplastics»<sup>1</sup> have long been ubiquitous in the Italian market to the extent that the Italian bioplastics industry now represents excellence at an international level with a preeminent role being plaid in bioeconomy and circular economy.

Bioplastics can be the end-point of increased valorisation of renewable resources such as organic or agro waste, can contribute to reducing the environmental impact of fossil-based conventional plastics (in terms of the uptake of pollutants and non-renewable resources) and can be recovering as part of a circular closed life cycle.

Italy has traditionally benefitted from a consolidated legislative background that relates bioplastics to the management of the organic fraction of Municipal Waste. A good case in point is Article 182-ter of Legislative Decree 152/2006 that provides that the organic waste fraction shall be separately collected by means of no-bag self-emptying containers or UNI EN 13432<sup>2</sup> certified compostable bags.

Historically, municipal waste collection and management have not been challenged by the placing on the market of bioplastics either qualitatively or quantitatively. However recently, also following the implementation of the SUP (Single Use Plastic) Directive<sup>3</sup>, “bioplastics” products, both quantitatively and qualitatively, have been soaring significantly, to the extent that they are being looked at as a present and especially future challenge by those who have responsibilities for managing municipal waste.

This document arises out of the attempt made by Utilitalia confederate bodies to prevent that the burden of uncertainty in bioplastics waste management and treatment, especially to the eyes of the general public and local authorities, be shouldered by waste collection and treatment companies alone, and consequently the solution to the problem be their own responsibility. As a matter of fact, Utilitalia believes that the issue in hand can and must be dealt with collectively calling on all the supply chain stakeholders to embrace the best waste management options for bioplastics from an environmentally sustainable and economically sound circular life cycle approach.

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<sup>1</sup> For the purpose of the present document «bioplastics» are defined as the materials used to produce UNI EN 13432 certified items – *Packaging – Requirements for Packaging recoverable through composting and biodegradation – Test scheme and evaluation criteria for the final acceptance of packaging*. Incidentally it should be stressed that fossil or renewable feedstocks can be used for the production of bioplastics.

<sup>2</sup> The national legislation has implemented the European standard EN 13432 which shall be adopted as a technical standard of reference by all parties thus eliminating confusion possibly arising from by general reference to misleading terms such as “biodegradable” (with no indication of time length and environmental conditions required by biodegradation), “ecological” and so on. Ref. :

- Articles 226-bis and -ter of legislative decree 152/2006 prohibiting and restricting placing on the market of non-compostable carrier plastic bags and ultra-light plastic bags which fail to comply with EN 13432 certification;
- Ministerial Decree of 25 July 2011 (concerning minimal environmental criteria regulating catering parties) under point 5.5.2 allows for the use of disposable cups, glasses, plates, crockery and cutlery provided they are biodegradable and compostable according to EN 13432 certification.

<sup>3</sup> DIRECTIVE (EU) 2019 of the European Parliament and Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment.



## THE EVOLUTION OF THE PLACING ON THE MARKET OF BIOPLASTICS FOR PUBLIC CONSUMPTION

According to national data, the placing on the market of bioplastics is generating a **growing business**. In 2018 the annual production amounted to almost 100.000 tons, with a 125% overall increase compared to 2012 and, more specifically, a 250% increase from 2016 to 2018 for the production of ultralight plastic films only (driven by the growing production of compostable shopping bags and the progressive withdrawal of conventional plastic bags)<sup>4</sup>.

In particular, the year 2019 saw a considerable growth in the demand for hard bioplastics products, with reference to plates, cutlery, cups and glasses, i.e. disposable products regulated by the recent Single Use Plastic Directive. The Directive aims at preventing and mitigating the impact of plastics on the environment through measures including market restrictions for single-use conventional plastic products<sup>5</sup>.

As to bioplastics, under recital 11, the SUP Directive reads:

«Plastics manufactured with modified natural polymers, or plastics manufactured from bio-based, fossil or synthetic starting substances are not naturally occurring and should therefore be addressed by this Directive. The adapted definition of plastics should therefore cover polymer-based rubber items and bio-based and biodegradable plastics regardless of whether they are derived from biomass or are intended to biodegrade over time. ».

In brief, according to the present legislation no distinction is made between biobased and single-use conventional plastic products. Such interpretation seems to be born out by Article 2 of the Directive which points out that «the Directive applies to the single-use plastic products listed in the Annex» without any further distinction being made in relation to plastic type. However, some bioplastics manufacturers claim a different interpretation of the Directive based on which biodegradable and compostable plastics are likely to fall outside the scope of the Directive<sup>6</sup>, with particular reference to restrictions on their placing on the market. Such interpretation is built upon recital 15 that explains the reasons why restrictions on their placing on the market should also cover products made from oxo-degradable plastic, because this type of plastic does not properly biodegrade and is not compostable<sup>7</sup>, and this, on the contrary, would make the restrictions on truly biodegradable and compostable plastic products unjustified.

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<sup>4</sup> *The supply chain of compostable polymer - 2018 Data - Plastic Consult (from Assobioplastiche)*

<sup>5</sup> Here the list of banned items:

- Cotton swabs or cotton buds (already prohibited in Italy early this year);
- Cutlery (forks, knives, spoons, chopsticks);
- Plates;
- Straws (except when they fall within the scope of Directive 90/385/ECC or Directive 93/42/ECC);
- Beverage stirrers;
- Expanded polystyrene foam food containers, such as boxes with or without a lid for eat-in or take-away;
- Expanded polystyrene foam beverage containers with lids or caps;
- Expanded polystyrene foam beverage cups with lids or caps;
- Oxo-degradable plastic products.

<sup>6</sup> It is worth reminding that the Directive will have to be transposed by all Member States by 3 July 2021. Nevertheless, it is envisaged that in order to be more specific about their forecasts, Member States will benefit from a several months' leeway prior to bringing the above law into force (See Article 17 "Transposition"). In addition, it is worth mentioning that the above Directive incorporates Directive 94/62/CE (Packaging) and Directive 2008/98/CE (Framework), being classified as a "*lex specialis*", to the extent that such its Articles shall prevail over those of other possibly conflicting laws at least as far as its legislative scope is concerned (e.g. restrictions on placing on the market, product requirements, marking and extended producer responsibility etc.).



Irrespective of how the SUP Directive will be practically implemented, market stakeholders seem to have identified a “virtuous” substitute for those conventional plastic products the European Directive has prohibited, and have consequently given rise to a progressive increased demand for single-use bio-based products.

Such a demand is fostered by a number of stakeholders, e.g. the retail sector, environmentalist organisation, public events, trade fairs and festivals promoters, and is particularly encouraged by the more or less verbatim implementation of specific Municipal or Regional resolutions/ordinances<sup>8</sup>.

The underlying cause for such an increased demand for manufacturing alternative (bio)plastics lies in a renewed perception of single-use (or multiple) plastic products being perceived as a “virtuous” alternative as “they can be disposed of with organic waste” (a contradiction in itself as the market limited awareness over waste demonstrates). PLA “bio bottles” are a clear case in point. PLA is expected to replace PET which in fact is being recycled throughout an efficient and consolidated supply chain. Of no benefit was the work carried out by national campaigns that seem to have taken for granted that the organic waste supply chain is capable of seamlessly and economically process integrate the present and future output of national bio-plastics waste.

In the light of the latest background, it is urgent to re-examine not only the **opportunities** but also the **risks** to be correlated with the progressive dissemination of bio-plastics products and to ensure that bioplastics development be driven by the most efficient management strategies throughout their entire life cycle.

In particular, it is important to prevent strategies from being made on the basis of a market-led logic only<sup>9</sup>, without constructing *ex ante* a preliminary strategy in which all supply chain stakeholders are involved. Given the present situation, the risk hovering in the background is that whoever is responsible for managing bio-plastics waste will be forced to accept and implement other people’s strategies that are based on a fascination for bio-based products and not on current or future waste collection, treatment and management systems. Given the new scenario, the cost for these strategies will have to be borne inevitably by end-users who pay for service fees that incorporate collection, sorting and treatment of organic and bioplastics waste.

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<sup>7</sup> Hereafter the text of recital (15): «The restrictions of placing on the market in this Directive should also cover products made from oxo-degradable plastic, as that type of plastic does not properly biodegrade and thus contributes to microplastic pollution in the environment, is not compostable, negatively affects the recycling of conventional plastic and fails to deliver a proven environmental benefit».

<sup>8</sup> The Tuscany Regional Law 37 of 28 June 2019 “Options to reduce the impact of plastic on the environment”, for instance, prohibits the use and administration of single use plastic in the shores and beaches of Tuscany regional coastline. The law does not envisage any derogation from such prohibition, however billboards advertising Plastic free Tuscany read: “The use of single use plastic products is allowed only if made of compostable material”, thus introducing an exception to the rule that the above mentioned Tuscany regional law explicitly purports not to contemplate.

<sup>9</sup> Or better business-driven and short-term market logics at odds with a global cost-based approach though seen through the lens of market logic (Whole-life cost or Total Cost).



## INCREASED IMPORTS FROM THIRD COUNTRIES (ASIA)

The identification of bioplastics as a virtuous substitute for replacing single use plastic products, besides being at odds with a more literal interpretation of the European Directive, is likely to push up domestic demand above the current national production capacity and increase current import levels, in particular from Asian countries, both for bioplastics and other type of “natural origin” products resulting from manufacturing by-products. It is worth noting that the dubious quality of imported materials has been already alarmingly reported by plastic film marketers among whom bioplastics producers warn about the presence of “illegal and unlawful” plastic bags in the market.

This was compounded by the growing demand for single use and alternative bioplastics products from a number of important large retail channels which are bringing to the shelves numberless uncertified products provided with captions urging users to throw the resulting waste in the organic bin. Irrespective of the type of waste collection and management system to be selected, it is self-evident that there is growing concern about those materials, which in itself calls for increasing attention to compliance with certifications and a strong commitment to protect products against counterfeiting.

## BIOPLASTICS AND MUNICIPAL WASTE COLLECTION SYSTEMS

Although the UNI EU 13432 represents a technical reference point and a preliminary benchmark that municipal waste utilities can rely on when asked to advise users on waste delivery behaviours, bioplastics waste collection systems is yet to be regulated by a single national standard so much so that utilities have been implementing a wide range of practices.

Only recently did the European delegated Act<sup>10</sup>, capitalizing on a provision laid down in the EU Directive 851 of 2018, stipulates that «waste with similar biodegradability and compostability properties which complies with relevant European standards or any equivalent national standards for packaging recoverable through composting and biodegradation, shall be collected together with bio waste [...]». Some general indication is laid down in relation to bioplastics waste management without any preliminary cost benefit analysis of the options available for which we will try to provide some useful food for thought.

The collection of bioplastics within the organic waste recovery flow can generate some **criticalities in the waste treatment phase**, especially in the long term, that we will try to describe in the following chapters. For now, it suffices to observe that having a specific weight significantly lower than that of organic waste, bioplastics volume per weight unit is considerably higher and this in the long term could lead to higher waste collection (and treatment) costs. In addition, since in most cases bioplastics waste consists in packaging, it falls within the scope of the CONAI Diversified Environmental Contribution that is expected to generate compensations for waste management costs incurred. However, at present the combined collection of bioplastics and organic waste is not envisaged under the National Packaging Consortium Obligation, therefore it is not possible<sup>12</sup> either for waste collection companies or for waste treatment plants to be eligible for COREPLA compensations.

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<sup>10</sup> Delegated Act 117 of 4 October 2019 for the transposition of European Directives and the implementation of other EU acts – European delegated Act 2018.

<sup>12</sup> Unless specifically provided for by an ad hoc - highly sought after - regulation that covers such waste product type collection through contributions paid by bioplastics manufacturers.



Consequently, the costs to be incurred for sorting and treating bioplastics disposed of (ref. second part of the document) shall be added to profit losses generated by unpaid contributions.

The option of channelling bioplastics waste into plastic or multi-material packaging waste collection systems shows some criticalities too. In fact, at present sorting plants fail to select bioplastics out of conventional plastics. The technology is not to blame, the waste treatment infrastructure is neither designed nor conceived to carry out such sorting task, which would be nonetheless a highly complex activity given the lack of recognition criteria (for example colour recognition criteria) applied to bioplastics placed on the market. While waiting for the emergence of new technologies capable of sorting out these two types of polymers, the “contamination” of the flow of conventional plastics undergoing recycling operations through bioplastics could generate inefficiencies or undermine the performance of national fossil-based plastics recycling industry.

The set up of separate collection systems exclusively dedicated to bioplastics would call for a preliminary evaluation of the technical and economic feasibility taking into account: 1. the possibility of making citizens truly aware of the various packaging delivery options for the same packaging (e.g. plastic bottles) depending on the type of polymers involved; 2. the amount of waste that can be feasibly collected and the direct costs thereof; 3. finally, the need to ensure integration of all waste treatment plants, in terms of capacity and ad hoc (stream based) pre-treatment and/or biological stabilization cycles (now applied to organic waste only).

**The fact that bio-plastic products fail to be easily and immediately differentiated** from conventional plastic waste items can generate some confusion for citizens (and to some extent for waste management operators as well), thus bringing about a potential increase in the volume of unwanted items in case of organic waste collection or waste collection dedicated to bioplastics with all the possible consequences in terms of inefficiencies and costs to be incurred by waste treatment infrastructures downstream.

Prior to taking for granted that these materials belong to the organic waste stream only, it is mandatory to explore all the possible options in terms of technical and economic feasibility, resource efficiency and costs and benefits. The comparison between the various options allows to identify the most appropriate conditions at each phase (collection, sorting and treatment) and to opt for the best combined management.

The specific features of these waste products (at the same time “packaging” and “compostable products”) could theoretically suggest collecting, sorting and processing waste along different industrial supply chains and possibly introducing raw materials recovery systems, and waste based feedstocks for the production of new bioplastics, just as happens for other types of waste fractions.

Since this option involves either designing new “greenfield” processes or technologies, or revamping old “brownfield” plants, it is clear that **no decision shall be made without *ex-ante* consultation with those who are responsible for managing waste.**



## BIODEGRADABILITY AND COMPOSTABILITY CERTIFICATION

The UNI EN 13432:2002 Standard "*Requirements for packaging recoverable through composting and biodegradability – Test scheme and evaluation criteria for the final acceptance of packaging*" is used to determine the biodegradability and compostability of packaging, *stricto sensu*, and now, by extension, of different bioplastic products (e.g. crockery, glasses, cups, cutlery etc.).

The standard defines the timeframe and the treatment conditions, i.e. temperature and humidity, required to control materials biodegradability (over a 6 months' period) and compostability, that is the materials' physical capacity to fall apart into very small fragments smaller than 2 mm over a period of approximately 3 months. However, the conditions and the timeframe envisaged by the standard do not overlap univocally with real-life industrial processes, and this is compounded by the fact that existing waste plants have been designed to treat specific materials (biodegradable waste originated from kitchens, canteens, restaurants, gardens and parks), certainly not bioplastics.

The "compostability trademark" of any material is often interpreted in a direct and broad sense, as a certification of its effective compatibility with the industrial treatment process of organic waste. Conversely, the fact that a material is certified as "compostable" indicates only that it complies technically with UNI EN 13432:2002 requirements and that compliance has been certified by an official UNI EN certification body. However, this does not amount to saying that such material, under any conditions and circumstances, can be subject to waste treatment together with organic waste. Compliance with the UNI EN 13432:2002 standard is a necessary but not sufficient condition for industrial<sup>13</sup> compostability. In order for bioplastics to be composted together with organic waste, they need to be compatible with existing organic waste treatment processes. For this reason, the Italian "compostable CIC" trademark comes with the sentence "Check out waste delivery and collection practices with your Municipality/Local Waste Management Authority".

How waste will be managed eventually cannot be defined only *ex ante* on the basis of whether specific technical characteristics of the product have been certified. How waste will be managed also depends on the adoption of specific municipal waste collection systems, on the technology deployed in the waste treatment plant - whose management at times is not responsible for operating waste collection - and on the general waste management organisation implemented in any given geographical area<sup>14</sup>. This does not amount to saying that waste collection systems and waste treatment technologies cannot or should not evolve, but that their evolution shall be technically feasible, economically sustainable, and a properly steered throughout the whole implementation process. Therefore, any evolution of this kind shall be the object of a shared strategy involving waste management administrations and stakeholders.

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<sup>13</sup> The situation can change in local composting systems, where process conditions are very different from industrial bio-waste treatment plants.

<sup>14</sup> It must be added that in Italy there is a multitude of industrial approaches to industrial composting with a wide range of solutions applied to the pre-treatment stage, anaerobic digestion, post-composting, management of the screening material and of pre-treatment waste. These choices are strictly connected with specific industrial strategies but are also largely affected by the local specific needs (area, quality and a variety of materials subject to treatment etc.). Given their own nature and physical properties (for which they look very much like the lignocellulosic/fibrous part and not so much like the putrescent fraction of bio-waste) bioplastics products are more compatible with some waste management plants and less with others.



## BIOPLASTICS AND ORGANIC WASTE TREATMENT PLANTS

The tests being carried out by organic waste treatment plants or by the “Lab Scale” have shown some performance limitations of such recovering system. These limitations have been confirmed by hands-on experience of a number of waste management companies, that to a different degree have reported inefficiencies associated to bioplastic product type, waste treatment technology and plant lay-out. As a matter of fact, while on the one hand, bioplastics carrier bags and compostable and biowaste collection plastic bags can be treated less cumbersome and contribute to improving organic waste separate collection, on the other, there are other bioplastic products that present some criticalities along a number of waste treatment processes. In addition, treatment period, temperature, humidity and all process specifications liable to be reported in any treatment plant heavily depend upon the implemented technology, mix of waste treated and regulatory restrictions. As mentioned above, technologies and waste treatment practices may not coincide with what EN 13432 test condition regulations provide for, thus it becomes impossible to objectively claim (without any specific in-depth validation) that “all products marked as compostable degrade completely in the bio-waste treatment plants”. Today’s plants are specifically designed to treat organic waste such as food waste, garden and park waste and by-products alike. They could be re-designed and re-engineered also in the light of the new EU fertilizing products regulation<sup>15</sup>, although this does not automatically lead to processing conditions capable of degrading bioplastic waste altogether. The following should be taken into account:

1. The biological transformation of organic waste is introduced by mechanical treatments that vary depending on the technology of the waste treatment plant and process conditions. Whenever these treatments include size-based separations, for instance screenings etc., most bioplastics products are disposed of together with other similar conventional plastic products. The outcome of this flow depends on a number of factors which may include subsequent treatment stages or departure from the flow of “waste” items allocated to energy recovery or disposal. Pre-treatments are often highly “advanced” in anaerobic treatment plants. If the waste collected is qualitatively good, the discarded fraction has little impact if any and can undergo post-composting (even though the process length and conditions, conceived to achieve anaerobic stabilization with wood fractions can hardly ensure bioplastics degradation altogether). In all other instances, separation between bioplastics and other non-compostable materials is technically not feasible therefore waste is disposed of or used for energy recovery. Substantially increased bioplastics feedstocks in organic waste treatment plants can generate more waste materials that are not targeted by the subsequent reprocessing and force waste treatment plants to incur higher operating costs. Such increase in costs is not only due to the amount of bioplastics waste removed upstream of the treatment plant along with other non compostable materials, but is magnified by the “dragging effect” whereby for each kilo of plastic (or bioplastics) discarded at pre-treatment stage a considerable amount (many times higher) of organic material that remains adhered to it has to be factored in.
2. The tests carried out (in the Lab Scale)<sup>16</sup> show that treatments based on anaerobic digestion fail to achieve adequate degradation for these materials.

<sup>15</sup> EU REGULATION 2019/1009 OF THE EUROPEAN PARLIAMENT AND COUNCIL OF 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No. 1069/2009 and (EC) No. 1107/2009 and repealing Regulation (EC) No. 2003/2003.

<sup>16</sup> BMP (Biomethane Potential) tests and assessment of mass balance carried out by CIC and CRPA within the scope of monitoring activities laid down in the Framework Agreement between Assobioplastiche, CIC, CONAI, Corepla.





3. In defining end-of-waste criteria according to which organic waste can be likened to a fertilizer product, both the legislative decree No. 75/2010 and the new EU Regulation on fertilisers lay down the maximum concentrations of materials that cannot be composted, among which plastics, to be found in the compost. The maximum limit value beyond which the macroscopic impurities are re-assessed is 2 mm. Bioplastics tendency to undergo biological decomposition by far exceeds that of conventional plastics. This specific feature, in the event of incomplete biodegradation, can lead to the formation of bioplastics particles whose size is greater than 2 mm, but smaller than that of similar materials resulting from conventional plastic decomposition. Standard compost screening technologies have been designed to remove conventional plastic, i.e. impurity fragments above the size of bioplastics ones, which instead can remain in the end product. These fragments cannot be differentiated from those of conventional plastic according to standard analytical procedures implemented by standard control authorities and therefore are reassessed as non compostable material. An increase in such fragments, driven by increased bioplastics upstream is likely to increase the risk of producing compost non-compliant with technical regulations. Therefore, it is deemed appropriate to explore this matter further also by means of specific tests at industrial level.

## COMMUNICATION CHALLENGES

Since the responsibility for advising on how to best use and deliver the different types of bioplastics waste falls on a number of stakeholders (i.e. from the retail sector and other market operators who seem to be comfortable with the market and its environmental policies, to local administrations who have made specific laws or issued ordinances to prohibit single use plastic products, but not bio-plastics), municipal waste management companies find themselves under increasing pressure from different sides and responsible for providing answers after taking into account each local situation.

Advising citizens in a diversified manner depending on the local situation may cause confusion and distrust, especially because it is difficult to make people understand the intricacies of managing this kind of waste even though bioplastics have recently become more visible in the eyes of citizens. Advertisement promoting the environmental qualities of these products is moving forward in leaps and bounds and expecting all possible waste management options to be thoroughly examined can be counterproductive and backfire on the communication conveyed to the public, in spite of growing evidence to the contrary<sup>17</sup>.

In the absence of any systemic approach and coordinated efforts, waste management companies, each in its own industrial and geographical “comfort zone”, will be increasingly urged to find solutions to problems caused by others.

## CONCLUSIONS

Bioplastics need to be dealt with from all angles looking at all their implications, so as to shed light on their real potentials as new materials, without seeking to hide their criticalities that have already propelled them to the forefront of the public agenda in an attempt to achieve a shared strategy and an efficient management of their end-life cycle.

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<sup>17</sup> There are state-of-the-art anaerobic digestion waste technologies deployed in the country that given the complexity and intricacies of bioplastic management prioritize delivery of organic waste through paper bags.



From all angles, any solution will have to contemplate actions to set up an Extended Producer Responsibility system at national level. Such a system would inevitably play a crucial role in improving the environmental efficiency of bioplastics products (supporting research in its attempts to make the design of bioplastics products more recognisable and to enhance biodegradability and compostability), to foster the required technological and organisational evolution of bioplastics waste collection and treatment systems and to promote widespread support for accurate information campaigns for consumers. To this end, Utilitalia welcomes with open arms the formation of a national biodegradable and compostable plastic recycling consortium.

Utilitalia member companies are pleased to take upon themselves the promotion of sustainable development of this industrial supply chain by providing assistance:

- To jointly launch tests and experiments on bioplastics compatibility with existing waste management systems, with particular reference to hard food packaging, bottles, cups, capsules and other single-use products that are not packaging (e.g. absorbent products, cotton swabs etc.);
- To assess the technical and economic feasibility of innovative bioplastics waste treatment plants (e.g. pre-treatment sorting systems to channel products into specific waste treatment streams);
- In concert with the relevant authorities and packaging chain operators, to evaluate alternative uses for CAC (CONAI Diversified Environmental Contributions) being levied upon bioplastics packaging, to facilitate technical and operational evolution in bioplastics waste management systems;
- To jointly look for alternative solutions in case no option for innovating the industrial process or the organization from a technical (insufficient quantity) or economic (high investment costs) perspective proves viable.

It is self-evident that the evolution of the bio-plastics industry shall call for a potential game changer in the near future for the country's entire waste management and recycling system. However, bioplastics will continue to offer major opportunities in terms of industrial efficiency and environmental sustainability on condition that such game changer be governed by a strategy jointly agreed upon by all stakeholders.