THE CONFERENCE BOARD

Bioplastics: A False Promise?

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As the world wakes up to the pros and cons of single-use plastic, manufacturers, restauranteurs, caterers, and retailers have rushed to replace them with products labeled as "compostable," "biodegradable," "environmentally friendly,"or "plant-based." But many are unaware that plastics made from bio-based materials are not necessarily biodegradable or compostable. Plastics labeled as "biodegradable" can be made from fossil fuels. Compostable plastics may only break down in industrial facilities, not in the compost heap at the end of someone's garden. Such confusion has led to skepticism and claims companies are using such terms to "greenwash," though they can be better for the environment in specific applications. Substituting conventional plastics with bioplastics alone will not address the plastic waste challenge.

A plastic material is defined as a bioplastic if it is either "bio-based"—derived from plants and other renewable agricultural, marine, and forestry material, or "biodegradable"—capable of being decomposed by bacteria or other living organisms, or both.

Insights for What's Ahead

- There are currently no policies or regulations that directly govern raw materials for bioplastics. However, production may be indirectly impacted through directives and policies aiming to increase the amount of recycled plastic, decrease dependence on fossil fuels, and reduce greenhouse gas emissions from extraction and production. For example, in January 2022, the European Commission launched a public consultation on bioplastics as part of the EU Plastics Strategy, which aims to clarify the role of bio-based, biodegradable, and compostable plastics in delivering on the Commission's commitments to a carbon neutral and circular economy. China, which produces a large proportion of global bioplastics, is developing a new national standard for the definition, classification, labeling, and degradability of bioplastics.

- To safeguard against reputational risks, company claims relating to the biodegradability of bioplastics need to be specific, accurate, relevant, and truthful, especially in the context of imminent regulatory intervention to standardize definitions of bioplastics. Companies need to understand that bioplastics may not necessarily have a lower lifecycle or environmental footprint compared to conventional plastics. (The environmental footprint of bioplastics can vary significantly depending on the feedstock used to produce it, geographical region, energy source used in refineries, and the end-of-life management of the final product.) The science is complex and conducting due diligence before substituting bioplastics for conventional plastics is a critical step before making any environmental claims or investments in bioplastics.

- The production and use of bioplastics entails a significant commitment of resources from companies. Companies need to assess supply chain dynamics and examine use of plastics across the entire value chain of their products. This calls for detailed contractual arrangements with suppliers and vendors to

avoid disruption and ensure a smooth transition from traditional plastics to bioplastics. An effective plastic reduction strategy begins with following established waste hierarchy principles: avoid, reduce, substitute, and move toward circular business models in which supply chains recover or recycle the resources used to create products. Any strategy that calls for greater use of bioplastics means factoring in the opportunity costs involved in making the shift from traditional raw materials to bioplastics. Engaging the R&D, products, strategy, and risk management teams and the board in a collective effort will help build robust policies at the company level. Bioplastics may remain a false solution to a real problem if no efforts are taken to adequately consider and address questions arising from its use, including:

  - Sourcing raw materials for it;
  - Its impact on food security and sustainability;
  - Its production, supply and distribution; and eventually,
  - Its disposal and recycling.

- There is greater awareness globally about the environmental hazards arising from the use of single use plastic as well as nonrecyclable plastics. Regulators, environmental experts, and consumers have become better informed about the risks posed by plastics; many consumers are seeking brands that match their objectives for environmental responsibility when it comes to the use of plastics. Bioplastics currently constitute a very small share (1 percent) of the plastics in circulation, but the demand for bioplastics is likely to rise in the coming decade. Getting out in front of this growing demand can create a competitive advantage and be a safeguard from potential reputation risks.

Not All Bioplastics Are Alike

Bio-based plastic	Biodegradable plastic	Compostable plastic
Plastic that is made from plants or other organic material instead of fossil fuels.	*Plastic that can biodegrade, i.e., can be broken down by microbes and turned into natural materials.*	*Plastic that can be composted, i.e., broken down only at appropriate composting conditions.*
	These can be conventional (made from fossil-fuels) or bio-based (made from plants or other organic material).	Industrial composting conditions require high temperatures (55-60°C), high relative humidity, and oxygen. Natural biodegradation conditions in soil, surface, and marine water are not optimal for composting.
Only certain types of bio-based plastics are biodegradable (biodegradable bioplastic). Accordingly, bio-based plastics should not be sent to landfills without prior segregation as they might not degrade in landfills on their own.	Biodegradable plastics cannot be recycled in the same way as nonbiodegradable plastic. They must be separated from nonbiodegradable plastic streams and dealt with separately.	Only certain types of biodegradable plastics are compostable. Accordingly, compostable plastic should be segregated from the larger set of biodegradable plastics.

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Bioplastic Is an Umbrella Term, Comprising a Whole Family of Materials

A plastic material is defined as a bioplastic if it is either bio-based, biodegradable, or features both properties. There are many different types of bioplastics. Some of the most common types of bioplastics are:

- **Polylactic acids (PLAs),** made by extracting sugar from plants like corn and sugarcane. PLA can look and behave like polyethylene (used in plastic films, packing, and bottles), polystyrene (Styrofoam and plastic cutlery), or polypropylene (packaging, auto parts, textiles).
- **Polyhydroxyalkanoates (PHAs),** engineered from microorganisms that produce plastic from organic materials and often used in medical devices like sutures and cardiovascular patches. These are at an early stage of development and are expensive.
- **Polybutylene adipate terephthalate (PBAT)**, made from petrochemicals yet is biodegradable. It can be produced on a large scale and has the physical properties needed to make flexible films that rival those from conventional plastics.
- **Polyethylene furanoate (PEF)**, a new polymer expected to enter the market in 2023, according to trade body European Bioplastics. PEF is comparable to polyethylene terephthalate (PET) but is 100 percent bio-based and claimed to feature superior barrier and thermal properties, making it an ideal material for the packaging of drinks, food, and nonfood products.

The Bioplastic Market Is Expected to Grow Fast in the Next Decade

Bioplastics account for less than 1 percent of the approximately 367 million tonnes of plastic produced annually across the globe, according to European Bioplastics, a bioplastics trade organization. However, the market has continuously grown, due to an increase in demand and the development of advanced applications and products.

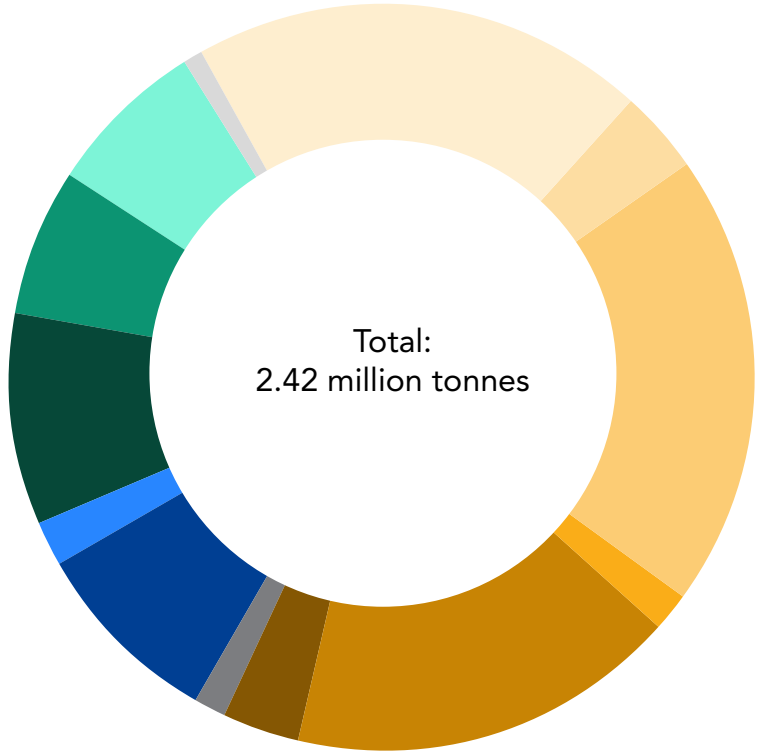
Global bioplastics production capacities are expected to increase from around 2.42 million 4 time in 2021 to approximately 7.59 million tonnes in 2026, with the share of bioplastics in the aggregate crossing 2 percent of the total global plastic production for the first time.

According to data from European Bioplastics, out of these bioplastics, biodegradable plastics (including PLA and PHA) are in higher demand than nonbiodegradable ones, accounting for more than 64 percent (1.5 million tonnes) of global bioplastic production capacity. Production is predicted to increase to nearly 5.3 million tonnes in 2026 owing to the development of polymers such as PBAT (polybutylene adipate terephthalate) and PBS (polybutylene succinate) and a continuous increase in the production of polylactic acids (PLAs).

Packaging remains the largest market for bioplastics with a 48 percent share of the total bioplastics market in 2021. However, given that more sectors, including catering, consumer electronics, automotive, agriculture/horticulture, toys, and textiles are increasing their use of bioplastics, the portfolio of applications continues to diversify.

The production costs of bioplastics significantly exceed the costs of producing fossil-based plastics. While the production cost of bioplastics may be high, the rise in prices of oil-based plastics due to oil shocks may render these alternatives more attractive in the long run. In the medium to long term, technological progress will continue to be essential for bioplastics to become more cost-competitive in the future.

Global production capacities of bioplastics 2021
(by material type)



Other (bio-based/ nonbiodegradable)	1.0%
PE	9.5%
PET	6.2%
PA	9.1%
PP	1.9%
PEF[1]	0.0%
PTT	8.1%

Bio-based/nonbiodegradable
35.8%

19.2%	PBAT
3.2%	PBS
18.9%	PLA
1.8%	PHA
16.4%	Starch blends
3.2%	Cellulose films[2]
1.2%	Other (Biodegradable)

Biodegradable
64.2%

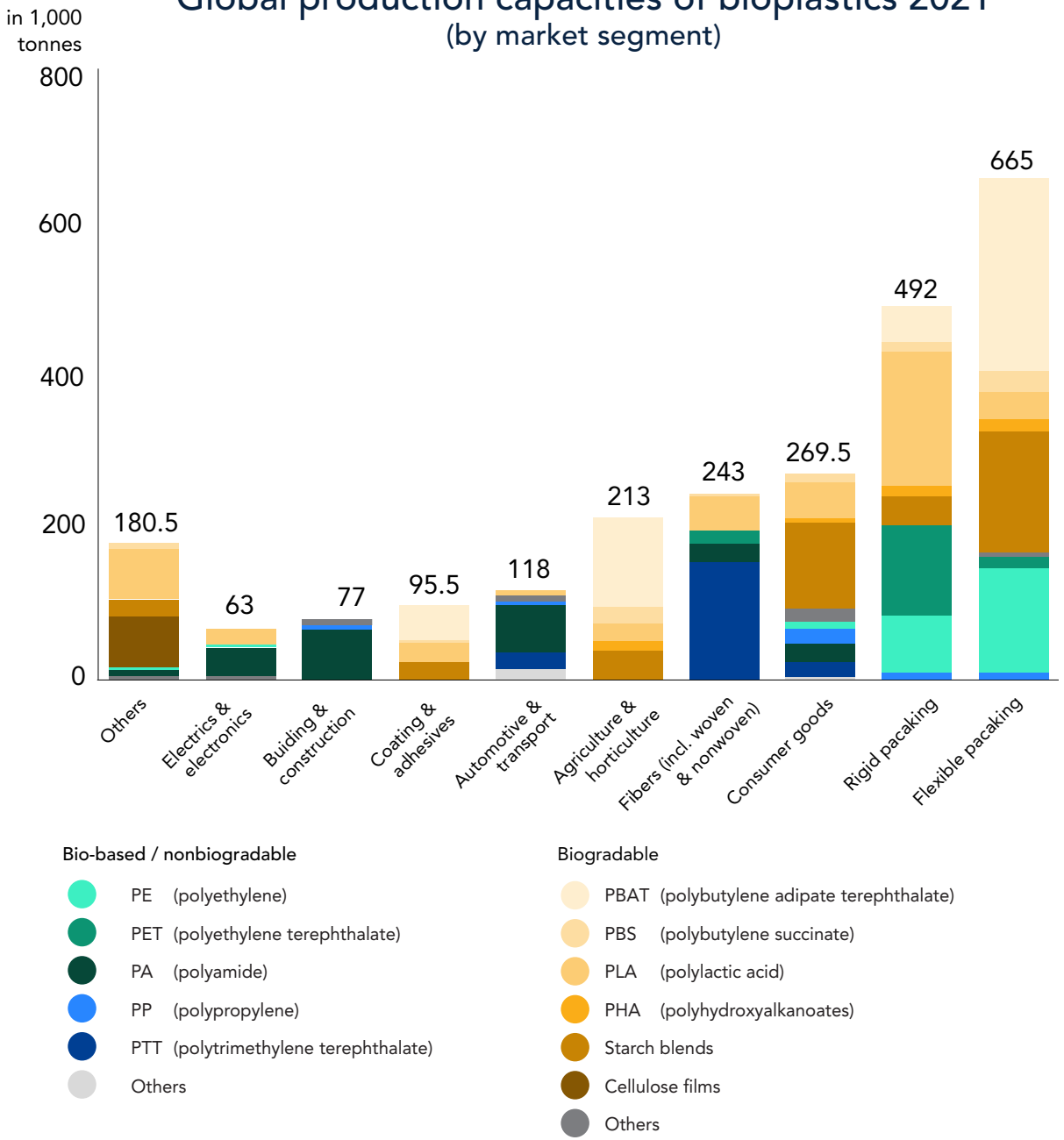
Legend :

PET	polyethylene terephthalate
PE	polyethylene
PA	polyamide
PP	polypropylene
PTT	polytrimethylene terephthalate
PBAT	polybutylene adipate terephthalate
PBS	polybutylene succinate
PLA	polylactic acid
PHA	polyhydroxyalkanoates

1) PEF is currently in development and predicted to be available at commercial scale in 2023.
2) Regenerated cellulose films.

Source: European Bioplastics, nova-Institute (2021)
More information: www.european-bioplastics.org/market and www.bio-based.eu/markets

Global production capacities of bioplastics 2021
(by market segment)



Source: European Bioplastics, nova-Institute (2021)
More information: www.european-bioplastics.org/market and www.bio-based.eu/markets

Regulatory Activity to Standardize Bioplastics Is Imminent

There are currently no policies or regulations that directly govern raw materials for bioplastics, according to a 2019 report by Principles of Responsible Investment, an institutional investors organization. However, it predicted that companies producing them may be indirectly impacted through directives and policies to increase the amount of recycled plastic, decrease dependence on fossil fuels, and reduce greenhouse gas emissions from extraction and production.

In January 2022, the European Commission launched a public consultation on bioplastics as part of the EU Plastics Strategy, European Green Deal, and Circular Economy Action Plan. It aims to clarify the role of bio-based, biodegradable, and compostable plastics in delivering on the Commission's commitments to a carbon neutral and circular economy. The commission seeks to harmonize rules for defining and labeling compostable and biodegradable plastics.

The commission also aims to improve the understanding of the full lifecycle and environmental impacts of these plastics, as well as the applications which are likely to be the most appropriate to deliver genuine environmental benefits compared to conventional plastics. It plans to adopt this initiative in July 2022 as part of its second circular economy package.

Even in China, which produces a large proportion of global bioplastics, a new national standard for the definition, classification, labeling, and degradability of such plastics is being developed, according to China Dialogue, a nonprofit organization dedicated to promoting a common understanding of China's environmental challenges. The current national standard, GB/T20197, which dates from 2006, identifies four types of degradable plastic: biodegradable, compostable (a subset of biodegradable), light degradable, and thermal-oxidative degradable. Production of biodegradable plastics has boomed in recent years, driven by the ban on nonbiodegradable, single-use plastic products. But in its plans for tackling plastic pollution from 2021 to 2025, China's National Development and Reform Commission and Ministry of Ecology and Environment called for more research into the impact and applicability of the materials and warned against expanding production. A draft consultation on the standard was published in November 2020, but nothing has yet come into force.

Bioplastics Certification Can Help Ensure Accuracy of Claims

Certification and standards can help end vague and misleading bioplastic terminology. Incorrect and misleading claims are nothing but greenwashing. Over the past decade, governments all over the globe have taken steps in relation to the biohazards of plastics and have imposed certain bans as well. With heightened levels of regulatory push to reduce environmental impact, companies should be even more careful with their engagements in this space. Consumers need to be provided complete clarity and should not be misled to make certain choices in any manner. Businesses should consult reliable sources when choosing how to label their products; several stakeholder initiatives can help to certify specific products:

- International Sustainability and Carbon Certification covers feedstocks for bioplastics. In addition, the Roundtable on Sustainable Biomaterials and REDCert have developed tools and certifications for biomaterials.
- The European Commission and the European Committee for Standardization (CEN) have issued a multitude of standards that can serve as a basis for evaluating claims for bioplastics and other bio-based products. For example, EN 13432 or EN 14995, defines the technical specification for the compostability of bioplastics products. European Bioplastics recommends that commercial users or retailers should ask distributors about their product certification and demand the certification number.
- The British Standards Institute (BSI) has developed a standard to measure the biodegradability of polyolefins. PAS 9017:2020 specifies the requirements needed for these materials to biodegrade in an open-air, land-based environment. It covers polyolefin composition targeted at biodegradability, degradation towards biodegradability from weathering, and criteria for the level of biodegradation to be achieved. However, it omits other environments for degradation, including marine, landfill, and composting; compatibility with recycling; and claims made by manufacturers to consumers about products.

Several European Countries, including Austria and Italy, Have Established Certification Schemes for Bioplastics

Environment	European Reference Standard	Certification and logos	Notes
Industrial composting	EN13432		EN 13432 refers to packaging. In addition, EN 14995 is a similar European standard for compostability of non-packaging products in industrial composting plants.
Well-managed home composting conditions	No European standard		The OK compost home label builds on a certification scheme developed by TÜV Austria Belgium NV. The DIN-Geprüft Home Compostable label is based on French standard NF T51-800 and/or the Australian standard AS 5810. National standards also exist in Belgium and Italy. A draft European standard exists for plastic carrier bags suitable for treatment in well-managed home composting installations (pr EN 17427:2020).
Soil	EN 17033		EN17033 applies to mulch films only. Based on a certification scheme developed by the label provider, but can be compliant with EN 17033 on request by adding two ecotoxicity tests.
Fresh water	No European standard		Based on a certification scheme developed by the label provider.
Marine water	No European standard		Based on a certification scheme developed by the label provider, using American standard ASTM D7081 (withdrawn) as a basis.

Sources: TÜV AUSTRIA (2012a, 2012b, 2012c, 2013, 2019), DIN CERTCO (2016, 2017, 2018); M. Hilton, Relevance of Biodegradable and Compostable Consumer Plastic Products and Packaging in a Circular Economy, Project Conducted Under Framework Contract No ENV.B.3/FRA/2017/005 for the European Commission DG Environment, accessed April 2020; European Bioplastics e.V. (2019, 2020a, 2020b), CIC (2020).

Bioplastics May Not Be the Silver Bullet to Our Plastics Problem

Bioplastics are still at the developmental stage and currently constitute a small share of the overall plastic in circulation. The environmental impact of bioplastics, which can vary significantly depending on the feedstock, geographical region, energy source used in refineries, and end-of-life management of the final product, remains an issue open to debate.

Many of the controversies surrounding bioplastics stem from confusion around end-of-life management of the final product. More than half (57 percent) of respondents to a survey in Germany in 2017 did not know what the term "bioplastics" meant. Despite this, the prefix "bio" led many to assume bioplastics to be completely plant-based, biodegradable, and even organically cultivated.

> The lack of consumers' understanding of the term bioplastics underlines the importance of educating consumers.

European Bioplastics acknowledges that nonexperts cannot distinguish bioplastics from conventional plastics and has published an Environmental Communications Guide providing general recommendations as well as specific guidelines for communicating environmental claims for bioplastics. The guide states that all claims should be "specific, accurate, relevant, and truthful," and that vague claims such as "green," "sustainable," and "environmentally friendly" should not be used. In addition, claims should be substantiated, ideally by independent third parties, and all data made available. Client Earth, an environmental law charity, is challenging the European Commission's classification of bioplastics as sustainable under its new taxonomy. The organization said that bio-based plastics are mainly used for single-use plastic applications, and as such, defining them as "sustainable" was "not only stupefying, but also unlawful," and that such labeling would increase investments in plastics instead of promoting the shift to a circular model. Further, companies should not hesitate to invest in research and testing of bioplastics in terms of their efficacy and safety. The chemical components of bioplastics must be scientifically tested and adequately assessed to ensure that none of their contents are toxic in nature. Sustainable raw materials and manufacturing techniques are very critical.

As noted in an earlier report by The Conference Board, *Plastic Solid Waste Management*, the world cannot tackle the plastic waste challenge in isolation; solutions to the plastics problem must be integral to the transition to a circular economy. Collective and coordinated action is needed from governments (e.g., policy intervention), industry (e.g., commitment to reduce plastic use, designing packaging that is reusable or recyclable), and society (e.g., informed, conscious decisions to reuse or refuse plastic) to curb plastic waste and protect the natural environment and oceans against plastic pollution.

In addition to the regulatory frameworks, companies must be conscious of their environmental footprint. Bioplastics may remain a false solution for the global plastic waste problem if market players do not take concrete steps to treat the plastics problem as a whole. Companies must engage their R&D, products, strategy, and risk management teams and the board in a collective effort to build robust policies at the company level to encourage the intelligent use of bioplastics.

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