european bioplastics

FAQ
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FREQUENTLY ASKED QUESTIONS ON BIOPLASTICS

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I ABOUT EUROPEAN BIOPLASTICS

When was EUBP founded and who are its members?

EUBP was founded in 1993 as Interessengemeinschaft Biologisch Abbaubare Werkstoffe e.V. (IBAW, International Biodegradable Polymers Association & Working Group). First, it constituted a German and later European representation and platform for the leading companies in the biodegradable plastics industry. By 2005, the bioplastics industry had evolved and grown, and developed a number of new innovative materials so that the focus of the association had broadened. As a result, the association was renamed to European Bioplastics. Today, it represents more than 80 member companies throughout the entire value chain of bioplastics.

These include:

- Renewable raw materials & green chemistry
- Plastic converters
- Bioplastics manufacturers and auxiliaries
- Research, consulting, standardisation & certification
- (Industrial) end users and brand owners
- RRM/intermediates RRM conversion
- Machinery/engineering/equipment
- Waste management and recycling

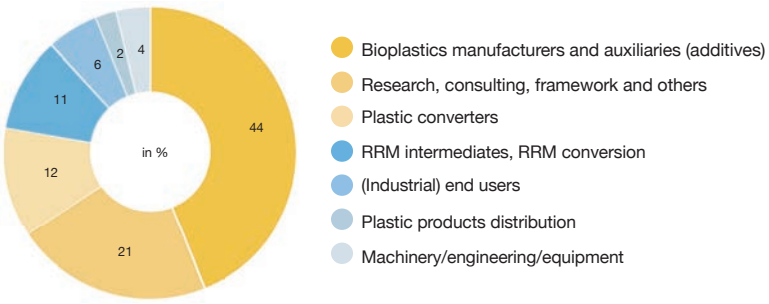


Figure: Membership European Bioplastics, 2022 .

Our members from all over the globe are engaged in the European market. About three quarters of our members are based in Europe. The remaining quarter consists of member companies from Brazil, the USA, and Asia.

http://www.european-bioplastics.org/about-us/
http://www.european-bioplastics.org/about-us/organisation/
http://www.european-bioplastics.org/about-us/members-membership/

What is EUBP's vision and mission?

We believe that bioplastics are a major driver in the evolution of plastics and that they contribute significantly to a more sustainable society. Our mission is to advance the economic and regulatory framework in Europe to allow for the bioplastics market to grow and flourish. Therefore, we aim to bring together all relevant partners and stakeholders and serve as both, a knowledge platform for all audiences and a business platform to support a sustainable technological development along the entire value chain as well as a full-scale market introduction of bioplastics.

http://www.european-bioplastics.org/about-us/mission/

How can I become a member of EUBP and what are the benefits of a membership?

Companies already involved in the bioplastics business sector but not yet a member of European Bioplastics should consider the advantages of connecting to our information and business platform and enlarging their network. Newcomers to our industry and/or the European market in particular can rely on European Bioplastics to help them get a foothold in the sector and benefit from our broad knowledge and contact database.

A membership offers access to a multitude of networking opportunities, visibility through representation across the field, business enhancement opportunities and support, access to comprehensive information resources, annual meetings and conference discounts.

The services available exclusively to members of European Bioplastics, include (but are not limited to):

- A 'members only' knowledge database including reports, political communiqués and financial programmes;
- Public relations and marketing measures and activities that increase awareness for bioplastics and our members' brands and products;
- Participation in association meetings and the opportunity to propose points of action for adoption;
- Matchmaking/consulting services through European Bioplastics, which create synergies between companies looking for specific services within the bioplastics sector;
- Reduced entry fees to industry events organised by European Bioplastics, and – where applicable – the opportunity to present products and network at the association's booth.

For more details, please see the membership benefits leaflet or our statutes and membership fee code and membership application form.

http://www.european-bioplastics.org/about-us/members-membership/
http://docs.european-bioplastics.org/2016/association/EUBP_membership_benefits.pdf
http://docs.european-bioplastics.org/association/EUBP_statutes_and_membership_fee_code.pdf
http://docs.european-bioplastics.org/association/EUBP_Application_form.pdf

II GENERAL QUESTIONS REGARDING BIOPLASTICS

How does EUBP define bioplastics?

According to European Bioplastics, bioplastics are biobased, biodegradable, or both.

The term "biobased" describes the part of a material or product that is derived from biomass. When making a biobased claim, the unit (biobased carbon content or biobased mass content) expressed as a percentage and the method of measurement should be clearly stated.

Biodegradability is an inherent property of certain polymers that can be suitable for specific applications, e.g. biowaste bags. Biodegradation is a chemical process in which materials, with the help of microorganisms, are metabolised to water, carbon dioxide, and biomass. When materials biodegrade under conditions and within a timeframe defined by the European standards for industrial composting EN 13432, they can be certified and labelled as industrially compostable.

http://www.european-bioplastics.org/bioplastics/

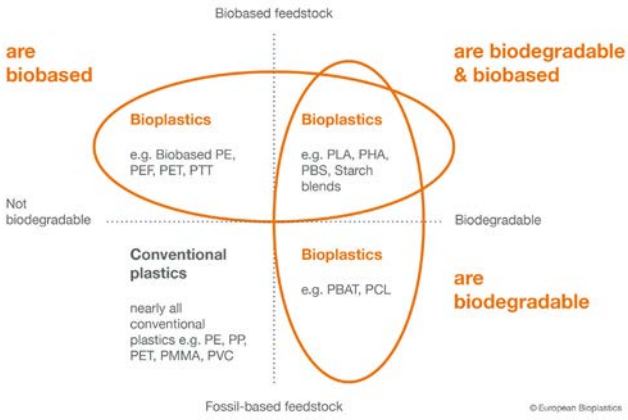


Figure: Material coordinate system of bioplastics (source: EUBP).

What are the advantages of bioplastics?

Biobased plastics can help to reduce the dependency on limited fossil resources, which are expected to become significantly more expensive in the coming decades. Biobased plastics are made from renewable sources instead of oil and that way gradually substitute fossil resources used to produce plastics with renewable resources (currently predominantly annual crops, such as corn and sugar beet, or perennial cultures, such as cassava and sugar cane).

Biobased plastics also have the unique potential to reduce GHG emissions or even be carbon neutral. Plants absorb atmospheric carbon dioxide as they grow. Using plants (i.e. biomass) to produce biobased plastics constitutes a temporary removal of greenhouse gases (CO_2) from the atmosphere. This carbon fixation can be extended for a period of time by establishing 'use cascades', that means if the material is being reused or recycled as often as possible before being used for energy recovery. In energy recovery, the previously sequestered CO_2 is released and renewable energy is being produced.

Another major benefit of biobased plastics is their potential to 'close the cycle' and increase resource efficiency. Depending on the end-of-life option, this can mean:

1. Renewable resources are used to produce biobased, durable products that can be reused, mechanically recycled and eventually incinerated whereby renewable energy is being produced.
2. Renewable resources are used to produce biobased, biodegradable and compostable products that can be organically recycled (industrial composting and anaerobic digestion) at the end of a product's life cycle (if certified accordingly) and create valuable biomass (humus) during the process. The humus can be used to grow new plants, thus closing the cycle.

Furthermore, plastics that are biobased and compostable can help to divert biowaste from landfill and increase waste management efficiency across Europe. For more information on that, please see the section on end-of-life (VII).

http://www.european-bioplastics.org/bioplastics/environment/
http://www.european-bioplastics.org/bioplastics/waste-management/

III THE BIOPLASTICS MARKET

What are the main characteristics of the bioplastic market?

The bioplastics industry is a young, innovative sector with an enormous economic and ecological potential for a low-carbon, circular bioeconomy that uses resources more efficiently. The current market for bioplastics is characterised by a dynamic growth rate and a strong diversification. Even though bioplastics still represent less than one percent of the about 367 million tonnes of plastics produced worldwide annually (Source: Plastics Europe), the market for bioplastics is growing very dynamically.

With a growing number of materials, applications and products, the number of manufacturers, converters and end users is increasing steadily. Significant financial investments have been made in production and marketing to guide and accompany this development. Bioplastics are a relevant and leading segment of the plastics industry.

The factors driving market development are both internal and external. Especially external factors make bioplastics the attractive choice. This is reflected in the high rate of consumer acceptance and increased consumer demand for more sustainable options and products. Moreover, the extensively publicised effects of climate change, price fluctuations of fossil materials, and the necessity to reduce the dependency on fossil resources also contribute to bioplastics being viewed favourably.

From an internal perspective, bioplastics are efficient and technologically mature materials. They are able to improve the balance between the environmental benefits and the environmental impact of plastics. Life cycle analyses demonstrate that some bioplastics can significantly reduce CO_2 emissions compared to conventional plastics (depending on the material and application). What is more, the increasing utilisation of biomass in bioplastic applications has two clear advantages: renewability and availability.

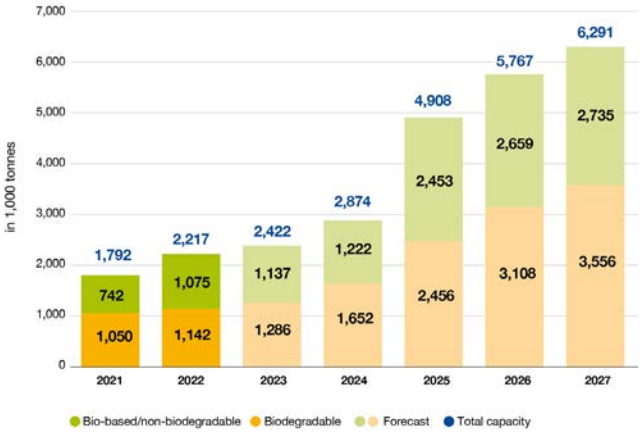
http://www.european-bioplastics.org/market/

How large is the bioplastics market – currently and in future?

Currently, bioplastics represent less than one per cent of the about 390 million tonnes of plastic produced annually. But as demand is rising and with more sophisticated materials, applications, and products emerging, the market is already growing very dynamically. According to the latest market data compiled by European Bioplastics, global production capacity of bioplastics is predicted to triple in the medium term, from around 2.22 million tonnes in 2022 to approximately 6.3 million tonnes in 2027.

http://www.european-bioplastics.org/market/

Global production capacities of bioplastics



Source: European Bioplastics, nova-Institute (2022). More information: www.european-bioplastics.org/market and www.bio-based.eu/markets

Figure: Global production capacities of bioplastics (source: EUBP).

Are bioplastic products penetrating the plastics market?

Today, there is a bioplastic alternative for almost every conventional plastic material and corresponding application. Bioplastics are moving out of the niche and into the mass market. The current market for bioplastics is characterised by a dynamic growth rate and a strong diversification.

With a growing number of materials, applications, and products, the number of manufacturers, converters and end-users also increases steadily. Significant financial investments have been made into production and marketing to guide and accompany this development. Legal framework conditions provide incentives for the use of bioplastics in several countries worldwide, providing stimulus to the market.

Big brand owners including Danone, Coca-Cola, PepsiCo, Heinz, Tetra Pak, Unilever and L'Occitane in the packaging market, or Ford, Mercedes, VW, Toyota in the automotive market have launched or integrated bioplastic products. With strong brand names driving the development, market penetration is gaining speed.

http://www.european-bioplastics.org/market/

Can a sufficient supply of bioplastics be guaranteed?
Supply is well ensured to meet the growing demand in the short and medium term. However, it is difficult to make long-term forecasts due to the dynamic and innovative nature of the bioplastic market. A reliable legislative framework in the EU would be beneficial to further attract investment and ensure supply in the long run.

In recent years, numerous joint ventures have been established and planned investments in bioplastic production capacities have been made. Initial facilities producing various types of bioplastics are operating in Europe, the Americas and Asia. Additional facilities and biorefineries are currently being set up or already started to operate in different regions from Italy to Thailand to produce bioplastics, including starch compounds, PLA, biobased PBS, biobased PE, biobased PET, or PEF. E.g. in response to the great demand for PLA, several bioplastic producers are planning or already expanding its production capacities for this biopolymer. These investments and scale-ups are reflected in European Bioplastics' market data, which show growth in capacity from around 2.22 million tonnes in 2022 to approximately 6.3 million tonnes in 2027.

http://www.european-bioplastics.org/market/

Can fossil-based plastics be completely substituted by biobased bioplastics?
Today, there is pretty much nothing that bioplastics can not do. For almost every conventional plastic material and application, there is a bioplastic alternative available that offers the same or in some cases even better properties and functionalities. The main challenge faced by the bioplastics industry is not of technical nature but the lack of effective policy measures or regulatory incentives to encourage a full-scale market entry. According to a PRO BIP study conducted by the University of Utrecht in 2009, bioplastics could technically substitute around 85 percent of conventional plastics. To make all plastics from biobased materials is not a realistic short- or mid-term development.

http://www.european-bioplastics.org/market/

What are the economic advantages of bioplastics?
As an important part of the bioeconomy, bioplastics are a future lead market for the European Union offering job creation, development of rural areas and global export opportunities for innovative technologies.

According to a recent job market analysis conducted by EuropaBio, the European bioplastics industry could realise a steep employment growth over the next decades. In 2013, the bioplastics industry accounted for around 23,000 jobs in Europe. With the right framework conditions in place, this number could increase more than tenfold by 2030, with up to 300,000 high-skilled jobs being created in the European bioplastics sector.

The European bioeconomy sectors are worth 2 trillion euros in annual turnover and account for 22 million jobs in the EU. That is approx. 9 percent of the EU's workforce.

http://www.european-bioplastics.org/market/

How many people are employed in the European bioplastics industry today?
In 2013, the bioplastics industry accounted for 23,000 jobs in Europe. With the right framework conditions in place, this number could increase more than tenfold by 2030, with up to 300,000 high-skilled jobs being created in the European bioplastics sector.

http://www.european-bioplastics.org/market/market-drivers/

How many jobs could be created in the bioplastics industry in Europe until 2030?
With the right legislative framework and market conditions in place, the European bioplastics industry could offer an immense employment growth potential. From 23,000 employees in 2013, the bioplastics industry could grow to 300,000 high-skilled jobs in 2030. The bioplastics industry could provide new impulses for the development of rural areas in Europe by presenting new opportunities for the agricultural sector and consequently contribute to the reindustrialisation and employment growth in Europe. Feasibility studies showed that bioplastics could technically substitute about 85 percent of all conventional plastics (according to PRO BIP study conducted by the University of Utrecht in 2009), even though this is not a realistic short- or mid-term development, it illustrates that bioplastics will be a significant part of the overall plastics market in the future.

http://www.european-bioplastics.org/market/market-drivers/

Are bioplastics more expensive then conventional plastics?
The cost of research and development still makes up for a share of investment in bioplastics and has an impact on material and product prices. Additionally, the currently low oil prices are making it difficult for bioplastics to achieve competitive pricing levels compared to conventional plastics at present. However, prices have continuously been decreasing over the past decade. As more companies and brands are switching to biobased plastics, and as production capacities are rising, supply chains and processes are becoming more efficient, and prices have come down significantly. With rising demand and more efficient production processes, increasing volumes of bioplastics on the market and oil prices expected to rise again, the costs for bioplastics will soon be comparable with those for conventional plastic prices.

Moreover, specific material properties of bioplastic materials can allow for a reduction of the overall volumes of materials needed for a product or application as well as for cost reduction in the use or end-of-life phase. Already today, there are several examples of cost competitive bioplastic materials and products.

http://www.european-bioplastics.org/market/

Where are bioplastics already being used?

Today, there is pretty much nothing that bioplastics can't do. For almost every conventional plastic material and application, there is a bioplastic alternative available that offers the same or in some cases even better properties and functionalities. Today, bioplastics are mainly being used in the following market segments:

- Packaging
- Food-services
- Agriculture & horticulture
- Consumer electronics
- Automotive & transport
- Consumer goods and household appliances
- Building & construction
- Coating & adhesives
- Fibers

The latest market data analysis by European Bioplastics shows that packaging remains the largest fields of application for bioplastics with 48 percent of the total bioplastics market in 2022. The data also confirms a decisive increase in the uptake of bioplastics materials in many other sectors, including consumer goods and applications in the automotive and transport sector, and the construction and building sector, where technical performance polymers are being used.

http://www.european-bioplastics.org/market/

Are bioplastics applied in mainly short-lived products?

Bioplastics have a multitude of durable but also short-lived applications. Durable, biobased commodity plastics such as biobased PE or biobased PET are used for short-life applications such as packaging as well as for long-lasting applications such as car parts, toys, or consumer electronics that can be easily recycled in existing streams. These so called 'drop-in solutions' represent the largest sector of global bioplastics production.

Innovative biobased and biodegradable materials such as PLA, PHA or starch blends are suitable for long-lasting products but are mainly used in short-lived applications such as packaging. They offer solutions with completely new functionalities such as compostability and in some cases optimised barrier properties for a prolonged shelf life and thus preventing food waste.

http://www.european-bioplastics.org/market/

Figure: Bioplastics are already part of our everyday life.

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Which retailers and brand owners are already using and selling bioplastics?
The number of brand owners that apply bioplastics in their solutions is growing steadily.

Prominent examples of big brands that have introduced bioplastic packaging are Danone, Coca-Cola (PlantBottle), and Ecover (cleaning products). The supermarket chains Carrefour, Sainsbury, Billa, Spar and Hofer offer different packaging products and/or shopping bags made of bioplastics. In the leisure/sport sector PUMA, for example, uses bioplastics, and in the automotive market, Ford, Toyota and Mercedes have introduced various bioplastic components in several car models. In the consumer electronics market, Fujitsu is a well known brand that uses bioplastics in some of its products.

http://www.european-bioplastics.org/market/applications-sectors/

How accepted are bioplastic products by consumers?
The increase in the use of bioplastics is driven by an increasing demand for sustainable products by consumers due to a growing awareness of the impact on the environment. To the environmentally conscious customer, the advantages of being biobased give bioplastics the competitive edge to conventional plastics. About 80 percent of European consumers want to buy products with a minimal impact on the environment (Eurobarometer survey, European Commission, 2013) and brands and companies turn to bioplastic solutions to respond to these demands.

What is more, according to the German Agency for Renewable Resources (FNR) and the Straubing Center of Science (2009), consumers want to see more products made from bioplastics on the market. Yet, consumers are not always very well informed about bioplastics, which leads to some misunderstandings and wrong expectations about the nature of bioplastics and poses a challenge for bioplastics penetrating the consumer market. Joint efforts by the bioplastics industry and brands to inform about bioplastic materials and products are however contributing towards an increased awareness and better understanding of bioplastics amongst consumers.

http://www.european-bioplastics.org/market/market-drivers/

IV MATERIAL, PROPERTIES AND TECHNOLOGY

What are bioplastics made of?

Today, bioplastics are mostly made of carbohydrate-rich plants such as corn, sugar cane or sugar beet – so-called food crops or first generation feedstock. First generation feedstock is currently the most efficient for the production of bioplastics, as it requires the least amount of land to grow and produces the highest yields.

The bioplastics industry is also researching the use of non-food crops (second and third generation feedstock), such as cellulose, with a view to its further use for the production of bioplastics materials. Innovative technologies are focussing on non-edible by-products of the production of food crops, which generates large amounts of cellulosic by-products such as straw, corn stover or bagasse that can be used to produce biopolymers.

http://www.european-bioplastics.org/bioplastics/materials/
http://docs.european-bioplastics.org/publications/pp/EuBP_PP_Feedstock_availability.pdf

What types of bioplastics do exist and what properties do they have?

Bioplastics are a diverse family of materials with differing properties. There are three main groups:

1. Biobased (or partially biobased), durable plastics such as biobased polyethylene (PE), polyethylene terephthalate (PET) (so-called drop-in solutions), biobased technical performance polymers, such as numerous polyamides (PA), or (partly) biobased polyurethanes (PUR);
2. Biobased and biodegradable, compostable plastics, such as polylactic acid (PLA), polyhydroxyalkanaoates (PHA), polybutylene succinate (PBS), and starch blends;
3. Plastics that are based on fossil resources and are biodegradable, such as PBAT and PCL, but that may well be produced at least partly bio-based in the future.

Biobased, durable plastics, such as biobased PE or biobased PET, possess properties that are identical to their conventional versions. These bioplastics are technically equivalent to their fossil counterparts; yet, they can help to reduce a product's carbon footprint. Moreover, they can be mechanically recycled in the according existing recycling streams.

Innovative materials such as PLA, PHA, or starch-based materials offer solutions with completely new functionalities such as biodegradability and compostability and in some cases optimised barrier properties.

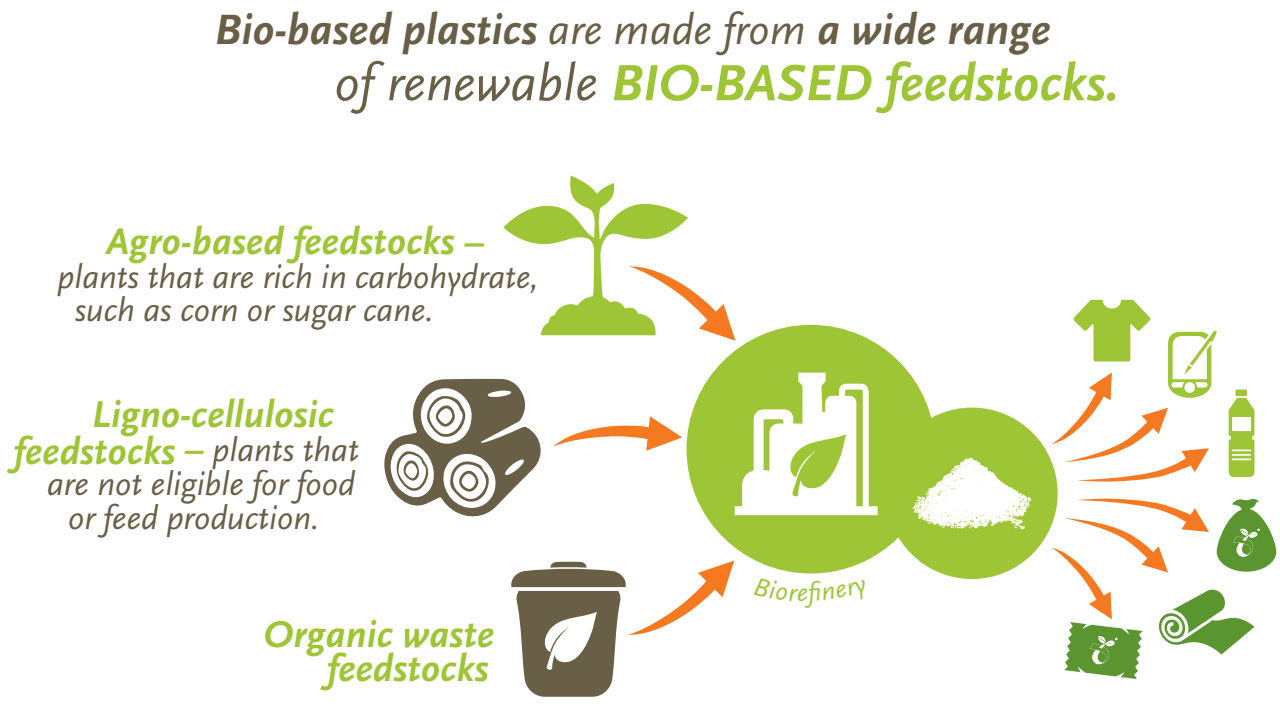

Figure: Biobased feedstock for bioplastics.

Along with the growth in variety of bioplastic materials, properties such as flexibility, durability, printability, transparency, barrier, heat resistance, gloss and many more have been significantly enhanced.

http://www.european-bioplastics.org/bioplastics/materials/

Is there a certain percentage threshold value that marks the minimal biobased carbon content / biobased mass content in a product/material to be called bioplastics?

There is no common agreement on a minimal value yet due to varying regional regulations in Europe. In Japan an industry-wide commitment sets the "biomass margin" at "25 percent renewable material". According to the USDA Bio-preferred Programme, "the minimum share of renewable material ranges from 7 to 95 percent" depending on defined product category rules.

Although there is no minimum value, acknowledged labelling options for biobased plastics are available to clearly and transparently indicate the biobased content of a material or product. The certifiers TÜV AUSTRIA Belgium and DIN CERTCO offer a progressive certification scheme and according labels based on the European standard EN 16640 or ISO 16620-2 (or ASTM D 6866), which provide proof the biobased carbon content of a material or product.

DIN CERTCO:

TÜV AUSTRIA Belgium:

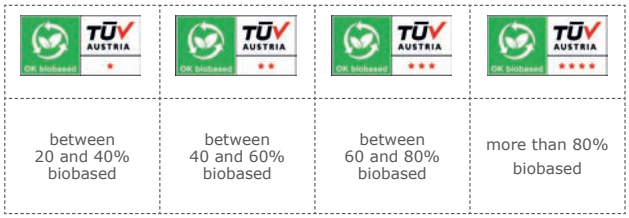

Figure: Labels depicting the biobased content of a bioplastic product.

http://www.european-bioplastics.org/bioplastics/standards/

Are the properties of bioplastics equal to those of conventional plastics?

Today, there is a bioplastic alternative for almost every conventional plastic material and corresponding application. Bioplastics – plastics that are biobased, biodegradable, or both – can have the same properties as conventional plastics and offer additional advantages, such as a reduced carbon footprint or additional waste management options such as industrial composting.

Some bioplastics offer additional functionalities, such as biodegradability or compostability, and improved properties, such as increased heat resistance, enhanced moisture or gas barriers, greater stiffness and flexibility or improved durability.

Bioplastics are available in a wide variety of types and compounds that can mostly be converted on the standard equipment generally used for processing conventional plastics.

http://www.european-bioplastics.org/bioplastics/materials/

V SOURCING OF FEEDSTOCK

Why does the bioplastics industry use agricultural resources?

The emerging shift from crude oil towards renewable resources is driven primarily by the sustainable development efforts of the plastics industry. Finite oil resources and climate change constitute two broadly acknowledged challenges for society in the coming decades. Reducing the dependency on oil and mitigating the effects of climate change are therefore two important drivers for the use of renewable resources for the production of plastics. Biobased plastics have the unique advantage over conventional plastics to reduce the dependency on limited fossil resources and to reduce greenhouse gas emissions.

Using biomass that is sustainably sourced and regrows on an annual basis is a major environmental benefit of biobased plastic products. Plants sequester carbon dioxide during their growth and convert it into carbon-rich organic matter. When these materials are used in the production of bioplastics the carbon is stored within the products during their useful life, which can be prolonged if the products are being recycled. This carbon is eventually released back into the atmosphere through energy recovery or composting. Consequently, biobased plastics can help the EU to meet its 2020 targets of greenhouse gas emissions reduction.

Moreover, bioplastics can make a considerable contribution to increased resource efficiency through a closed resource cycle and use cascades, especially if biobased materials and products are being either reused or recycled and eventually used for energy recovery (i.e. renewable energy).

http://www.european-bioplastics.org/bioplastics/environment/
http://docs.european-bioplastics.org/publications/pp/EuBP_PP_Feedstock_availability.pdf

How much agricultural area is used for bioplastics?

Today, bioplastics are mostly made from carbohydrate-rich plants, such as corn or sugar cane, so called agro-based or 1st generation feedstock. Currently, 1st generation feedstock is the most efficient feedstock for the production of bioplastics as it requires the least amount of land to grow on and produces the highest yields.

The feedstock currently used to produce bioplastics relies on less than 0.02 percent of the global agricultural area – compared to 91 percent of the area, which is used for pasture and the production of food and feed. Despite the predicted continued growth in the bioplastics market at the current stage

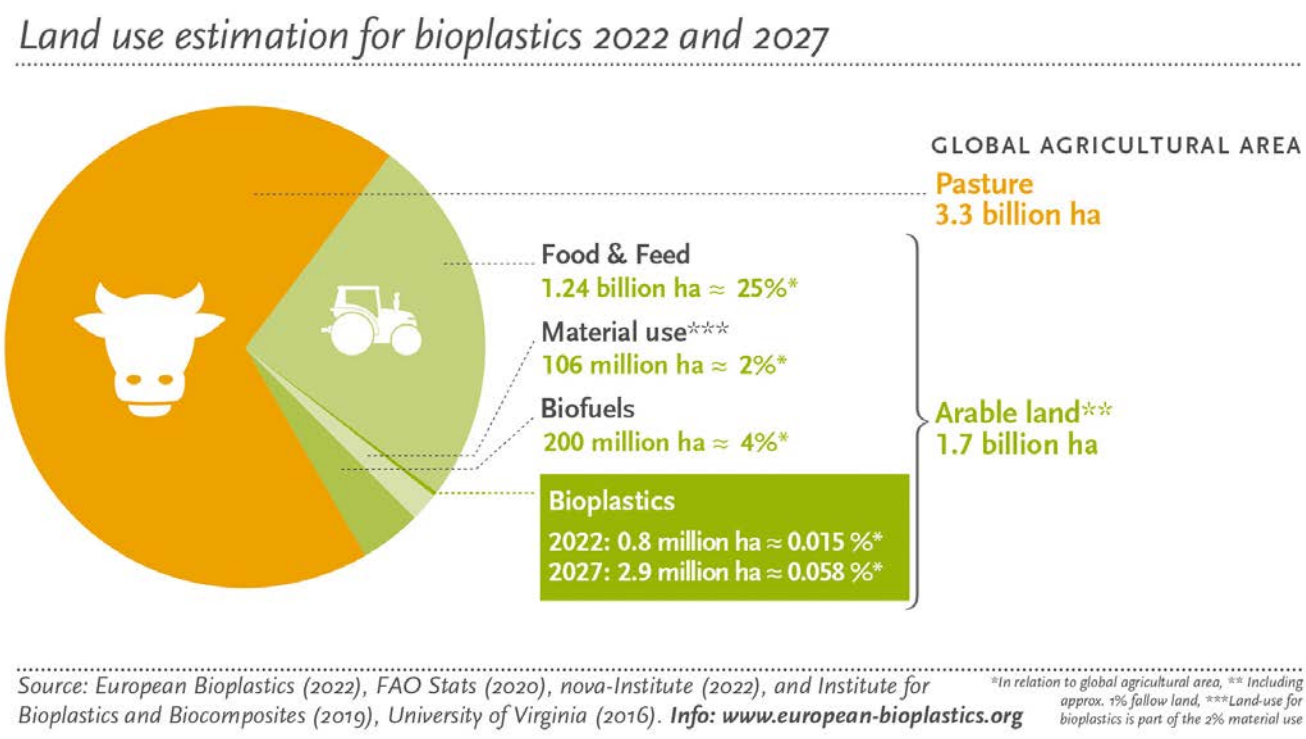

Figure: Land use for bioplastics 2022 and 2027.

of technological development, the share of global agricultural area used to grow feedstock for the production of bioplastics will only slightly increase to still below 0.06 percent in 2027. This clearly demonstrates that there is no competition between food/feed and industrial production.

A report by Wageningen Food & Biobased Research (Biobased and biodegradable plastics – Facts and figures, 2017) calculates that "even if we would base all present world-wide fossil plastics production on biomass as feedstock instead, the demand for feedstock would be around 5 percent of the total amount of biomass produced and harvested each year". Yet, this scenario is unlikely to happen, as the bioplastics industry is also looking into the use of non-food crops (ligno-cellulosic feedstock), such as wood, straw, as well as waste products and side streams of the agro-industry to produce bioplastics. Using an increased share of food residues, non-food crops or cellulosic biomass could lead to even less land needed for bioplastics than the numbers given above.

http://www.european-bioplastics.org/bioplastics/feedstock/
http://docs.european-bioplastics.org/publications/pp/EuBP_PP_Feedstock_availability.pdf

Is there competition between food, feed and bioplastics regarding agricultural area?
The feedstock currently used for the production of bioplastics relies on less than 0.02 percent of the global agricultural area – compared to 97 percent of the area, which is used for the production of food and feed. This clearly demonstrates that there is no competition between food/feed and industrial production.

Of the 13.4 billion hectares of global land surface, around 36 percent (4.8 billion hectares) is currently used for agriculture. This includes pastures (69 percent, approx. 3.3 billion hectares) and arable land (30 percent, approx. 1.4 billion hectares). The arable land is further divided into areas predominantly used for growing food crops and feed (26 percent, approx. 1.24 billion hectares), as well as crops for materials (2 percent, approx. 106 million hectares, including the 790,000 hectares used for bioplastics, 0.016%)[1], and crops for biofuels (1 percent, approx. 53 million hectares).

Moreover, advanced integrated production processes, for example in biorefineries, are already able to produce several different kinds of products out of one specific feedstock – including products for food, feed, and products, such as bioplastics.

Is the current use of food crops for the production of bioplastics ethically justifiable?
According to the FAO, about one third of the global food production is either wasted or lost every year. European Bioplastics acknowledges that this is a serious problem and strongly supports efforts to reduce food waste.
Other deficiencies that need to be addressed are:

- logistical aspects such as poor distribution/storage of food/feed,
- political instability, and
- lack of financial resources.

When it comes to using biomass, there is no competition between food or feed and bioplastics. The land currently needed to grow the feedstock for the production of bioplastics amounts to only about 0.02 percent of the global agricultural area – compared to 97 percent of the area that is used for the production of food and feed.

Agro-based feedstock – plants that are rich in carbohydrates, such as corn or sugar cane, is currently the most efficient and resilient feedstock available for the production of bioplastics. Other solutions, such as non-food crops or waste from food crops that are providing ligno-cellulosic feedstock, will be available in the medium and long term.

There is no well-founded argument against a responsible and monitored (i.e. sustainable) use of food crops for bioplastics. There is even evidence that the industrial and material use of biomass may in fact serve as a stabilizer for food prices, providing farmers with more secure markets and thereby leading to more sustainable production. Independent third party certification schemes can help to take social, environmental and economic criteria into account and to ensure that bioplastics are a purely beneficial innovation.

[1] The 2 percent comprise e.g. natural fibres (primarily cotton), rubber, bamboo, plant oils, sugar and starch. Of these 106 million hectares only 400.000 hectares are used to grow feedstock for bioplastics (primarily sugar and starch).

Will there be sufficient agricultural area in the world to sustain production of food, feed, fuel and bioplastics?

There are various ways to ensure a sufficient supply of biomass for the production for food, feed, and industrial/material uses (including bioplastics) now and in future. These include:

1. Broadening the base of feedstock: The bioplastics industry is currently working mostly with agro-based feedstock (i.e. plants that are rich in carbohydrate, such as corn or sugar cane). Several projects, however, are already looking into using plant residues or other lingo-cellulosic feedstock.
2. Increasing yields: Increasing the efficiency of industrial conversion of raw materials into feedstock, for example by using optimised yeasts or bacteria and optimised physical and chemical processes would increase the total availability of resources.
3. Taking fallow land into production: There is still plenty of arable land in various geographical regions available for production, even in the European Union[2].

Is the use of non-food feedstock feasible?

Yes, to some extend. Today, bioplastics are predominantly produced from agro-based feedstock (i.e. plants that are rich in carbohydrates). At the same time, the bioplastics industry is investing in the research and development to diversify the availability of biogenic feedstock for the production of biobased plastics. The industry particularily aims to further develop fermentation technologies that enable the utilisation of ligno-cellulosic feedstock sources, such as non-food crops or waste from food crops, in the medium and long term. The production of ligno-cellulosic sugars and ethanol in particular are regarded as a promising technological approach.

http://www.european-bioplastics.org/bioplastics/feedstock/
https://www.european-bioplastics.org/wp-content/uploads/2017/11/Land_use_estimation_2017-2022_full_en.jpg
http://docs.european-bioplastics.org/publications/pp/EuBP_PP_Feedstock_availability.pdf

Are GMO crops used for bioplastics?

The use of genetically modified (GM) crops is not a technical requirement for the production of any bioplastic materials that are commercially available today. If GM crops are used, the reasons usually lie in the regional feedstock supply situation or are based on economic decisions.

Most bioplastics producers do not use GMO feedstock for the production of their biobased plastic materials or offer GMO-free options. Yet, even if GM crops are used for the production of bioplastics, the multiple-stage processing and high heat used to create the polymer removes all traces of genetic material. This means that the final bioplastic product contains no genetic traces. The resulting bioplastic product is therefore well suited to use in food packaging as it contains no genetically modified material and cannot interact with the contents.

http://www.european-bioplastics.org/bioplastics/feedstock/

How can the industry support the supply of sustainable feedstock?

Sustainable sourcing of feedstock is a prerequisite for more sustainable products.

That is why European Bioplastics supports:

1.) the general sparing use of resources and increase of resource efficiency (e.g. through use cascades),
2.) the implementation of good agricultural practice,
3.) corresponding third-party certification, and
4.) a responsible choice of feedstock: The use of food residues or by-products of (food) crops can contribute to more sustainable sourcing. In addition, the biorefinery concept is promising in transforming cellulosic, non-food biomass feedstock into a variety of chemicals, e.g. ethanol, lactic acid, or many others, which can also be used to manufacture bioplastics.

Sustainable sourcing of the renewable feedstock and good agricultural practices and technologies are continuously enhanced and ensured through the emergence of reliable and independent sustainability certification schemes such as ISCC Plus, RSB, or REDcert.

http://www.european-bioplastics.org/bioplastics/feedstock/

[2] Different sources come up with varying figures for „free" arable land, the French National Institute For Agricultural Research gives 2.6 billion hectares of untapped potential (article in ParisTech, 2011), the nova-Institute calculates 570 million hectares based on figures of OECD and FAO (2009). The bottom line – there is an ample amount of unused land available.

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VI HUMAN HEALTH

Does the use of GMO feedstock for the production of bioplastics, e.g. for packaging applications, have an impact on human health?

If GM crops are used for the production of biobased plastics, the multiple-stage processing and high heat used to create the polymer remove all traces of genetic material. This means that the final bioplastic product contains no traces of GMO. Should the bioplastic be used for e.g. food packaging, this packaging will be well suited for the purpose as it contains no genetically modified material and cannot interact with the contents. However, most bioplastics in the market are made from GMO-free feedstock.

Is Bisphenol A used in bioplastics?

European Bioplastics and its members are committed to avoiding the use of harmful substances in their products. Many plastic products do not use any plasticisers but a range of acceptable plasticisers is available if necessary. The wide range of bioplastics is based on thousands of different formulas. This means specific information regarding a certain material or product can only be obtained from the individual manufacturer, converter or brand owner using the material.

Are any contaminants or harmful substances left behind when compostable plastics biodegrade?

Compostable plastics that are tested and certified according to the European standard for industrial composting EN 13432 are required to disintegrate after 12 weeks and completely biodegrade after six months. That means that 90 percent or more of the plastic material will have been converted to CO_2. The remaining share is converted into water and biomass, which no longer contains any plastic. EN 13432 also includes test on ecotoxicity and heavy metal contents to ensure that no harmful substances are left behind.

VII END-OF-LIFE

Can bioplastics be integrated into established recycling and recovery schemes?

Bioplastics are a diverse family of materials. Depending on the material and the application, recycling in existing waste streams is certainly an option. Drop-in solutions such as biobased PE or biobased PET can easily be recycled in existing recycling streams together with their conventional counterparts. Innovative materials such as PLA can also be mechanically recycled. Once sufficient volumes are on the market, the establishment of a separate recycling stream will become feasible. Biodegradable plastic products that have been certified compostable according to EN 13432 are suitable for industrial composting. All bioplastic materials offer (renewable) energy recovery as they contain a high energy value.

http://www.european-bioplastics.org/bioplastics/waste-management/

Photo: Mechanical recycling plant.

Can bioplastics be mechanically recycled?

If a separate recycling stream for a certain plastic type exists, the bioplastic material can simply be recycled together with their conventional counterpart – e.g. biobased PE in the PE-stream or biobased PET in the PET stream – as they are chemically and physically identical in their properties.

The post consumer recycling of bioplastics materials for which no separate stream yet exists, will be feasible, as soon as the commercial volumes and sales increase sufficiently to cover the investments required to install separate recycling streams. It is expected, that new separate recycling streams for PLA for example will be feasible and introduced in the short to medium term.

http://www.european-bioplastics.org/bioplastics/waste-management/

Do bioplastics 'contaminate' mechanical recycling streams?

As with conventional plastics, bioplastics need to be recycled separately (by stream type). Available sorting technologies such as NIR (near infrared) help to reduce contamination.

Bioplastic materials for which a recycling stream already exists (e.g. biobased PE and biobased PET) can easily be recycled together with their conventional counterparts. Other bioplastics for which no separate streams yet exist, are very unlikely to end up in mechanical recycling streams due to sophisticated sorting and treatment procedures (positive selection). Innovative materials such as PLA can technically easily be sorted and mechanically recycled. Once sufficiently large volumes are sold on the market, the implementation of separate recycling streams for PLA will become economically viable for recyclers.

http://www.european-bioplastics.org/bioplastics/waste-management/

What is biodegradation?

Biodegradation is a chemical process in which materials are metabolised to CO_2, water, and biomass with the help of microorganisms. The process of biodegradation depends on the conditions (e.g. location, temperature, humidity, presence of microorganisms, etc.) of the specific environment (industrial composting plant, garden compost, soil, water, etc.) and on the material or application itself. Consequently, the process and its outcome can vary considerably.

http://www.european-bioplastics.org/bioplastics/materials/biodegradable/

What is meant by 'organic recycling'?

Organic recycling is defined by the EU Packaging and Packaging Waste Directive 94/62/EC (amended in 2005/20/EC) as the aerobic treatment (industrial composting) or anaerobic treatment (biogasification) of packaging waste.

The EU Directive refers to the harmonised European standard for the industrial compostability of plastic packaging: EN 13432. An equivalent standard has been approved by the European standardisation organisation CEN for the testing of compostability of plastics: EN 14995.

In order to make organic recycling of biodegradable packaging more effective, a mandatory separate collection of biodegradable waste and legal access for certified compostable products to enter the respective recycling systems would be needed.

http://www.european-bioplastics.org/bioplastics/waste-management/
http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf

How does industrial composting (aerobic treatment) of bioplastics work?
Compostable plastics that are tested and certified according to the European standards for industrial composting EN 13432 (for packaging) or EN 14995 (for plastic materials in general) fulfil the technical criteria to be treated in industrial composting plants. These plants provide controlled conditions, i.e. controlled temperatures, humidity, aeration, etc. for a quick and safe composting process.
EN 13432 requires for the compostable plastics to disintegrate after 12 weeks and completely biodegrade after six months. That means that 90 percent or more of the plastic material will have been converted to CO_2. The remaining share is converted into water and biomass – i.e. valuable compost.

Compost is used as a soil improver and can in part also replace mineral fertilisers.

http://www.european-bioplastics.org/bioplastics/waste-management/
http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf

Are all bioplastic materials/products biodegradable?
No. Bioplastics are a large family of materials that can be either biobased, biodegradable or both. Biobased, non-biodegradable (durable) materials have a share of under 36 percent. The largest share (more than 64 percent) of bioplastics currently on the market are biodegradable materials. Biodegradability is an inherent property of certain polymers that can be preferable for specific applications (e.g., biowaste bags).

Biodegradable/compostable products should feature a clear recommendation regarding the suitable end-of-life option and correct disposal for this product. European Bioplastics recommends acquiring a certificate and according label for biodegradable plastic products meant for industrial composting according to EN 13432.

http://www.european-bioplastics.org/bioplastics/materials/
http://www.european-bioplastics.org/market/applications-sectors/

What is the difference between 'biodegradable' and 'compostable'?
Biodegradation is a chemical process in which materials are metabolised to CO_2, water, and biomass with the help of microorganisms. The process of biodegradation depends on the conditions (e.g. location, temperature, humidity, presence of microorganisms, etc.) of the specific environment (industrial composting plant, garden compost, soil, water, etc.) and on the material or application itself. Consequently, the process and its outcome can vary considerably.

In order to be recovered by means of organic recycling (composting) a material or product needs to be biodegradable. Compostability is a characteristic of a product, packaging or associated component that allows it to biodegrade under specific conditions (e.g. a certain temperature, timeframe, etc). These specific conditions are described in standards, such as the European standard on industrial composting EN 13432 (for packaging) or EN 14995 (for plastic materials in general). Materials and products complying with this standard can be certified and labelled accordingly.

Please note that in order to make accurate and specific claims about compostability the location (home, industrial) and timeframe need to be specified.

http://www.european-bioplastics.org/bioplastics/materials/
http://www.european-bioplastics.org/bioplastics/standards/
http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf

What are the required circumstances for a compostable product to compost?
Industrial composting is an established process with commonly agreed requirements concerning temperature and timeframe for biodegradable waste to metabolise to stable, sanitised products (biomass) to be used in agriculture (humus/fertiliser). This process takes place in industrial or municipal composting plants. These plants provide controlled conditions, i.e. controlled temperatures, humidity, aeration, etc. for a quick and safe composting process.

The criteria for the industrial compostability of packaging are set out in the European standard EN 13432. EN 13432 requires the compostable plastics to disintegrate after 12 weeks and completely biodegrade after six months. That means that 90 percent or more of the plastic material will have been converted to CO_2. The remaining share is converted into water and biomass – i.e. valuable compost. Materials and products complying with this standard can be certified and labelled accordingly.

There is currently no international standard specifying the conditions for home composting of biodegradable plastics. However, there are several national standards, such as the Australian norm AS 5810 “Biodegradable plastics – biodegradable plastics suitable for home composting”. Belgian certifier TÜV Austria had developed the OK compost home certification scheme, requiring at least 90% degradation in 12 months at ambient temperature. Based on this scheme, the French standard NF T 51-800 “Plastics — Specifications for plastics suitable for home composting” was developed, specifying the very same requirements for certification.

http://www.european-bioplastics.org/bioplastics/waste-management/composting/
http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf
http://docs.european-bioplastics.org/publications/pp/EUBP_PP_Home_composting.pdf
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf

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What are the advantages of biodegradable/compostable bioplastic products?
Using biodegradable and compostable plastic products such as biowaste bags, fresh food packaging, or disposable tableware and cutlery increases the end-of-life options. In addition to recovering energy and mechanical recycling, industrial composting (organic recovery / organic recycling) becomes an available end-of-life option.

Compostability is a clear benefit when plastic items are mixed with biowaste. Under these conditions, mechanical recycling is not feasible, neither for plastics nor biowaste. The use of compostable plastics makes the mixed waste suitable for organic recycling (industrial composting and anaerobic digestion), enabling the shift from recovery to recycling (a treatment option which ranks higher on the European waste hierarchy). This way, biowaste is diverted from other recycling streams or from landfill and facilitating separate collection – resulting in the creation of more valuable compost.

http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf

Do (industrially) compostable plastics decrease the quality of the compost?
Compostable plastics that are tested and certified according to the European standard for industrial composting EN 13432 are required to disintegrate after 12 weeks and completely biodegrade after six months. That means that 90 percent or more of the plastic material will have been converted to CO_2. The remaining share is biomass, which no longer contains any plastic. EN 13432 also includes test on eco-toxicity and heavy metal contents to ensure that no harmful substances are left behind.

Photo: Compostable trays (source: natura).

Very short composting cycles may not be sufficient to allow for a full disintegration of some types of biowaste as well as for some compostable plastic packaging. However, leftover scraps (usually ligno-cellulosics) in composting plants are sifted out and added to the next fresh compost batch for another composting cycle where they fully metabolise to water, carbon dioxide, and biomass.

http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf

What is the difference between oxo-fragmentable and biodegradable plastics?
So-called 'oxo-fragmentable' products are made from conventional plastics and supplemented with specific additives in order to mimic biodegradation. In truth, however, these additives only facilitate a fragmentation of the materials, which do not fully degrade but break down into very small fragments that remain in the environment.

Biodegradability is an inherent characteristic of a material or polymer. In contrast to oxo-fragmentation, biodegradation results from the action of naturally occurring microorganisms. The process produces water, carbon dioxide, and biomass as end products.

Oxo-fragmentable materials do not biodegrade under industrial composting conditions as defined in accepted standard specifications such as EN 13432, ISO 18606, or ASTM D6400.

http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf
http://www.european-bioplastics.org/bioplastics/standards/oxo-degradables/
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf
http://docs.european-bioplastics.org/publications/bp/EUBP_BP_Additive-mediated_plastics.pdf

How can one distinguish oxo-fragmentable from biodegradable plastics?
Truly biodegradable plastics can be distinguished from so-called 'oxo-fragmentable' plastics through the use of labels and certification that adhere to acknowledged industry standards for biodegradation. The European standard for industrial compostable packaging EN13432, for example, is such a clear and specific option, and corresponding certification and labels such as the 'Seedling' logo (according to EN 13432) are available to substantiate the claims of biodegradability and compostability.

http://www.european-bioplastics.org/bioplastics/standards/labels/
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf
http://docs.european-bioplastics.org/publications/bp/EUBP_BP_En_13432.pdf
http://docs.european-bioplastics.org/publications/bp/EUBP_BP_Additive-mediated_plastics.pdf

What are enzyme-mediated plastics?

Enzyme-mediated plastics are not bioplastics. They are not biobased and they are not proven to be biodegradable or compostable in accordance with any standard[3]. Enzyme-mediated plastics are conventional, non-biodegradable plastics (e.g. PE) enriched with small amounts of an organic additive. The degradation process is supposed to be initiated by microorganisms, which consume the additives. It is claimed that this process expands to the PE, thus making the material degradable. The plastic is said to visually disappear and to be completely converted into carbon dioxide and water after some time, which could not yet been proven by any available study.

http://docs.european-bioplastics.org/publications/bp/EUBP_BP_Additive-mediated_plastics.pdf

How can one recognize enzyme-mediated plastics?

Enzyme-mediated plastics usually neither look nor feel different from conventional plastics. However, when a product carries claims such as "this plastic degrades faster", or "makes conventional plastics like PE or PP biodegradable" together with "organic additives" and "eco-friendly", it is likely that the material is an enzyme-mediated plastic.

http://docs.european-bioplastics.org/publications/bp/EUBP_BP_Additive-mediated_plastics.pdf

Are enzyme-mediated plastics truly biodegradable / compostable?

Biodegradation is defined as the biochemical process by which materials metabolise completely to water, carbon dioxide, and biomass with the help of microorganisms. However, the term "biodegradable" is not valuable if the timeframe and the conditions are not specified and related scientific data is not provided. Currently, there are no known, scientifically reliable test results for enzyme-mediated plastics, which provide evidence for biodegradability or compostability. Likewise, there has not been any documentation of enzyme-mediated plastic fulfilling the criteria of the EN 13432 (European standard for industrial compostability) standard.

http://docs.european-bioplastics.org/publications/bp/EUBP_BP_Additive-mediated_plastics.pdf

Are biodegradable plastics a solution for the littering problem?

A product should always be designed with an efficient and appropriate recovery solution in mind. In the case of biodegradable plastic products, the preferable recovery solution is the separate collection together with the biowaste, organic recycling (e.g. composting in industrial composting plant or anaerobic digestion in AD plants), and hence the production of valuable compost or biogas. European Bioplastics does not support any statements that advertise bioplastics as a solution to the littering problems. Littering refers to careless discarding of waste and is not a legitimate means of disposal.

Biodegradable plastics are often regarded as a possible solution to this problem as they can be decomposed by microorganisms without producing harmful or noxious residue during decomposition. However, the process of biodegradation is dependent on certain environmental conditions (i.e. temperature, presence of microorganisms, timeframe, etc.). Products suitable for industrial composting (as defined according to the European standard for industrial compostability EN 13432) are fit for the conditions in a composting plant, but not necessary for those outside in nature.

Littering should never be promoted for any kind of material or waste. It is imperative for the consumer to continue to be conscious of the fact that no matter what type of packaging or waste, it must be subject to appropriate disposal and recovery processes.

http://www.european-bioplastics.org/bioplastics/waste-management/

Are biodegradable plastics a solution for the problem of marine litter?

Marine litter is one of the main threats to the environment. The largest share of marine litter consists of plastics that originate from a variety of sources, including shipping activities, ineffectively managed landfills, and public littering. In order to minimise and ultimately prevent further pollution of the marine environment, the full implementation of EU waste legislation and an increase in the efficiency of waste management around the globe are crucial. Moreover, the introduction of a Europe-wide ban on landfilling for plastic products and appropriate measures to expand recycling and recovery of plastic waste are necessary.

In areas where separate biowaste collection exists, compostable biowaste bags can help divert biowaste – including the bags in which it is collected – from landfills, thereby reducing the amount of plastic bags entering into the marine environment in the first place. Yet, biodegradable plastics should not be considered a solution to the problem of marine litter. Littering should never be promoted or accepted for any kind of waste, neither on land nor at sea – including all varieties of plastics. Instead, the issue needs to be addressed by educative and informative measures to raise awareness for proper and controlled ways of management, disposal, and recycling.

[3] *"Biodegradability" refers to a process during which microorganisms from the environment convert materials into natural substances such as water, carbon dioxide and biomass without the use of artificial additives.*

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The UNEP report on 'bioplastics and marine litter' (2015) recognises that polymers, which biodegrade on land under favourable conditions, also biodegrade in the marine environment. The report also states, however, that this process is not calculable enough at this point in time, and biodegradable plastics are currently not a solution to marine litter. European Bioplastics (EUBP) agrees with the report's call for further research and the development of clear standards for biodegradation in the marine environment. Currently, there is no international standard available that appropriately describes the biodegradation of plastics in the marine environment. However, a number of standardization projects are in progress at ISO and ASTM level on how to test marine biodegradation processes.

http://docs.european-bioplastics.org/publications/pp/EUBP_PP_Marine_litter.pdf

How do bioplastics behave in landfills? Do they release methane gas?
Studies have shown that there is little risk posed by biodegradation of biodegradable plastics in landfills (Kolstad, Vink, De Wilde, Debeer: Assessment of anaerobic degradation of Ingeo® polylactides under accelerated landfill conditions, 2012). Most bioplastics remain inert in landfills.

Landfilling remains a widely applied method of waste treatment in Europe. Forty-two percent of all post consumer plastics waste in Europe is still buried in landfills, which means that the material value or the energy value of the waste remain unused. Therefore, European Bioplastics supports a restriction on landfilling of recyclable plastic waste in Europe in favour of strengthening measures to strengthen the recycling and recovery of plastics.

http://www.natureworksllc.com/~/media/The_Ingeo_Journey/EndofLife_Options/landfill/Assessment-of-anaerobic-degradation-of-Ingeo-polylactides-under-accelerated-landfill-conditions_pdf.pdf

What is the recommended end-of-life option for bioplastics?
Bioplastics are a large family of different materials with widely varying properties. Drop-in solutions, such as biobased PE or biobased PET can be mechanically recycled in established recycling streams. Biodegradable and compostable plastics can be organically recycled (industrial composting and anaerobic digestion). All bioplastics can also be treated in recovery streams (incineration and the production of renewable energy due to the biobased origin). As with conventional plastics, the manner in which bioplastics waste is recovered depends on the type of the product, the bioplastics material used, as well as the volumes and recycling and recovery systems available.

http://www.european-bioplastics.org/bioplastics/waste-management/
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_End-of-life.pdf

VIII SUSTAINABILITY OF BIOPLASTICS

Are biobased plastics more sustainable than conventional plastics?

Biobased plastics have the same properties as conventional plastics but also feature the unique advantage to reduce the dependency on limited fossil resources and to potentially reduce greenhouse gas emissions. Consequently, biobased plastics can help to decouple economic growth from the resource depletion and help the EU to meet its 2020 targets of greenhouse gas emissions reduction. Moreover, bioplastics can make a considerable contribution to increased resource efficiency through a closed resource cycle and use cascades, especially if biobased materials and products are being either reused or recycled and eventually used for energy recovery (i.e. renewable energy).

When it comes to sustainability, according to a study by the German Environment Agency "bioplastics are at least as good as conventional plastics". The study also mentions that "considerable potential is yet untapped" (ifeu/GEA, 2012).

http://www.european-bioplastics.org/bioplastics/environment/

Do bioplastics have a lower carbon footprint than fossil-based plastics? How is this measured?

Biobased plastics have the unique advantage over conventional plastics to reduce the dependency on limited fossil resources and to reduce greenhouse gas emissions. Plants sequester atmospheric carbon dioxide (CO_2) during their growth. Using these plants (renewable biomass) to produce biobased plastics removes CO_2 from the atmosphere and keeps it stored throughout the entire product life. This carbon fixation (carbon sink) can be extended for even longer if the material is recycled.

Substituting the annual global demand for fossil-based polyethylene (PE)[4] with biobased PE would safe more than 42 million tonnes of CO_2. This equals the CO_2 emissions of 10 million flights aground the world per year.

The carbon footprint of a product (CFP) can be measured by carbon footprinting or the life cycle assessment (LCA, standard ISO 14040 and ISO 14044). Information on how a carbon footprint should be established is set out in the ISO 14067 standard entitled the "Carbon Footprint of Products" published in 2013.

http://www.european-bioplastics.org/bioplastics/environment/
http://docs.european-bioplastics.org/publications/EUBP_Environmental_communications_guide.pdf

[4] *Based on the global demand for conventional polyethylene in 2015 (PlasticsEurope) and a CO_2 equivalent of biobased PE of -2,78 p.t. (Braskem, 2016).*

How can the environmental impact of bioplastics be assessed?

Biobased plastics have the unique advantage to reduce the dependency on fossil resources, curb greenhouse gas (GHG) emissions, and increase resource efficiency. They are also an essential part of the bioeconomy which is worth 2.4 trillion euros in annual turnover and accounts for 18.5 million jobs in the EU. Although, compared to conventional plastics, the production of bioplastics is still small (less than 1 percent of the entire global plastics production), the potential for growth and further innovation and development is enormous. These yet untapped opportunities for the bioplastics industry and the positive environmental, and socio-economic effects need to be considered when assessing the environmental impact of bioplastics – especially when compared to established conventional plastics. Currently, there are two meaningful indicators that sustainability assessments of bioplastics should focus on, as they rely on common methodologies and standards:

- biobased/renewable content (EN 16440, EN 16785-1 /-2, ASTM 6866)
- reduction of greenhouse gas emissions (ISO/TS 14067, GHG Protocol, PAS2050).

Life cycle assessments (LCAs) are an important tool for substantiating environmental claims (ISO 14040 and 14044) as they take into account many different factors such as energy use, GHG emissions, and water use. In order to get a complete picture of a product's impact on the environment, the complete life cycle must be considered. Yet, LCAs can only shine a spotlight on a single product. They are not suitable for comparing different products as materials (e.g., fossil-based and biobased) and processes vary widely, limiting the ability to make sound, substantiated comparisons.

http://www.european-bioplastics.org/bioplastics/environment/
http://docs.european-bioplastics.org/publications/EUBP_Environmental_communications_guide.pdf

Can the environmental impact of bioplastics and conventional plastics be compared?

Comparing two different products is difficult as the materials (fossil-based and biobased) and production processes vary widely, and current assessment tools and methods are limited in their ability to make sound, substantiating comparisons. Whereas the carbon footprint of products (CFP or PCF – product carbon footprint ISO/TS 14067) of two products can be compared, the life cycle assessments (LCAs, ISO 14040 and 14044, EN 16760) of two different products may have limited significance as they can consider different impact categories, differ in scope, and leave ample room for interpretation. A sound comparison based on LCA can, however, be made for one product when switching from fossil to biobased plastics as a way to assess the environmental impact of the product before and after the switch. Such comparison will clearly show where the biobased solution is advantageous as long as it is conducted in the same way considering the exact same impact categories.

http://www.european-bioplastics.org/bioplastics/environment/
http://docs.european-bioplastics.org/publications/EUBP_Environmental_communications_guide.pdf
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf

IX STANDARDISATION, CERTIFICATION, LABELLING

What are the relevant standards for bioplastics?

Working Group 3 of the Technical Committee (TC) 411 of CEN has developed different standards for the measurement of the renewable content of biobased materials and, therefore, bioplastics. Most importantly, the European norm EN 16640 „Biobased products – Determination of the biobased carbon content of products using the radiocarbon method", published in 2017, describes how to measure the carbon isotope 14C (radiocarbon method). In addition, the standard EN 16785-1 „Biobased products – Biobased content – Part 1: Determination of the biobased content using the radiocarbon analysis and elemental analysis" has been developed to also account for other biobased elements in a polymer through elemental analysis.

EN 13432 "Requirements for packaging recoverable through composting and biodegradation" is the European standard for biodegradable packaging designed for treatment in industrial composting facilities and anaerobic digestion. It requires at least 90% disintegration after twelve weeks and includes tests on ecotoxicity and heavy metal content.

There is currently no international standard specifying the conditions for home composting of biodegradable plastics. However, there are several national standards, such as the
Australian norm AS 5810 "Biodegradable plastics – biodegradable plastics suitable for home composting" as well as the French standard NF T 51-800 "Plastics — Specifications for plastics suitable for home composting" requires at least 90% degradation in 12 months at ambient temperature.

A new standard EN 17033 "Biodegradable mulch films for use in agriculture and horticulture – Requirements and test methods" (expected to be published in 2017) specifies the requirements for biodegradable films, manufactured from thermoplastic materials, to be used for mulching applications in agriculture and horticulture, which are not intended to be removed. A degradation of at least 90% in two years at preferably 25°C will be required.

For a comprehensive overview of all relevant standards and labels for bioplastics, please have a look at our fact sheet: http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf

http://www.european-bioplastics.org/bioplastics/standards/

How do standard, certification and label work together?

A standard can be used as the basis for a certification scheme if it clearly defines the criteria and the testing procedures for the material or product. Once the certifier confirms compliance with the defined requirements, the respective product can be labelled with the corresponding logo.

http://www.european-bioplastics.org/bioplastics/standards/
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf

Which institutions are involved in the certification of bioplastics in Europe?

Certification of biodegradable/compostable products is available from TÜV AUSTRIA Belgium (Belgium) and DIN CERTCO (Germany) or one of its co-operating institutes such as AfOR (UK) and COBRO (Poland). The Seedling logo for industrial compostable plastic packaging (based on EN 13432) can be acquired from TÜV AUSTRIA Belgium or DIN CERTCO following successful certification.

Certification for biobased products based on EN 16640 is available from DIN CERTCO (Germany) and TÜV AUSTRIA Belgium.

http://www.european-bioplastics.org/bioplastics/standards/certification/
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf

Which labels for bioplastic products do exist in Europe?

Labels referring to the biobased content are for example DIN-Geprüft biobased, OK biobased (both offering different labels reflecting the product's share of biobased content), and the new logo by Nederlandse Norm (NEN), based on EN 16785-1.

Labels for industrially compostable products are, for example, the Seedling Logo, OK Compost, and DIN-Geprüft Industrial Compostable.

Labels proving home compostability are OK compost Home and the DIN-Geprüft Home Compostable Mark.

The label OK biodegradable Soil is certified by TÜV AUSTRIA Belgium in case a product meets the requirement of their certification scheme. DIN CERTCO awards DIN-Geprüft biodegradable in soil in accordance with CEN/TR 15822.

Graphs: Logos for certification.

http://www.european-bioplastics.org/bioplastics/standards/labels/
http://docs.european-bioplastics.org/publications/fs/EUBP_FS_Standards.pdf
http://docs.european-bioplastics.org/publications/EUBP_Environmental_communications_guide.pdf

FAQ
MAR 2023

What are the advantages of labels marking biobased property or compostability of bioplastics?

A label awarded in accordance with independent certification based on acknowledged standards guarantees that the product fulfils the criteria claimed. As bioplastics cannot be distinguished from conventional plastics by non-experts, reliable labelling helps the consumer to identify these products. It also informs the consumer of particular additional qualities the material or product possesses. Another advantage provided by compostability labels in particular is that they facilitate correct waste separation, collection and recovery.

http://www.european-bioplastics.org/bioplastics/standards/labels/
http://docs.european-bioplastics.org/publications/EUBP_Environmental_communications_guide.pdf

How are environmental claims of bioplastic products soundly communicated?

Environmental claims of bioplastic products should be specific, accurate, relevant and truthful. Furthermore, there should be independent third party substantiation for these claims.

European Bioplastics has published a detailed guide regarding environmental communication.

http://docs.european-bioplastics.org/publications/EUBP_Environmental_communications_guide.pdf

FAQ
MAR 2023

X POLITICAL FRAMEWORK

What regulatory framework is there for bioplastics on EU-level and what initiatives are underway?

Currently there is no EU law in place applying specifically to biobased, biodegradable and compostable plastics. Yet, the European Union has made increasing efforts to introduce or adapt policies, regulatory frameworks, and standards to strengthen and implement the bioeconomy and circular economy in Europe in recent years, all of which affect the bioplastics sector in one way or other.

In particular, the future policy framework for biobased, biodegradable and compostable plastics, as part of the Commission's Circular Economy Action Plan and Green Deal, is a crucial piece of legislation. It has the potential to boost the role of bioplastics in developing a truly circular bioeconomy, enabling innovation, and attracting new investments. Currently, there is no legislation in place at EU level specifically designed for our industry. Hence, the implications of the new policy framework for the bioplastics sector will be extremely important.

European top-level strategies supporting bioplastics:

- EU Bioeconomy Strategy (2018)
- EU Plastics Strategy (2018)
- EU Green Deal (2019)
- New EU Circular Economy Action Plan (2020)
- EU Climate Law (2021) & EU Taxonomy (2020)
- Packaging & Packaging Waste Directive (review 2022)
- Waste Framework Directive (review 2023)

Other relevant policy initiatives include:

- Single-Use Plastics Directive (2019) incl. restrictions on oxo-degradable plastics
- EU rules on recycled plastics for food-contact materials (2022)
- Substantiating claims on environmental performance (2022)
- Sustainable Products Initiative (2022) / Proposal on ecodesign for sustainable products Regulation
- Policy Framework for biobased, biodegradable and compostable plastics (2022)
- Sustainable Carbon Cycles (2021)

The European Green Deal (2019) is nothing less than the EU's committment to making Europe climate neutral by 2050. The plan is to review each existing law, and to introduce new legislation on the circular economy, building renovation, biodiversity, farming, and innovation. The Deal plans to decouple economic growth from resource use, to set ambitious greenhouse gas emissions reduction targets (zero net emissions by 2050), carbon pricing mechanisms, and the decarbonisation of the energy system. In the deal, the Commission specifically foresees the adaption of a new Circular Economy Action Plan with strong focus on the plastics sector, especially "sustainable products" and a circular design for all products. However, the Commission should be cautious to not solely focus on mandatory provisions for recycled content, which hampers other innovative pathways of material innovation that help achieve zero net emissions. Alternative sustainable feedstocks such as biobased feedstocks need to be encouraged as well to reduce dependency on fossil resources.

In 2018, the European Commission adopted the first EU strategy for plastics with the overall aim to contribute to the transition towards a carbon neutral circular economy. It sets goals to curb plastic waste, to increase resource efficiency, and to create value and job growth in Europe. It highlights the importance of biodegradable and compostable plastics in separate collection systems for organic waste to improve clean waste streams and recycling quality.

Furthermore, the Commission's Sustainable Products Initiative (2022) and the Ecodesign for Sustainable Products Regulation (ESPR) proposal will be the cornerstone of EU environmental policy and will have a major impact on product design and market access. Published on 30 March 2022, the proposal builds upon the "Ecodesign Directive" which currently only covers energy related products. The Commission is proposing a general framework as well as sector specific legislation for different product categories. Ecodesign requirements will be adopted through delegated acts for each product group. The Commission will publish a preliminary work plan for the next 3 years, with the timeline for the publication for the Delegated Acts.

http://www.european-bioplastics.org/policy/

What policies would be needed to pave the way for a full-scale market introduction of bioplastics in Europe?

The European bioplastics industry has a strong record for developing innovative technological solutions and aligning industrial objectives with environmental sustainability. In order for Europe to reinforce its position as a front-runner of resource efficiency and green growth, forward-looking sectors with strong environmental credentials and growth potential, such as bioplastics, need to be promoted.

European Bioplastics has identified a number of key issues at political and regulatory level that will need to be addressed to ensure that the bioplastics sector can unfold its full environmental, economic, and social potential in Europe. These key issues are:

- Guaranteeing access to competitively priced agricultural feedstock and biomass in sufficient quantities and quality, and establishing a level playing field for industrial use of biomass with an integrated EU policy approach for material and energy uses of biomass and feedstock.

- Providing financial and political support through supportive market mechanisms similar to the "BioPreferred programme" in the United States or national investment programmes in several countries in South-East Asia. Additionally, Europe should further encourage a market shift towards increased production and use of biobased products, in order to support and stimulate industry in Europe. This could involve incentivising the use of biobased materials or putting a price tag on fossil carbon through carbon pricing mechanisms.

- Raising awareness and informing consumers about the importance of a transition to a biobased circular economy and the benefits and essential role of products such as bioplastics in that shift.

http://www.european-bioplastics.org/policy/

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