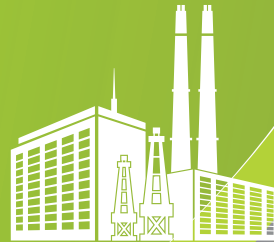


BIOPLASTICS

facts and figures



europaean
bioplastics



DEAR READER

Plastics are an integral part of our modern life. They play an essential role in providing, protecting, and delivering high-quality products in pretty much every market segment to consumers around the world. Today, there is a bioplastic alternative for almost every conventional plastic material and corresponding applications.

the demand for bioplastic materials and products. On the other hand, big brands and manufacturers are looking for innovative ways to reduce their environmental footprint and are tapping into the many benefits and advanced technical properties bioplastics have to offer.

European Bioplastics defines bioplastics as plastics that are bio-based, biodegradable, or both.

Bioplastics – plastics that are bio-based, biodegradable, or both – have the same or similar properties as conventional plastics but offer additional benefits, such as a reduced carbon footprint, better functionalities, or additional waste management options, such as organic recycling.

Bio-based plastics have the unique advantage over conventional plastics to reduce the dependency on limited fossil resources and to reduce greenhouse gas emissions. Currently, bioplastics still only represent well under one per cent of the about 300 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 by about 20 to 100 per cent per year.

On the one hand, the growing environmental awareness of consumers as well as the knowledge about the finite nature of the planet's fossil resources are spurring

The Bioplastics industry is fast-growing and innovative, and it has the potential to decouple economic growth from resource depletion and environmental impact. The European Commission has recognised the essential role of bioplastics in the bioeconomy and their potential to accelerate the transition to a circular economy. European Bioplastics, the association representing the interests of the bioplastics industry in Europe, is working closely with the European institutions and all other relevant stakeholders to shape the economic and policy landscape in Europe in which the bioplastics industry can thrive.

This brochure will give you an overview of the bioplastics industry, the market development, and the work of European Bioplastics.

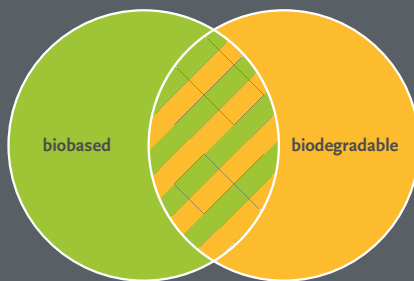
Yours sincerely
European Bioplastics

BIOPLASTICS – *definition, materials and technology*

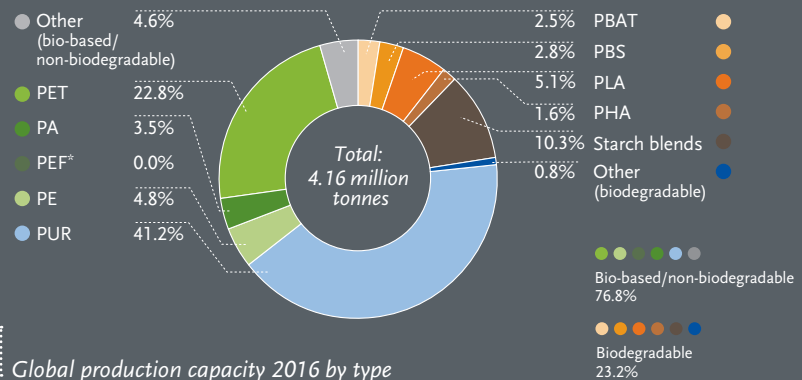
Bioplastics are not just one single material. They comprise of a whole family of materials with different properties and applications. According to European Bioplastics, a plastic material is defined as a bioplastic if it is either bio-based, biodegradable, or features both properties. There are three groups of bioplastics, each with their own characteristics:

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

Bioplastics offer a broad range of functionalities optimised for each type of application. They can be processed into a vast array of products using conventional plastics processing technologies. In most cases, the process parameters of the processing equipment simply have to be adjusted to the individual specification of each polymer.



According to European Bioplastics' definition, bioplastics are bio-based, biodegradable, or both.



Global production capacity 2016 by type

Source: European Bioplastics, nova-Institute (2016).

BIOPLASTICS – *benefits and innovative properties*

Reduced carbon footprint

Bio-based plastics have the unique advantage over conventional plastics to reduce the dependency on limited fossil resources and to reduce greenhouse gas emissions by replacing the fossil content in plastics with plant-based content. Some life cycle analyses show that bio-based plastics feature a significant CO₂ saving compared to conventional plastics, depending on the feedstock, the product and the application. Consequently, bio-based plastics can help the EU to meet its 2020 targets of greenhouse gas emissions reduction.

Increased resource efficiency

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

Innovative materials for better performance

Bio-based or partially bio-based durable drop-in plastics, such as bio-based PE or PET, possess the same physical properties as their conventional counterparts, and while they can be mechanically recycled in existing recycling streams, they have the additional benefit of reducing a product's carbon footprint.

The bioplastics industry has come up with numerous innovative technical and material solutions. Many bio-based plastics offer new material properties for an improved performance, including enhanced breathability, increased material strength, reduced thickness, and improved optical properties. New, innovative materials such as PLA, PHA, or PBS offer additional end-of-life solutions by being compostable. Other new materials such as 100% bio-based polyethylene furanoate (PEF) feature better barrier properties than established polymers and can easily be mechanically recycled.



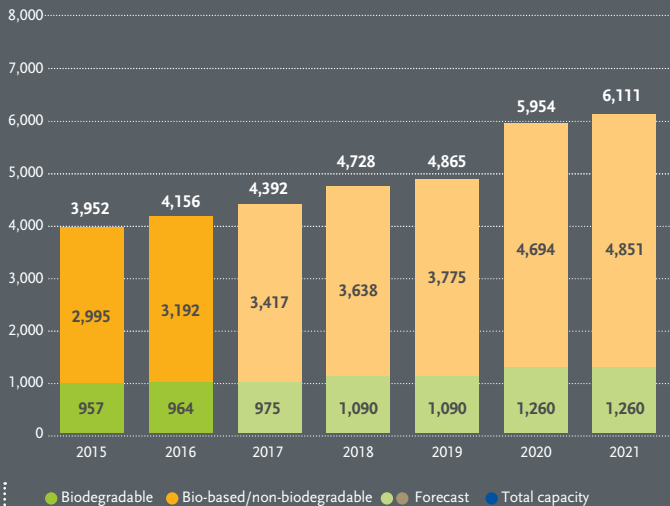
MARKET – *dynamic growth and development*

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 EU has started to acknowledge the many benefits of the bio-based economy and is now allocating funds and resources to research and development in this sector.

The global market for bioplastics is predicted to grow continuously over the next years. According to the latest mar-

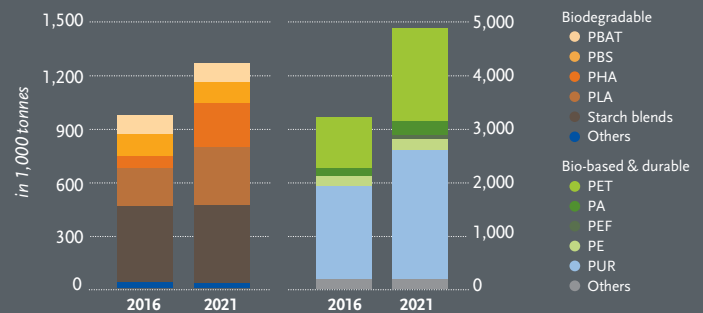
ket data compiled by European Bioplastics in collaboration with the nova-Institute, global production capacities of bioplastics are predicted to grow from around 4.16 million tonnes in 2016 to approximately 6.11 million tonnes by 2021.

Bio-based, non-biodegradable plastics, such as bio-based PE and bio-based polyurethanes are in the lead, while PLA will be the major growth driver in the field of biobased and biodegradable plastics.



Global production capacity of bioplastics (2016)

Source: European Bioplastics, nova-Institute (2016).



Biodegradable vs. Bio-based & durable bioplastics (2016 vs. 2021)

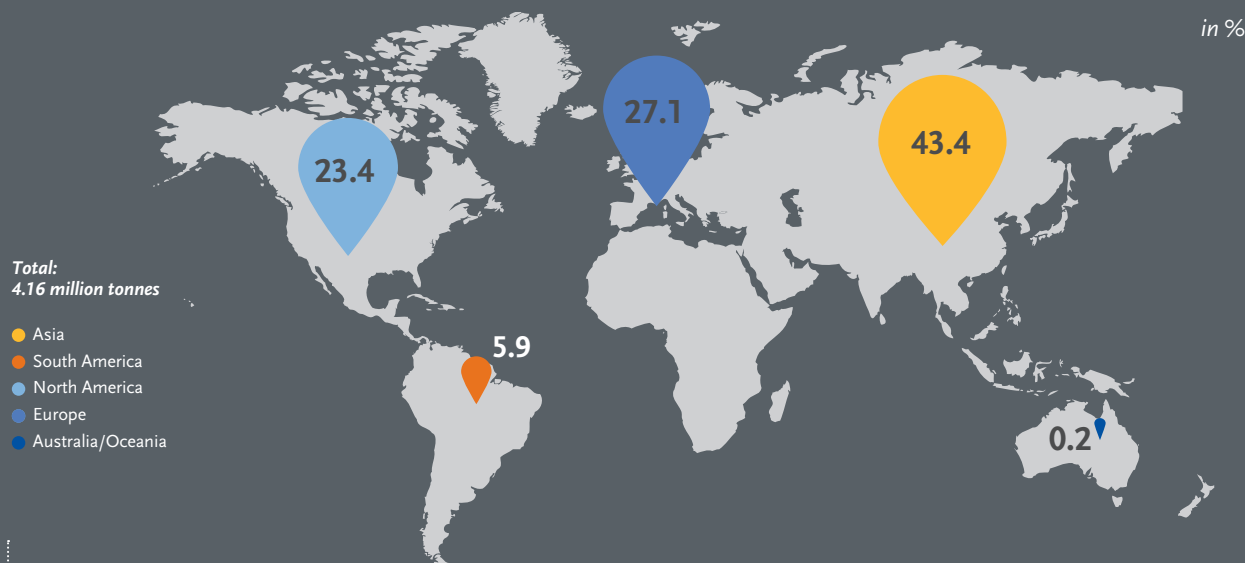
Source: European Bioplastics, nova-Institute (2016).

MARKET – *regional development*

Europe is a major hub for the entire bioplastics industry; it ranks highest in the field of research and development and is the industry's largest market worldwide. With a view to the actual production of bioplastics and regional capacity development, Asia is and will further expand its role as major production hub. In 2016, more than 43 percent of bioplastics were produced in Asia. Whereas regions such as Asia, the USA, and Latin America are implementing close-to-market measures to attract investment and production hubs to promote faster market develop-

ment, the European market for bioplastics is curtailed by the lack of economic and policy measures that would allow for a larger scale-up of production capacities within Europe.

Against this background, the implementation of a European policy framework that secures equal access to bio-based resources, creates measures to facilitate market entry for bio-based products, and accounts for the facilitating role of compostable plastics for efficient waste stream management, is of paramount importance.



Global production capacity by region in 2016

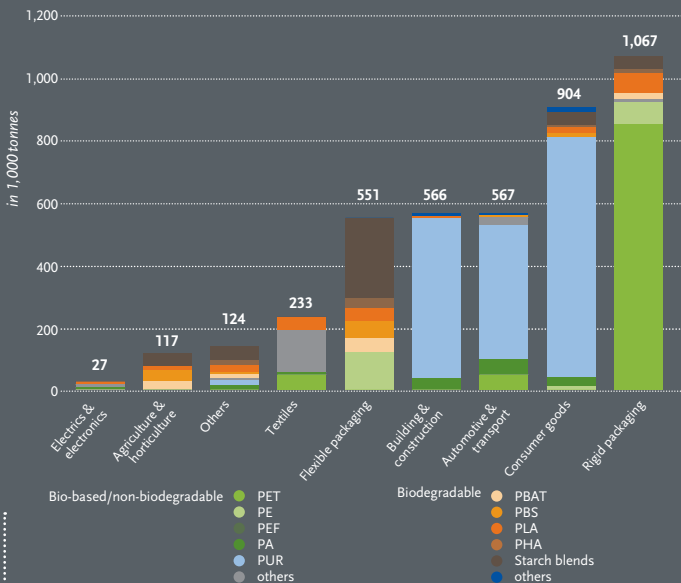
Source: European Bioplastics, nova-Institute (2016).

MARKET – *vast applications for bioplastics*

Bioplastics are used in an increasing number of markets, from packaging, catering products, consumer electronics, automotive, agriculture/horticulture and toys to textiles and a number of other segments.

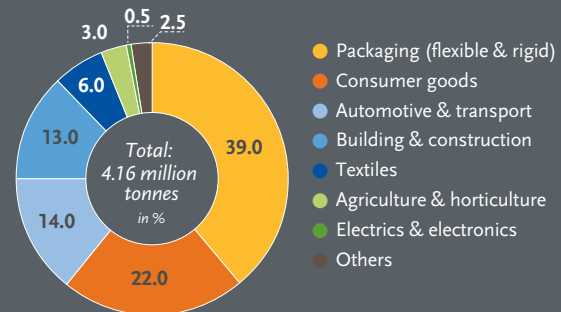
Packaging is one of the largest fields of application for bioplastics with a share of almost 40 percent of the total bioplastics market. Because bioplastics materials are extremely well suited for packaging applications, this

number is expected to increase further to 42 percent in 2021. The market data also shows a decisive increase in the uptake of bioplastic materials in many other sectors, including textiles, construction and building, consumer goods, and automotive applications. Bio-based plastics do not only help to make cars lighter to save fuel, but they provide additional means to reduce carbon emissions and the impact on the environment.



Global production capacities of bioplastics 2016 (by market segment)

Source: European Bioplastics, nova-Institute (2016).



Global production capacities of bioplastics in 2016 (by market segment)

Source: European Bioplastics, nova-Institute (2016).



BIOPLASTICS – *an important part of the EU bioeconomy*

Bioplastics are an essential part of the bioeconomy. They are a fast-growing, innovative industry that has the potential to decouple economic growth from resource depletion and negative environmental impact, and to help deliver better economic and environmental outcomes by replacing fossil feedstock with bio-based feedstock, while continuing to harness the benefits of plastics.

Besides its contributions towards a sustainable future, the budding bioplastics industry has the potential to unfold an immense economic impact in Europe over the coming decades. According to a recent market analysis conducted by EuropaBio¹, the European bioplastics industry could realise a steep employment growth, most of which will have positive effects on the development of rural areas. In 2013,

Bioplastics create jobs and growth in Europe

Moreover, bioplastics contribute to an increased resource efficiency by applying the principles of the circular economy: from sustainable sourcing to product design, and to ensuring that plastics do not become waste but instead re-enter the economy as valuable technical material or biological nutrients.

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. Yet, an integrated European political and economic framework is needed to unlock the potential of a full-scale market introduction of bioplastics in Europe.

¹ EuropaBio – The European Association for Bioindustries: Jobs and growth generated by industrial biotechnology in Europe (2016)

BIOMASS FOR BIOPLASTICS – *efficient use of feedstock*

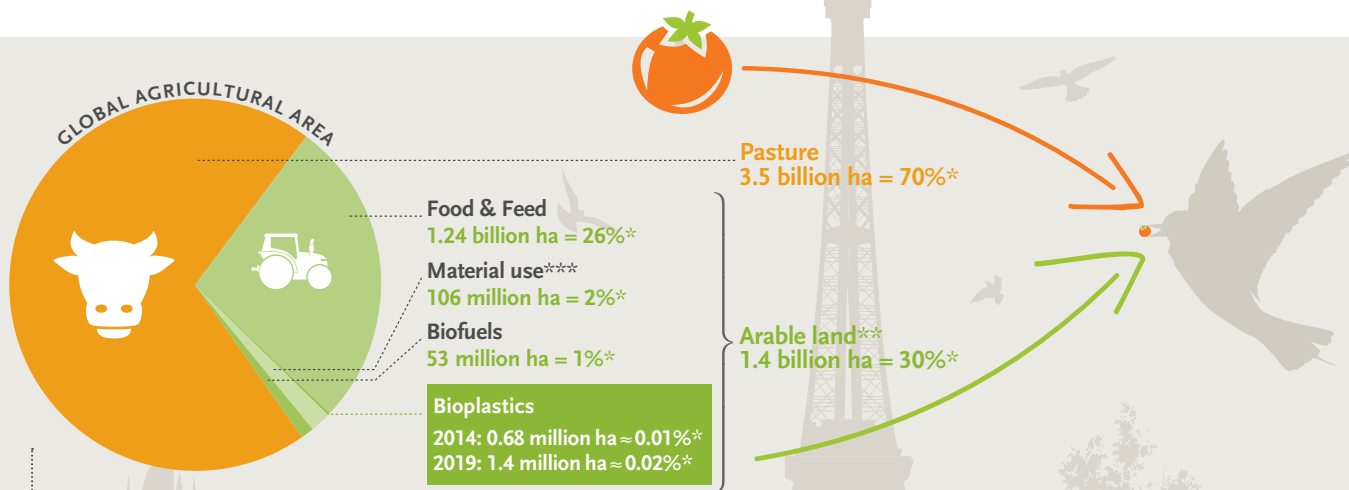
Today, bioplastics are mostly made of agro-based and ligno-cellulosic feedstock. Currently, agro-based feedstock (plants that are rich in carbohydrate, such as corn or sugar cane) is the most efficient and profitable option, since these plants are designed to produce the highest yields and withstand pests and demanding weather conditions. Ligno-cellulosic feedstock includes plants that are not eligible for food or feed production. The bioplastics industry is also developing new technologies that use waste materials from the mentioned feedstocks with a view to its further use for the production of bioplastics materials in the future.

Land use

In 2014, the global production capacities of bioplastics amounted to 1.7 million tonnes, which required approxi-

mately 680,000 hectares of land to grow the renewable feedstock. The surface required to grow sufficient feedstock for today's bioplastics production is about 0.01 percent of the global agricultural area of a total of 5 billion hectares. Metaphorically speaking, this ratio correlates to the size of an average cherry tomato compared to the Eiffel Tower.

The area used to grow crops for the production of bioplastics is no competition to the production of food and feed. Increasing the efficiency of feedstock and agricultural technology is continuously enhancing good agricultural practices. Today, the sustainability of biomass sourcing is ensured through the growing importance and implementation of reliable and independent sustainability certification schemes such as ISCC plus, RSB, or BonSucro. Additionally, standards have been developed on CEN level.



Land use for bioplastics in 2014 and 2019

Source: European Bioplastics, Institute for Bioplastics and Biocomposites, nova-Institute (2015).

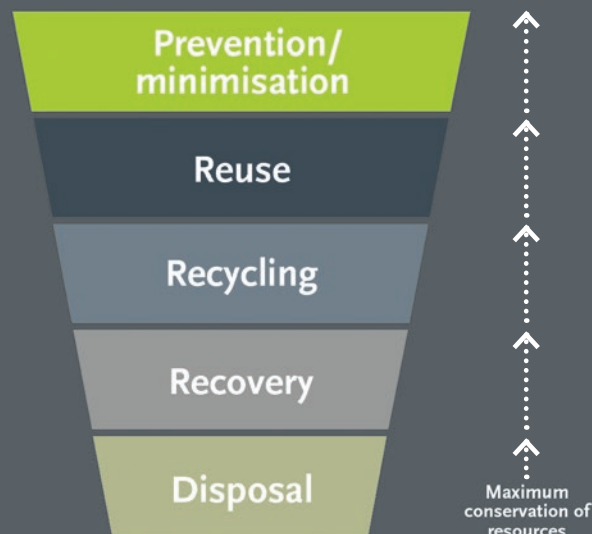
* In relation to global agricultural area
** Also includes approx. 1% fallow land
*** Land-use for bioplastics is part of the 2% material use

BIOPLASTICS – *contributions to improved waste management*

Bioplastics are suitable for a broad range of end-of-life options with the overwhelming part of the volumes of bioplastics produced today already being recycled alongside their conventional counterparts where separate recycling streams for certain material types exist (e.g. bio-based PE in the PE-stream or bio-based PET in the PET stream). This way, bioplastics can contribute to higher recycling quotas in the EU and more efficient waste management. New materials such as PEF and PLA can also be mechanically recycled but still face the hurdles of low market shares.

Compostability is a property of certain types of bioplastics that offers additional waste treatment options at the end of a product's life. Biodegradable products, such as compostable biowaste bags, food packaging, or cutlery can be treated together with organic waste in industrial composting plants or AD plants and are thus diverted from landfills and turned into biogas or valuable compost. If bioplastics can no longer be reused or recycled, they can be used for the production of renewable energy.

Efficient waste management is key to the European Commission's flagship policy goal of a resource efficient Europe and its circular economy vision. The EU Waste Framework Directive (2008/98/EC) defines a five-step waste hierarchy, ranking the treatments of waste based on their ability to conserve resources.



EU Waste hierarchy

100% SAFE – *transparent claims and reliable standards*

The use of independent and internationally respected labels to mark bioplastic products is important for consumers to receive transparent and correct information about the product and to safeguard the positive image of bioplastics.

Bio-based labels

Substantiation of bio-based claims should conform to the EU standards EN 16640 and/or EN 16785. Those standards specify the calculation method for determining the bio-based (carbon) content in monomers, polymers and

plastic materials and products, based on the C14 content measurement or C14 method and elemental analysis, respectively.

Compostability labels

Biodegradable products certified according to the standards EN 13432 and EN 14995 can be called (industrially) compostable. The ‚Seedling‘ logo is a reliable label for industrial compostability, which assists in the decision on purchasing and disposing a product or packaging.

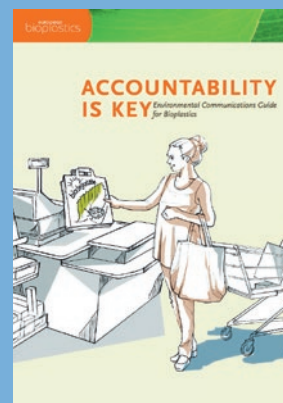
Trustworthy labels are always linked to an internationally accepted standard via an independent certification scheme. European Bioplastics supports corresponding certification schemes and labels for product identification and disposal, and their EU-wide implementation.

There are two organisations in Europe, DIN CERTCO (Germany) and Vinçotte (Belgium) that provide certifications and corresponding labels based on these standards.

Environmental communications

European Bioplastics has compiled a comprehensive Environmental Communications Guide providing general recommendations as well as specific guidelines for communicating environmental claims for bioplastics.

Selection of labels for bioplastics:

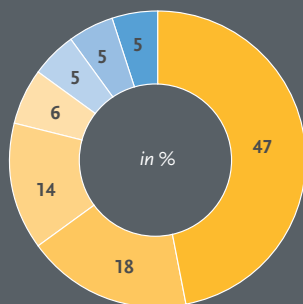


EUROPEAN BIOPLASTICS – *the European Association of the bioplastics industry*

European Bioplastics (EUBP) is the association representing the interests of the bioplastics industry along the entire value chain in Europe. EUBP is working very closely with bioplastics businesses, with EU policy makers, and other key stakeholder groups to ensure a supportive policy and economical framework in Europe for our budding industry to thrive in.

European Bioplastics has been a key player in shaping the policy environment for our industry in Europe for over 20 years. Founded in 1993 as a German association for biodegradable polymers, EUBP evolved into a European association that represents both bio-based and biodegradable plastics.

EUBP currently represents about 70 members from the entire value chain of bioplastics, from producers of renewable feedstock, bioplastics producers, and converters to brand owners, research institutes, and waste management organisations. The increase in the use of bioplastics in all market segments is driven by the increasing demand for sustainable products by consumers and brands alike due to a growing awareness of the impact on the environment as well as the continuous advancements and innovations of the bioplastics industry in new materials with improved properties and new functionalities.



- Bioplastics manufacturers and auxiliaries (Additives)
- Plastic converters
- Research, consulting, framework and others
- RRM/Intermediates RRM conversion
- Machinery/Engineering/Equipment
- (Industrial) End Users
- Waste and Recycling

..... Members according to industry sectors, 2015



EUROPEAN BIOPLASTICS – *driving the evolution of plastics*

European Bioplastics serves as both knowledge partner and business network for companies, experts, and all relevant stakeholder groups of the bioplastics industry.

Our primary task is to raise awareness and inform policy makers, brands, businesses, consumers, media, and the interested public about the properties, benefits, and potentials of bioplastics for a sustainable society.

Our activities at a glance:

- We formulate and communicate our industry's positions on relevant issues.
- We represent our members' interests in consultations and developments around relevant policy issues in Brussels.

- We provide comprehensive information on all relevant topics surrounding bioplastics, including the comprehensive annual global market data update.
- We provide opportunities and platforms to connect and network, such as our annual European Bioplastics Conference – the leading business event of our industry in Europe.

Benefits of becoming a member

If you would like to know more about our activities, our members, or the benefits of becoming a member of European Bioplastics, visit our website www.european-bioplastics.org or contact us directly at info@european-bioplastics.org.



9th European Bioplastics Conference, opening speech of former EU Commissioner for Environment Janez Potočnik, 2014



Contact & more information

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MAKING THE DIFFERENCE

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