BioCannDo

Key messages

For communicators and multipliers

Bio-based food packaging

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What is bio-based food packaging?

Key message #1 – Bio-based food packaging is partly or wholly made from renewable resources such as wood, corn, sugar cane or agricultural residues.

- Paper and cardboard are traditional bio-based packaging materials.
- New and innovative bio-based packaging materials include bio-based plastics and composite materials.
- Bio-based packaging is suitable for many products such as dairy products, biscuits, beverages, ready meals and fresh products such as fruits and vegetables.
- Bio-based does not automatically mean organic, biodegradable or compostable. Bio-based only means that a product is made from renewable resources. It can also be biodegradable, but it doesn't necessarily have to be.
- When communicating about plastic made from renewable resources it is recommended not to simply use the term bioplastics. Be rather specific and use terms such as bio-based plastic, plastics from renewable resources or even better name the specific material of the packaging product.

Background info

Bio-based means made from renewable resources

Communication and terms around bio-based food packaging can be tricky. The term “bio” and “organic” are often confused. If a product or material is bio-based this only means it is made from renewable resources such as plants, trees or animals. It does not necessarily mean that these plants were cultivated organically or that the product is biodegradable or compostable (see also key message #3).

Traditional bio-based packaging materials are paper and cardboard

Paper and cardboard account with 41% for the largest share of the volume of packaging materials (including all types of packaging, not just food). It is biodegradable, recyclable and suitable for thermal incineration. In Europe, 72% of all paper and cardboard is recycled, but not all paper packaging is suitable for recycling e.g. if it contains food residues, or if additional plastic or aluminium barrier layers have been added, it is difficult or even impossible to recycle.

Paper and cardboard need more water, raw materials and energy in their production than plastic, but are very suitable for recycling. Overall, less virgin material is needed compared to other types of packaging material. It can also be made from various types of biomass residues (e.g. grass, tomato stems or sugarcane tops and leaves).

Background info

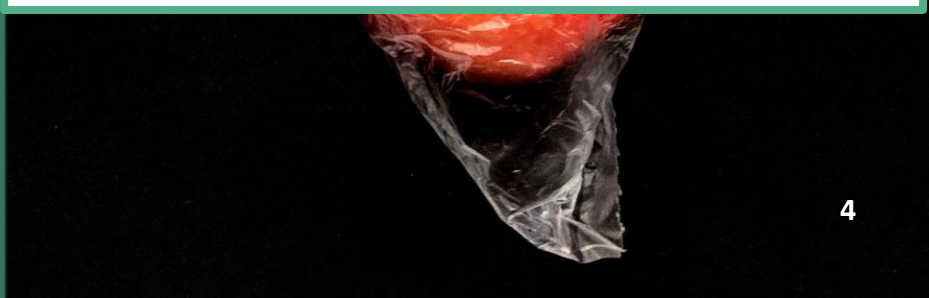
Bio based plastics are innovative packaging materials

Plastic packaging accounts for around 19% of all packaging waste generated. At the moment, only 1% of all plastic packaging is bio-based. 99% is still fossil-based.

There is a variety of bio-based plastics used in packaging. Depending on their properties (e.g. barrier properties for CO_2, water and oxygen) they can be used for different applications.

A first group of bio-based plastics are chemically identical to fossil-based ones. They are called “drop-in plastics”, a kind of “bio-similar” copy of petrochemical plastics but made from biomass instead of fossil oil. Examples include Bio-PET (polyethylene terephthalate) or Bio-PE (polyethylene). Bio-PET is partly bio-based (30%). A well-known application is the Coca Cola PlantBottle®. Bio-PE is 100% bio-based. It is for example used for dairy and cosmetic packaging

A second group are dedicated bio-based plastics, such as PLA (polylactid acid), PHA (polyhydroxyalkanoate), PEF (polyethylenefuranoate) or starch blends. These newly developed materials do not have an identical fossil-based counterpart. Some of them are already in commercial use (PLA) and some are under development (PEF).



Bio-based doesn't mean biodegradable

The terms bioplastics and bio-based plastics cause confusion because they can mean different things. In scientific discussions the term bioplastic includes bio-based plastics, i.e. plastics made from renewable resources (biodegradable and non-biodegradable), as well as fossil-based plastics if they are biodegradable—yes, there are some fossil-based plastics which are biodegradable. When communicating about bioplastics this differentiation must be considered to avoid misleading or confusing messages.

Oxo-degradable plastics are not bio-based plastics

Oxo-degradable plastics cannot be considered bioplastics. **They are conventional plastic materials with additives that do not biodegrade but merely fragment into small pieces and finally microplastics that remain in and potentially harm the environment and endanger recycling and composting.** That is why the EU included oxo-degradable plastics in its proposed ban for single-use-plastics.

Environment and Climate Protection

Key message #2 – Bio-based packaging materials contribute to more environmentally friendly packaging, but they are not automatically more sustainable than fossil-based packaging materials.

- Prevention, reduction, re-use and recycling are the most important steps to reduce the environmental impact of packaging. **Bio-based food packaging is no solution to littering.**
- Using bio-based resources such as wood, corn or sugar cane causes less CO_2 emissions and helps to keep fossil-based feedstocks such as crude oil in the ground.
- **Bio-based materials are not automatically more sustainable.** They can contribute positively to the environment provided the biomass used in its production is cultivated and processed according to standards aimed at preventing deforestation and protecting biodiversity, soil, water and air.
- Especially the use of agricultural by-products as feedstock will have a positive environmental impact, because they don't need to be purposely grown.
- Currently, less than 0.02% of the global agricultural land is needed to produce renewable resources for bio-based plastics.

Background info

Sustainable food packaging: Prevent, reduce, re-use, recycle

Sustainable packaging can refer to many different aspects such as reduction of packaging material, use of recycled materials and packaging or use of materials with a lower ecological footprint. **The best packaging though, is the one that is not needed**. In 2016, 169.7 kg of packaging waste was generated per inhabitant in the EU-28. The packaging waste accounts for around 35% of the total waste generation per inhabitant (486kg). The quantity of packaging waste varied between 54.9 kg per inhabitant in Croatia and 220.6 kg per inhabitant in Germany. **Paper and cardboard (41 %), plastic (19 %), glass (19 %), wood (16 %) and metal (5 %) are the most common types of packaging waste in the EU-28.** Other materials represent less than 0.3 % of the total volume of packaging waste generated in 2016. Therefore, prevention and reduction of packaging is key. Also, packaging materials should be easily separable and recyclable no matter what material is used.

Bio-based packaging materials are no excuse for littering

Bio-based food packaging materials are no solution to littering. Reusable products and materials should be applied whenever possible**. Even though a product might be claimed as biodegradable or compostable, that doesn't mean you can just throw it into the environment.** The right treatment of a product at its end of life is very important. Biodegradability does not automatically mean that a product will degrade in any environment. In most cases industrial composting with specific conditions is needed.

Bio-based materials can contribute to more sustainable packaging

Bio-based packaging materials are not automatically more sustainable than their fossil-based counterparts. On the one hand, bio-based packaging materials usually perform better than fossil based materials when it comes to greenhouse gas emissions and fossil resource consumption. Data shows, for instance, that compared to conventional plastics, the production of PLA reduces CO_2 emissions by 60% and fossil resource consumption by 50%. On the other hand, in the acidification and eutrophication categories they mostly perform worse.

This is especially due to the mostly conventional cultivation of plants and the use of fertilizers and pesticides. However, the environmental impacts depend heavily on the type of land use (for example, intensive use in monoculture versus extensive use in organic farming) and on the local availability of the resource water. Ecological management of biomass cultivation could offset the negative factors.

At the present time bio-based plastics may not perform better than conventional plastics in terms of lifecycle impact. However, production of bio-based plastics is still in its infancy and has great development and innovation potential, and a much more efficient production will be possible in the future. In addition, when considering conventional plastics, factors such as environmental damage from oil drilling or negative effects on ecosystems in mining areas are systematically excluded to date.

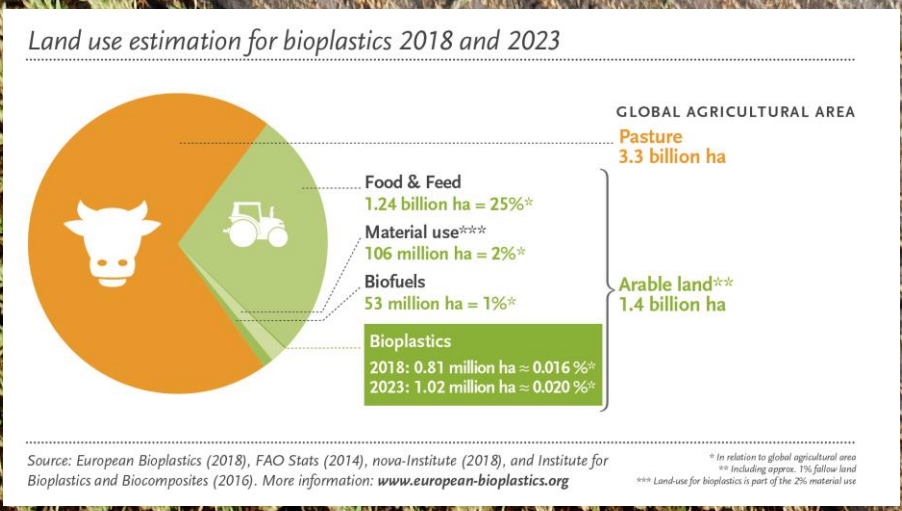
Definitive statements about the environmental performance of bio-based packaging materials can only be made on product level and based on a transparent life cycle assessment.

Biomass for bio based plastics

Biomass can provide renewable carbon as a sustainable raw material for the chemical and plastics industries to replace fossil carbon. Various studies have shown that there are considerable potentials for the cultivation of biomass for material use on a global level even when conditions such as the preservation of biodiversity and climate protection are taken into account.

In 2018, the global production capacities of bio-based plastics amounted to 2.11 million tonnes, which required approximately 0.81 million hectares of land to grow the renewable feedstock. **The surface required to grow sufficient feedstock for today's bioplastics production is less than 0.02 percent of the global agricultural area of a total of 4.9 billion hectares**

At the same time increasing volumes of currently underutilized and/or undervalued agricultural by-products can be used as biomass feedstock.



Source: European Bioplastics

Key message #3 – The best option for disposing bio-based packaging depends strongly on the application of the packaging material and the available waste management infrastructure.

Disposal

- If a packaging material cannot be reused, recycling is the preferred end-of-life option.
- Theoretically, all bio-based packaging materials can be recycled, but for most new bio-based plastics recycling systems are not yet established.
- If a bio-based packaging material cannot be recycled, energy recovery through incineration or biogas production is the preferred option.
- Composting can be a good disposal option for some special applications if a collection system for organic waste is in place.

Avoid, reduce, reuse, recycle

In general, bio-based packaging materials can be mechanically recycled, composted, incinerated or landfilled. Overall, in the EU-28 almost 66% of the packaging waste is recycled (material recycling + organic recycling /composting). These high recycling rates result from glass and paper recycling. To date, only 40% of the plastic packaging is recycled in the EU.

Bio-based plastics can be recycled, but recycling systems still need to be established

Theoretically, all bio-based plastics can be mechanically recycled. Bio-based “drop-in plastics” such as “Bio-PE” or “Bio-PET” are chemically identical to their fossil based versions “PE” and “PET”. Therefore they can be perfectly integrated in established recycling streams. **Other bio-based plastics need to be recycled in separate streams for each material type, because the purity of recyclate streams is important**. But the volumes of these bio-based plastics are currently not large enough to do the recycling economically. This might change when volumes increase. At present, bio-based plastics represent about one percent of the about 335 million tonnes of plastic produced annually around the world.

Background info

If recycling is not possible, at least the energy can be recovered

Until suitable recycling system are established, bio-based plastics which are not drop-ins will normally be sent to waste incineration plants, which at least allows the recovery of energy. In contrast to fossil-based plastics, the CO_2 from incinerated bio-based plastics does not contribute to a net increase in atmospheric CO_2. This is because **the CO_2 released from the burning of bio-based plastics was captured from the atmosphere by plants, and burning it only brings it back into the atmosphere.** Therefore, there is no CO_2 added to the atmosphere - rather it is just being shifted around. However, fossil fuels consist of carbon that was held in reserves beneath the earth which have not been part of this atmospheric cycle since their entrapment in the ground millions of years ago. By mining them back to the surface of the earth and then burning them, CO_2 that existed below the ground is now being released into the above-ground atmosphere and added to the plant-atmosphere carbon cycle.

Composting can be a good option in some cases

In principle, recycling and energy recovery are the preferred waste management options. Composting should only be considered for specific applications where recycling is too difficult, for instance, because the packaging is highly contaminated with organic residues.

Tea bags are an example where composting can make sense. Although they contain non-biodegradable fossil-based polypropylene (PP) as sealants tea bags often end up in the composting bin. By replacing the PP with polylactic acid (PLA) the tea bag becomes fully compostable. It is important though, that bio-based materials are accepted by local collecting systems for organic waste. This can vary from region to region.

Health and safety

Key message #4 – All bio-based food packaging materials must comply with the European health and safety regulations for food-contact materials.

- Food comes into contact with many materials and articles during its production, processing, storage, preparation and serving, before its eventual consumption. Such materials and articles are called Food Contact Materials (FCMs).
- Examples include containers for transporting and packaging food, machinery to process food, kitchenware and tableware.
- The safety of FMCs is evaluated by the European Food Safety Authority (EFSA).
- The safety of FCMs is tested by the business operators placing them on the market, and by the competent authorities of the Member States during official controls.
- All materials and additives used in the production of (bio-based) plastics have to be listed in EU Regulation No. 10/2011 on plastic materials and articles intended to come in contact with food.

New and advantageous properties

Key message #5 – Bio-based food packaging materials offer new properties which are advantageous for some applications such as fruits, vegetables or salads.

- Bio-based packaging can help to reduce food waste by keeping perishable food such as lettuce or bread fresh for a longer time compared to conventional packaging materials.
- Innovative bio-based materials such as PEF require fewer resources because thinner packaging can be applied.

Background info

Bio-based packaging materials keep perishable products fresh for longer

The breathing capability of various bio-based plastic packaging materials is a big advantage, because it extends the life of perishable products like lettuce, and it keeps bread fresh for longer.

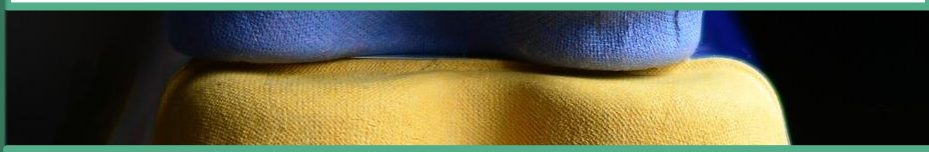
It can also contribute to a reduction in food waste. In the EU as much as 20% of the total food produced is wasted, which is about 173 kilograms of food waste per person and year. According to the European Commission, food waste alone generates about 8% of the global greenhouse gas emissions.

Researchers from Wageningen UR estimated that if better packaging methods (such as those using bio-based plastic) can decrease the amount of lettuce wasted by 10%, the usable land saved from being able to cut back on lettuce production outweighs the additional land used to grow the bio-based feedstock for the production of the packaging.

Bio-based packaging does not only keep food fresh longer, it may also improve the taste of fruit, as research on blueberries in PLA packaging has indicated. Consumers distinguished between blueberries from different packages. “A consumer preference for flavour, texture, external appearance and overall quality of blueberries packaged in PLA containers was observed in the paired comparison test” (Almenar 2010: Consumer acceptance of fresh blueberries in bio-based packages).

Bio-based packaging materials offer new properties

Bio-based plastics are suitable for many food packaging applications and have mostly the same gas barrier and mechanical properties as fossil-based plastics. **All new types of bio-based plastics are more permeable to water vapour than fossil-based plastics, which is a weakness or strength depending on the requirements of the food packaging.**



Innovative bio-based material requires fewer resources

An innovative bio-based material currently under development is PEF (polyethylene furanoate). Used in bottles it outperforms PET-bottles in many areas, particularly in (CO_2, water and oxygen) barrier properties, which result in longer-lasting carbonated drinks and an extended shelf life. It also offers better UV-stability, is recyclable and offers a higher mechanical strength. Using PEF require fewer resources because thinner packaging can be applied.

Innovation

Key message #6 – Introducing bio-based packaging is high on the agenda of frontrunners in the food industry.

- The European Commission and the bio-based Industries are jointly funding a number of research, demonstration and flagship projects targeting the development of new and superior bio-based packaging materials to overcome the current limitations of existing bio-based materials.

Bio-based insulation products contribute to climate protection

BIOSMART has the ambition to develop active and smart bio-based and compostable packages, addressing the needs of fresh and pre-treated food applications, as for example, light weighting, reduced residues, shelf life monitoring and lengthening shelf life and easier waste handling.

The aim of the PULPACKTION project is to develop cellulose-based packaging solutions for specific food and electronic packaging applications that need medium and high barrier requirements, and that currently are packaged in fossil based solutions.

The FRESH project develops a ready-meal packaging tray which is fully bio-based and biodegradable.

The BioBarr project responds to the industrial and technological challenge of developing new, fully biodegradable food packaging with barrier performances that allow at least a 10% extension of its shelf life.

The objective of the SHERPACK project is to develop a renewable, biodegradable and recyclable flexible paper-based packaging material that can be easily converted by heat-sealing and folding, with improved stiffness and grip, in order to replace materials such as plastics or aluminium foil currently used in the market.

RefuCoat aims to develop fully-recyclable food packaging with enhanced gas barrier properties and new functionalities using high performance coatings.

The PEFerence project seeks to replace fossil-based polyesters, such as PET, with a new 100% bio-based polyester called PEF (polyethylene furanoate). PEF is a dedicated bio-based chemical that offers potential to make bottles, films and fibres.

For further reading:

Wageningen UR: Biobased Packaging Catalogue, 2015

Wageningen UR: Bio-based and biodegradable plastics – Facts and Figures. Focus on food packaging in the Netherlands, 2017

FNR: Wissensforum Biobasierte Kunststoff-Verpackungen 2018 (in German)

Deutsche Umwelthilfe: Bioplastics – Myths and Facts, 2017

Fraunhofer UMSICHT takes position. Topic: Recycling of bioplastics

AÖL: Bioplastic tool

Netherlands Enterprise Agency: Biobased Plastics in a Circular Economy, 2017

EC report on the impact of the use of oxo-degradable plastic

RoadToBio: Bio-based drop-in, smart drop-in and dedicated chemicals

Wageningen UR: Biobased Plastics 2019 (in Dutch)

Almenar E, Samsudin H, Auras R, Harte J (2010) Consumer acceptance of fresh blueberries in bio-based packages. Journal of the Science of Food and Agriculture 90(7):1121-1128

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on bio-based food packaging materials**

**For more information: Erik Lohse
e.lohse@fnr.de**

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