



Netherlands Institute
for Sustainable Packaging

FACT SHEET

Biobased plastic packaging



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Introduction

The Netherlands Institute for Sustainable Packaging (KIDV) frequently receives questions from businesses about biobased plastic packaging and about biodegradable packaging. To answer these and other questions, KIDV has drawn up the “Biobased plastic packaging” and “Biodegradable packaging” fact sheets. Both documents are an update of the “Biodegradable plastic packaging” fact sheet from 2018.

This fact sheet concerns biobased plastic packaging. You can download the fact sheet about biodegradable packaging [here](#). Both fact sheets have been drawn up in collaboration with CE Delft.

What is this fact sheet about?

In this fact sheet, KIDV provides a general overview of the current state of affairs concerning biobased plastic packaging. Further details and more in-depth information can be found in the reports that are referenced in this fact sheet.

Biobased plastics for packaging are used to replace fossil plastics. Of course, wood, paper and cardboard can also be used as biobased packaging materials.

This fact sheet covers the following topics: definition and properties of biobased plastics, the application of biobased plastics in packaging, sustainability (CO₂ impact, raw materials and waste phase). It also covers identified opportunities and bottlenecks. KIDV also offers businesses guidelines in the form of concrete suggestions and considerations regarding the application of biobased packaging, based on the national government's current policies and current recycling practices. This fact sheet will be updated if and when new waste sorting techniques, new materials or new policies are introduced.

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For whom was this fact sheet created?

This fact sheet was written for the producers and importers of packaged products, their suppliers and consultants.



Clarification

Definition and properties of biobased plastics

The term “biobased plastics” is an umbrella term for different types of plastics that are made entirely or partially out of organic raw materials. The terms “bioplastics” and “biopolymers” are also sometimes used.

Three properties of biobased plastics are particularly relevant:

Origin

Biobased plastics are plastics that are manufactured out of organic (renewable) raw materials, which distinguishes them from plastics made from oil. Note that plastics can be partially biobased if they are made from a combination of fossil and renewable raw materials.

The amount of biobased content can be measured. The relevant definitions and measurement methods are recorded in the European standards EN16640 and EN16785. Biobased content can be certified, e.g. via TUV (the OK biobased certification) and NEN (biobased content).

NOTE: Even though biobased plastics are made from renewable raw materials, they are usually still plastics. That means the policy regulations for plastics, such as the European guideline for Single Use Plastics ([SUP](#)) (link only available in Dutch), also apply to biobased plastics.

Chemical structure

The chemical structure of plastics is determined by the monomers that are used.

In most cases, biobased plastics are produced using the same production processes as fossil plastics. That means the biobased plastics consist of the same monomers and therefore have the same chemical structure as fossil plastics. This group of plastics is also known as drop-in biobased plastics, because their similar chemical structure makes them directly compatible with existing processes for production and waste processing.

Sometimes, new biobased plastics are produced that have a different monomer composition and therefore a different chemical structure than fossil plastics. These polymers are called new biobased plastics (see also the [Action Plan Biobased Plastics¹ \[only available in Dutch\]](#)).

¹ Plastics Transition Team, 2020



Degradability

The degree to which biobased plastics are biodegradable depends on a number of factors, such as the chemical structure of the plastic, the temperature, the microbial activity and the humidity of the environment. KIDV has drawn up the "Biodegradable packaging" fact sheet about the degradability of (bio)plastics. You can download this fact sheet [here](#).

Application of biobased plastics in packaging

An extensive overview of all applications of biobased plastics can be found in the [Biobased Packaging Catalogue²](#) (only available in Dutch).

At the moment, circa one percent of the total volume of plastics used in the Netherlands consists of biobased plastics. At the European level, this is also circa one percent. In the Netherlands, 20 kt of biobased plastics are used every year, compared to a total volume of plastics used of 2,000 kt³. Biobased plastics are primarily used for the production of packaging. In 2020, nearly half of the total produced volume of biobased plastics was used in packaging. This primarily concerns bio-PE, bio-PET, PLA and starch blends.

The Dutch government and the plastics-processing industry want to raise the percentage of biobased plastics to 15% by 2030. This goes for all biobased plastics, including biobased plastic packaging. To attain this goal, businesses, the government and NGOs developed an Action Plan Biobased Plastics in 2020⁴. In 2021, the national government will respond to the action plan and indicate how it believes the target of 15% biobased plastics can be attained by 2030 in collaboration with businesses.

The Dutch plastics-processing industry wants to increase the percentage of biobased plastics to 15% by 2030. This is recorded in the Transition Agenda Plastics. The target applies to all biobased plastics, including biobased plastic packaging. To attain this goal, the sector developed the Action Plan Biobased Plastics in 2020.

In a letter⁵ to Parliament (Clarification policy biobased and biodegradable plastics), the state secretary of Infrastructure and Water Management acknowledges the problem analysis and the plastics sector's ambitions. The goal is to increase the production of sustainable produced and recyclable biobased plastics and limit the applications of non-recyclable biodegradable plastics.

² Molenveld & van den Oever, Wageningen University & Research, 2014

³ National government, 2018

⁴ Plastics Transition Team, 2020

⁵ National government, 2021



Sustainability

The process of making packaging more sustainable is about reducing the environmental impact, e.g. by making the packaging part of a circular economy and thereby preventing as much CO₂ emission as possible. Biobased plastics are an alternative. In general, they positively contribute to a sustainable economy due to their relatively low carbon footprint.

As a replacement of fossil plastics, biobased plastics have a lower environmental impact, particularly because of the reduced carbon emissions. This conclusion is often drawn from a life cycle analysis (LCA), which compares biobased and fossil plastics from an environmental perspective. An LCA considers the environmental impact of a product-packaging combination across its entire life cycle. However, the results of an LCA are coloured by the research design (delineations with regard to production chains, applications and other methodological choices). It is therefore often difficult to make a fair and well-balanced comparison between different materials. The results may differ from case to case.

Although the number of high-quality case studies is limited, it is possible to draw a number of overall conclusions⁶:

CO₂ impact

LCAs show that biobased plastics have a lower CO₂ impact than fossil plastics (a CO₂ reduction of up to 80%) in some cases, while hardly any CO₂ reduction is achieved in other cases. For some applications, the volume of CO₂ emitted may even increase, especially if a relatively large amount of biobased plastic is needed compared to the alternative of fossil origin. Note that this is true for all materials (e.g. when paper or glass are used as an alternative solution). An LCA must therefore always be conducted for the packaging as a whole, rather than just the material it is made of.

In some cases, there is little difference between the environmental impact scores of biobased and fossil plastic packaging. In such instances, small details have a major impact on the final result (e.g. the effects of labels, printing, logistics, etcetera). Unfortunately, this detailed information is often unavailable, which means the results of such studies must be treated accordingly⁷.

In an LCA for the European Union, specific applications of biobased plastics were examined⁸. Biobased plastics that score exceptionally well in terms of CO₂ reduction are e.g. bio-PE used in shopping bags, starch blends used in horticultural clips and agricultural films and bio-PP from frying oil used in plastic cups. Furthermore, PLA (used in food packaging and cups), starch blends (used in shopping bags) and bio-PP⁹

⁶ CE Delft, 2020

⁷ Bishop, Styles & Lens, 2021

⁸ COWI/UU, 2018

⁹ Bio-PP from frying oil performs better with regard to the reduction of CO₂ emission than bio-PP from other raw materials because frying oil is a waste stream and the environmental impact of its production is therefore not taken into account.

from frying oil (used in packaging films) result in a moderate CO₂ reduction compared to using fossil plastics for the same applications. Bio-PET used in bottles does not result in a CO₂ reduction compared to using fossil PET in bottles.

In terms of environmental impact, biobased plastics can have the biggest impact during the production phase. No oil is needed for their production and the environmental impact of their production can be lower than that of fossil plastics if they are sustainably produced from efficiently produced bio-resources or organic waste streams.

Raw material

The production of the raw materials used for biobased plastics requires fertile land, water and nutrients. The agricultural methods used can be either sustainable or polluting.

Environmentally-conscious producers of biobased plastics opt for sustainable, certified agricultural and production methods. Some examples of applicable certifications are ISCC+, Bonsucro and Better Biomass¹⁰. If the government wants to stimulate the application of biobased plastics, as is currently being considered in both the Netherlands¹¹ and the European Union, sustainability criteria will likely be drawn up - as was done for the biofuels used in the transport sector¹².

Waste phase

The system of “reduce, reuse and recycle” applies to the circularity of biobased plastics as it does for other types of plastics. Incineration with energy recovery is only used as a final measure. Similar to fossil-based plastics, biobased plastics break down into CO₂ and water when incinerated. The resulting combustion heat can be used to generate power. When biodegradable plastics are composted, they also break down into CO₂ and water, although the energy released during this process goes to waste. Partly for this reason, incineration is generally preferable to the composting of biodegradable plastics. See also the KIDV fact sheet [Biodegradable packaging](#).

KIDV's [Sustainable Packaging Compass](#) can be used to compare the sustainability of plastic packaging. With this Compass, businesses can assess the sustainability of a packaging based on three key aspects: recyclability, circularity and environmental impact. Furthermore, it is possible to compare the current product-packaging combination to other alternatives. It is also possible to make a comparison between different fossil plastics and their biobased variants.

¹⁰ Holland Bioplastics

¹¹ Businesses and the government advocate this stimulation in their [Action Plan Biobased Plastics](#) (Raw Materials Transition Team, 2020)

¹² CE Delft, 2020

KIDV recommendations for businesses

As with all other materials, the environmental impact of biobased plastics is largely determined by the production of raw materials, the usage phase and the processing method used during the waste phase. Businesses that are considering the use of biobased plastics in their packaging are advised to keep the following points of attention in mind. Note that functionality is always the primary concern when developing a packaging. For more information, see [KIDV model Five perspectives on sustainable packaging](#).

Raw materials

Sustainable production

The use of sustainably produced raw materials is one of the steps towards making a packaging more sustainable. Businesses should know exactly what their packaging consists of. The raw materials used in a packaging's production can be traced using the Chain of Custody¹³.

For some raw materials, there is already a certificate that demonstrates that the material was produced in a sustainable manner. For example, certifications for sustainable forest management (such as FSC) are used in the paper and cardboard sector. However, such certificates are not yet available for all raw materials used in the production of packaging. The production of biobased plastics requires natural resources, such as land, water and fertilisers. The European government is expected to introduce specific requirements once the regulations for biobased and biodegradable packaging have been substantiated further.

Waste phase

Reuse

Whenever possible, opt for a reusable packaging. Although reuse can have a positive environmental impact, it also comes with its own challenges. Consult the [KIDV Reuse dossier](#) for the latest information.

Recycle

Biobased plastics such as Bio-PE, Bio-PP and Bio-PET are so-called drop-ins. This means their chemical structure is similar to that of the fossil materials PE, PP and PET and that they can be recycled along with these materials. You can use the [KIDV Recycle Checks](#) to determine whether your packaging has good recyclability.

According to the KIDV Recycle Check, packaging that is not made of PE, PP or PET currently does not qualify as having good recyclability. Examples include PC (polycarbonate), PS (polystyrene) and PLA (polylactic acid). The waste streams for these materials are currently too small to be sorted and recycled in a

¹³ In legal contexts, the chain of custody (CoC) represents the chronological documentation and recording of (physical and electronic) evidence. This concept is particularly important in criminal cases, although it is also used in civil cases and - in a broader context - to e.g. improve the traceability of food products or guarantee that wooden products come from sustainably managed forests. The term is sometimes also used as a synonym for the origin of a product.



cost-effective manner on a large scale. As a result, these materials end up in the mixed stream, where they are either incinerated or their recyclate is used for the production of new thick-walled products.

When recycling a certain type of plastic (the primary stream), other types of plastic (disruptive streams) can negatively impact the quality of the recyclate. This can be caused by e.g. the entirely different molecular structure of the latter, which means the disruptive plastic will melt at a different temperature or exhibit some other disruptive property. Sorters and recyclers take various measures to generate optimally pure waste streams that recyclers can then process into a granulate used for the production of new products.

Specifically for PLA (a new type of biobased plastic), CE-Delft was commissioned by the Plastics Transition Team to demonstrate that the sorting and recycling of PLA can be economically viable, provided that there is a sufficient volume of PLA in the waste stream¹⁴. Sorting tests conducted by the National Test Centre for Circular Plastics confirm that sorting from Dutch waste is a viable option in practice¹⁵. In the [Action Plan Biobased Plastics](#) (only available in Dutch), the signatories call for an exploration of the volume of PLA that will be used in the future and whether it can help attain the target of 15% biobased plastics by 2030.

Bio-based PEF, which is currently being developed, appears to be fairly compatible with PET during the waste processing phase. Threshold values of two and five percent have been reported¹⁶.

Composting

Information about composting can be found in the KIDV fact sheet [Biodegradable packaging](#).

Communication about biobased packaging

On 30 November 2022, the European Commission published a Communication on an EU policy framework for biobased, biodegradable and compostable plastics. This Communication provides more clarity on biobased, biodegradable and compostable plastics. It also sets out the conditions to ensure that the environmental impact of the production and consumption of these plastics is positive. This Communication is not legally binding, but provides insight and guidance for policy, purchasing or investment decisions.¹⁷

A biobased product must meet the following condition:

- The term 'biobased' should be used only if the exact and measurable share of biobased plastic content in the product is specified, so that consumers know how much biomass has actually been used in the product. In addition, the biomass used must be sustainably sourced, with no harm to the

¹⁴ CE Delft, 2019

¹⁵ CE Delft, 2021

¹⁶ Alaerts, Augustinus, & Van Acker, 2018

¹⁷ https://ec.europa.eu/commission/presscorner/detail/en/qanda_22_7158



environment. The sourcing of these plastics should comply with sustainability criteria. Producers should prioritise organic waste and residues.

Anticipating new regulations

The European Commission will introduce regulations ([Packaging and Packaging Waste Regulation](#)) about the use of a mandatory percentage of recyclate in new products and packaging. Criteria for carbon emissions will be implemented as well. KIDV advises businesses to use raw materials whose supplier can prove that they contribute to a CO₂ reduction of at least thirty percent compared to the use of fossil plastics, or which offer a specific sustainability benefit (e.g. a co-benefit or reduced leakage). Various types of bio-PE, bio-PP and starch blends already meet these requirements.



Anticipating long-term developments

As described in [The State of Sustainable Packaging](#), we are working on intrinsically sustainable packaging. Although we do not currently know exactly what an intrinsically sustainable packaging will ultimately look like, bio-based packaging could contribute to this goal, e.g. by reducing the environmental impact or by contributing to a cleaner delivery chain.

The users of packaging made from bio-based materials have to compare the environmental impact (per product-packaging combination) and ensure that the packaging does not contain any substances that can negatively affect the chain. That, in turn, requires insight into the packaging's composition.

In the long run, fossil resources will become increasingly scarce and this will result in a higher acceptance of bio-based raw materials. As before, it will be important to consider the overall environmental impact of the product-packaging combination.

KIDV will involve businesses in the development of new avenues.

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