Bioplastics - furthering efficient waste management

Recycling and recovery options for bioplastics

Waste management in Europe

Efficient waste management is key to the European Commission’s flagship policy of a resource efficient Europe and its vision of a circular bioeconomy. Yet, today, the waste management infrastructure still varies immensely within the EU.

In the European Union Waste Framework Directive 2008 a waste hierarchy has been defined in five steps according to their desirability: 1) prevention; 2) preparation for re-use; 3) recycling; 4) other recovery options, such as energy recovery; and 5) disposal. The goal is to conserve resources as best possible.

With increasing recycling targets and a gradual phase-out of landfilling, Europe is on the road to fulfilling its efficiency targets and realising a true ‘closed loop’ economy. Bioplastics can contribute to this development on different levels.

Bioplastics can further efficient waste stream management in the EU.

Based on renewable feedstock, bioplastics spare fossil resources and offer great potential for reducing greenhouse emissions. When it comes to waste management options, it is important to note that bioplastics include a whole family of different materials. They can be treated in various established recycling and recovery streams, and offer additional options such as organic recycling (composting).

Graph: EU waste hierarchy

Classification of waste management options according to the order of their environmental impact.
Waste management options and benefits of bioplastics

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 recovery systems available.

**Prevention and reduction**

This step of the waste hierarchy requires the use of manufacturing processes and materials that minimise resource use and maximise the functional performance of the product. Plastics have consistently proved their suitability, with products becoming increasingly thinner, lighter, and stronger. The rules of competition as well as the economic and ecological demands of the market also lead to bioplastics increasing their performance and resource efficiency. The amount of products already available on the market and the high growth rates testify to what bioplastics have achieved.

**Reuse**

There is already a large number of plastic products that can be reused multiple times. PET bottles can be recirculated in recycling systems after cleaning, and the same is true for biobased PET. Carrier bags made from biobased PE, PLA, or starch materials can be reused many times before the material wears out. Bioplastics offer numerous opportunities for creating reusable products.

**Mechanical recycling**

Examples of easily recyclable plastic products are large surface films (e.g. carrier bags), large hollow containers (e.g. bottles), or construction materials (e.g. window frames). The recyclability of plastic products depends on the product design, material composition, and the cost effectiveness of the process. The task is simpler for products, which are not made from complex material blends and which can easily be separated into recyclable materials.

The new biobased versions of PE, PET or (upcoming) PP are chemically and physically identical to their widely used fossil-based counterparts and, thus, can easily be disposed of in established recycling streams.

The post-consumer recycling of other bioplastics for which no separate stream yet exists will be feasible as soon as the commercial volumes and sales increased sufficiently enough to cover the investments required. New separate streams...
Commercial technology is also available to transform the resulting alcohols into chemical feedstock such as ethylene or Monoethyleneglycol used in the production of polyolefines and polyesters (e.g. PET).


Organic recycling/composting

Using biodegradable and compostable plastic products such as (biowaste) bags, packaging, or cutlery can increase the options for the end-of-life treatment of those products. In addition to recovering energy and mechanical recycling, industrial composting (organic recovery/organic recycling) becomes a waste management option.

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

In order to be suitable for organic recycling, products and materials need to meet the strict criteria of the European norm EN 13432 on industrial compostability. Following successful certification, these products and materials are permitted to be advertised and labelled as ‘compostable’. The Seedling label is a well-known mark for products conforming to EN 13432.

Feedstock recovery

Whenever mechanical recycling experiences technical difficulties or is not economically viable, feedstock recovery is the recommended alternative. These processes are considerably less sensitive to contaminants and can easily be operated with mixed materials. This includes the recovery of plastic waste as a secondary raw material in concrete or steel production, for instance. Bioplastics perform just like their fossil counterparts in this process and are therefore easily recovered in the same way.

Furthermore, biobased and non-biobased plastics together with municipal waste can be transformed into syngas through the process of gasification. The resulting syngas features a significant biobased content that is determined by the input amount of biobased plastics and organic waste. Syngas can be used for either electricity generation, the production of fuel (synthetic petroleum), or the production of methanol and ethanol. In the latter case, it can subsequently be transformed into chemical feedstock such as olefins and acrylates with a high biobased content for the polymerization of polyethylene, polypropylene, polyester and other polymers.3

Energy recovery

Inceration of plastic waste to create heat and energy (electricity) is one of the most frequent recovery option for plastic waste in Europe (39.5 percent of plastic waste in 2014 was recovered through energy recovery processes).3 The high calorific value of plastics makes them an ideal replacement for coal and heating fuel. Whether they are biobased or fossil-based makes no technical difference to the recovery process. However, in the case of biobased plastics, renewable energy can be obtained from the biogenic carbon – a significant advantage.

Landfill

Landfilling is a hurdle to resource efficiency. Even though it is still one of the main disposal options in many countries in Europe, continual progress towards a phase-out can be observed. In 2014, around 31 percent of plastic waste went to landfills,4 7 percent less compared to 2012. European Bioplastics supports a European-wide ban on landfilling for

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2 Successfully operating plants for the transformation of syngas with a certain biobased content into methanol and ethanol already exist in Canada (ENERKEM) and the United States (INEOS BIO). Commercial technology is also available to transform the resulting alcohols into chemical feedstock such as ethylene or Monoethyleneglycol used in the production of polyolefines and polyesters (e.g. PET).

plastic products and supports any measures in order to increase recycling and recovery of plastics waste.

**Communicating end-of-life options**

*General guidelines for accurate environmental communication:*

1. Ensure that environmental claims are specific, accurate, relevant and truthful.
2. Omit vague, general claims that do not fulfil these criteria, such as ‘green’, ‘sustainable’, ‘environmentally friendly’ and ‘climate friendly’.
3. Substantiate claims with methods/data corresponding to international standards, ideally provided or verified by independent third parties. Make the data available to all interested parties.
4. Update substantiation and claims as required.

**Communicating end-of-life options correctly:**

1. Depending on the material or product, a clear end-of-life recommendation should be given (recycling, biowaste collection, etc.).
2. A claim for a specific end-of-life option can only be made, if a ‘reasonable proportion of the consumers’ has access to the corresponding facilities (European Commission).
3. End-of-life claims shall comply with the essential requirements of the relevant European legal frameworks; for packaging the European Packaging Directive is of particular relevance.
4. On top of the European legal framework, producers should check specific national waste legislation or agreements in place for bioplastics.
5. If a product claims to be compostable, certification according to EN 13432 or equivalent standards should be acquired.

**Conclusion**

Bioplastics can be mechanically or organically recycled and at the end of a product’s life energy can be recovered. Being partially or fully biobased and offering more waste options than conventional plastics, bioplastics drive resource efficiency in Europe and help the EU in creating a true circular bioeconomy.