POLYBAGS

MAKING A SMART DECISION

A GUIDE TO HELP YOU MAKE INFORMED PURCHASING DECISIONS WHEN CHOOSING PACKAGING

Current edition: Oct 2019

As materials and manufacturing processes develop, this guidance may change and be updated to reflect new research findings.

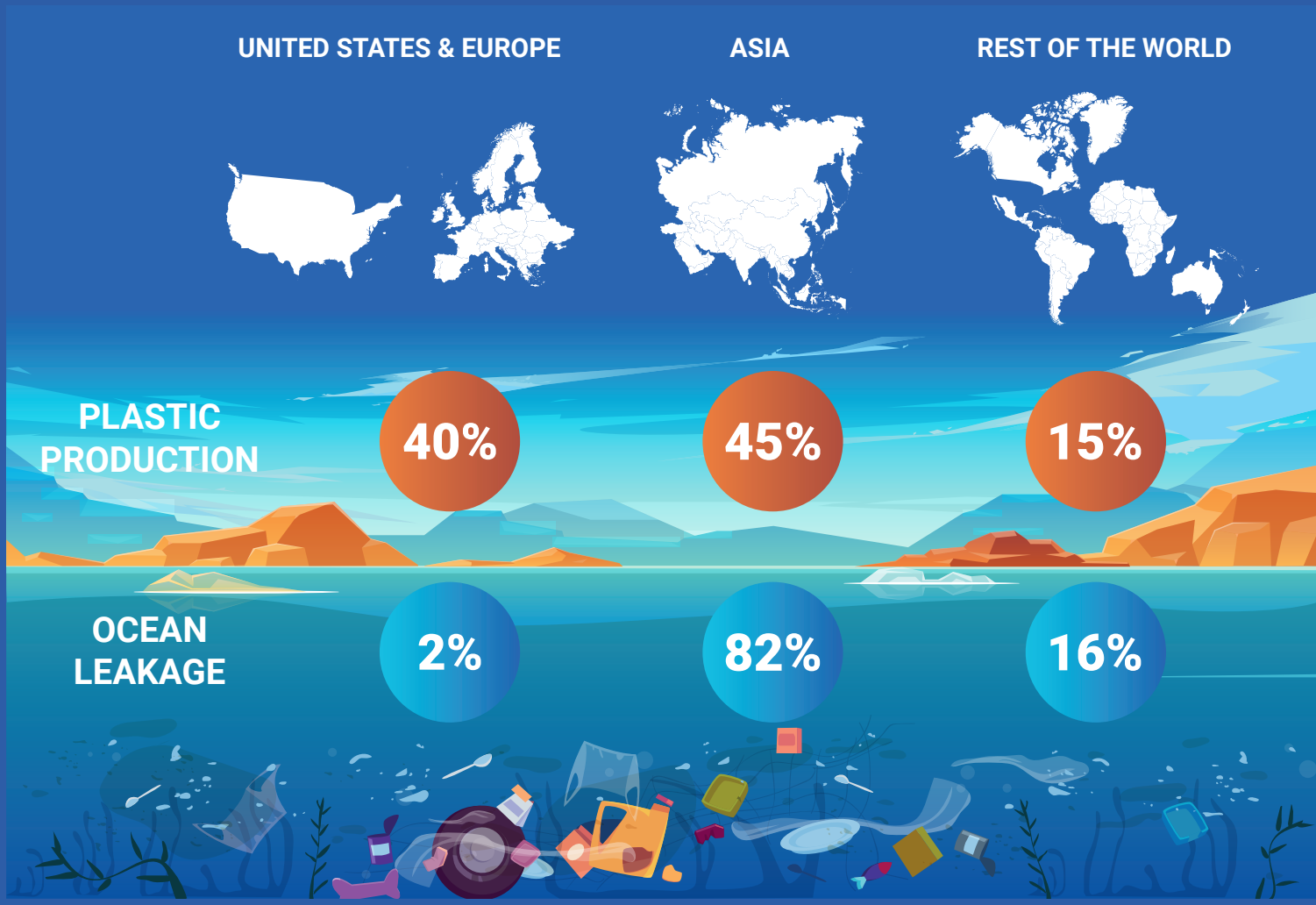
Packaging - The Big Picture

Any modern economy would not function efficiently without packaging. Many of the goods manufactured or grown would be damaged or spoiled before they reached consumers. *In less developed countries without the sophisticated distribution and packaging systems that we have in the UK, as much as 50% of food never reaches consumers.*[1]

There is no single magic material for Eco-friendly packaging. The only real solution is simply reducing the amount of packaging products used in the first place. But where there is no alternative, the aim is to minimise the carbon footprint, reduce (ideally eliminate) the amount of packaging that is not recovered and goes to waste.

Global Plastic Litter

"Countless large items of plastic debris are accumulating in marine habitats worldwide and may persist for centuries[2]*. About half of all of the plastic waste (leakage) that ends up in the oceans comes from just five countries: China, Indonesia, Vietnam, the Philippines and Thailand*[3]*."*



The UN estimates that *"at least 2 billion people worldwide still lack access to solid waste collection*[4]*."* As these people are left to rely on dumpsites, which are often located near oceans or waterways, it is understandable how this leakage occurs.

1 Source: Industry Council for Packaging and the Environment - incpen.org
2 Source: Brevia - Lost at Sea: Where Is All the Plastic?
3 Source: 2015 Ocean Conservancy report
4 Source: UNEP, Global Waste Management Outlook, 2015

European Objective

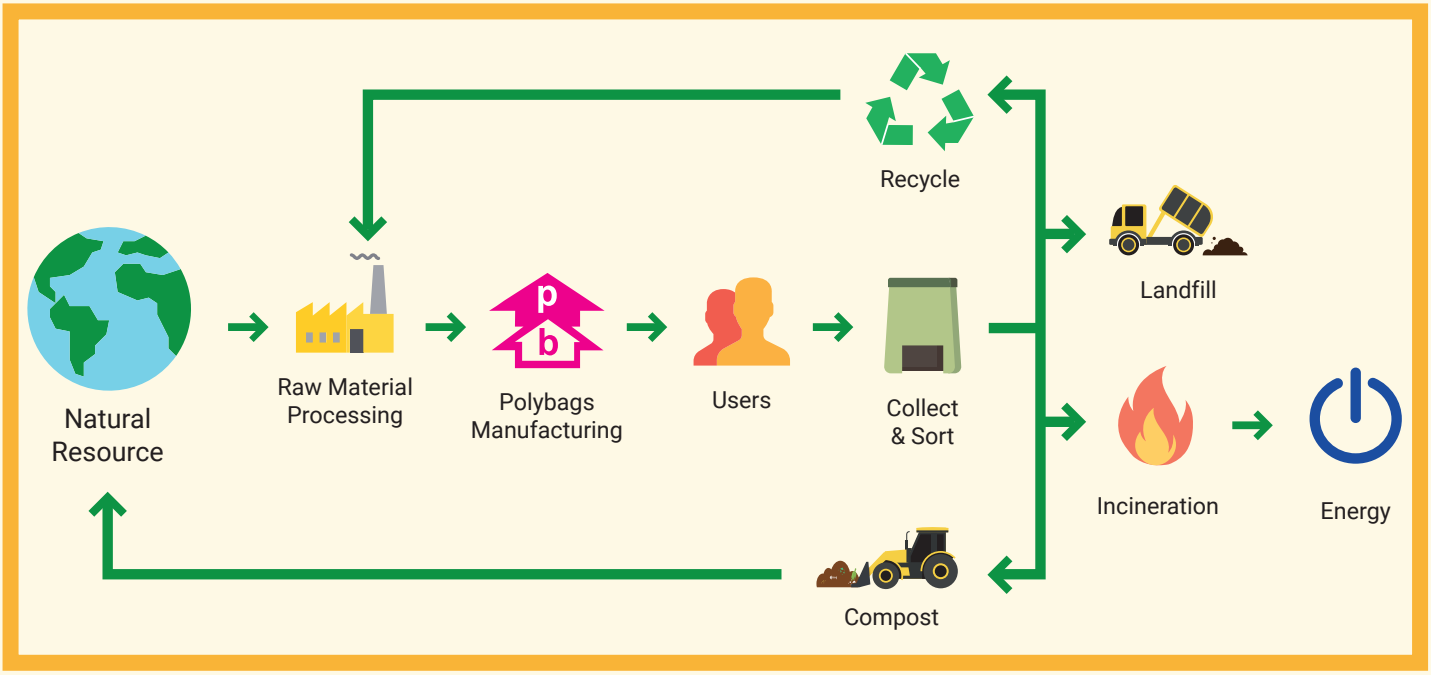
"The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource-efficient and competitive economy[5]."

The target is to ensure that, by 2025, 10 million tonnes of recycled plastics find their way into new products on the EU market. Actions by the European Commission include:

- Invest in collection, sorting and recycling infrastructure.
- Develop quality standards for sorted plastic waste and recycled plastics.
- Develop Green Public Procurement criteria on integrating recycled content.
- Improve traceability of materials to boost recycling rates & ensure clean, safe material cycles.

The UK Strategy

The UK government has set objectives for the UK to become a world leader in using resources efficiently and reducing the amount of waste created as a society. The strategy aims to minimise waste, promote resource efficiency and move towards a circular economy. *"Provisional figures for 2017 indicate that 70.2% of UK packaging waste was either recycled or recovered, which exceeds the EU target to recycle or recover at least 60% of packaging waste[6]."*



The Packaging Recovery Note (PRN) system was designed to help the UK achieve recycling targets set by the government. A PRN is a document that provides evidence waste packaging material has been recycled into a new product. PRN's are issued by accredited reprocessors (including Polybags) when they have recovered and recycled a tonne of packaging material. The system does not finance the full cost of recycling or recovery, but does provide a subsidy to incentivise reprocessors to process sufficient material to meet EU recycling targets.

5 Source: European Commission - Closing the loop - An EU action plan for the Circular Economy 2015
6 Source: Department for Environmental Food & Rural Affairs: UK Statistics on Waste 2019

What is an Eco-friendly Product ?

The environmental benefits of green / eco-friendly products are not that they somehow fix the environment or have zero impact, but rather that their environmental impacts are less than those of similar products. *Life Cycle Assessment (LCA) is a tool for the systematic evaluation of the environmental aspects of a product through all stages of its life cycle. As such, if implemented well, it can provide a valuable tool to evaluate different options at any given point in time*[7].

How to measure Environmental Impact?

Total Environmental Impact = Cost of Production + Cost of Use + Cost of Disposal

The key indicators/variables to compare include:

PRODUCTION - *What is the impact of producing?*
- Energy input, Natural resource use, Transportation, Emissions from manufacturing.

USE - *How use of the product impacts humans or the environment*
- Impact on human health, Lifespan of the product, Environmental impact of use.

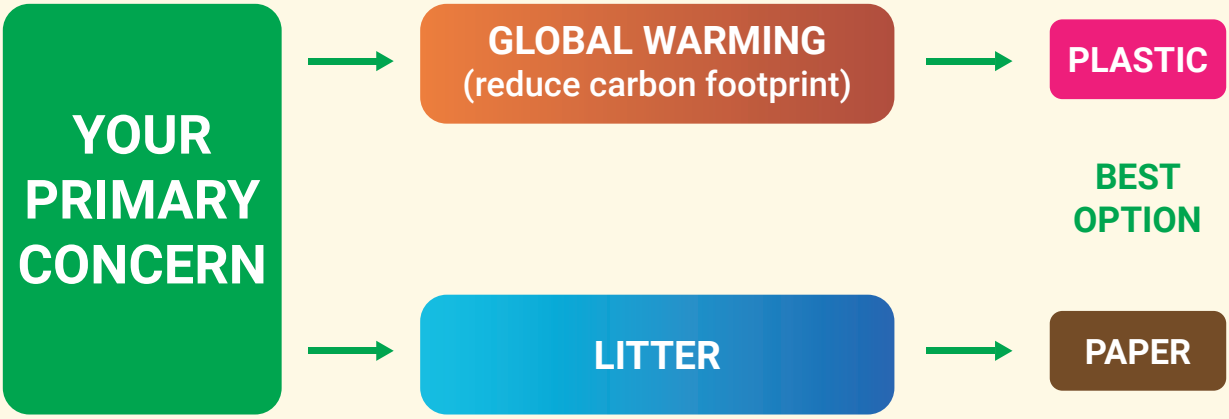
POST-USE - *How disposal of the product impacts the environment*
- Pollution of natural environment, Emissions from disposal, Cost of recycling.

According to a study, a plastic bag in eight out of nine impact categories (eg. carbon footprint, ecotoxicity, eutrophication, human toxication) has a lower impact compared to a paper equivalent. Products can have eco-friendly properties from one perspective but not from another. *"It takes more than four times as much energy to manufacture a paper bag as it does to manufacture a plastic bag and paper manufacturing process, produces a higher concentration of toxic chemicals. However, paper is more widely recyclable and decomposes much more quickly than plastic, therefore it is less likely to be a source of litter and pose a risk to wildlife*[8]*."*

The key issue with plastic bags = LITTER

The key issue with paper bags = CARBON EMISSIONS

Largely due to this discrepancy in weight, plastic "whether it is petroleum-based or plant based" almost always has a lower carbon footprint than an equivalent paper-based counterpart. As such, a lifecycle analysis based approach, in which a company chooses optimal packaging based on its carbon footprint is typically likely to preference plastic over paper.

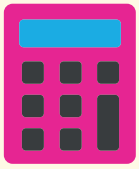


7 Source: The New Plastics Economy: Rethinking the future of plastics. World Economic Forum 2016
8 Source: Environment Agency: Report SC030148

Carbon Footprint Calculations

If you don't have the time or resources to complete a full assessment, the most common and simple comparison for environmental impact is the product's overall 'carbon footprint' which measures how much it contributes to global warming.

In 2018, UK net emissions of carbon dioxide were provisionally estimated to be 364.1 million tonnes (Mt). Carbon dioxide (CO2) is the main greenhouse gas, accounting for 81 per cent of total UK greenhouse gas emissions[9].



Calculations used by Polybags have been gathered from various published sources including ***Universities, UK Environment Agency, Carbon Trust and European Environment Agency*** *reports.*

Polythene

The rule of thumb is that half the fossil fuel goes into the plastic itself, while the remaining half is combusted to provide the energy during manufacture. Thus, it takes about 2kg of fossil fuel to produce 1kg of plastics. Since petroleum holds in average 43MJ/kg, it takes approximately 86MJ to produce 1kg of plastics, and, with about 3 hydrogen atoms for every carbon atom in the fuel consumed in production (molar mass of 15 grams per mole), the CO2 emission (with molar mass of 44 grams per mole) is 44/15 = 2.9kg of CO2 for every kg of plastics produced[10]. One tonne of conventional polyethylene results in approximately 2.6 tonnes of carbon emissions[11].

Paper

The production of 1 metric ton of paper requires approximately 17 trees, consumes 51,500 MJ of energy, 25m3 of water, 680 gallons (2.57m3) of oil and generates 6.9 tonnes of CO2[12].

Transportation

The choice of transportation severely influences the amount of CO2 related to a product. In 2018 in the UK, an estimated 33% of carbon dioxide (CO2) emissions were from the transport sector, 27% from energy supply, 18% from business and 18% from the residential sector[13]. *The following shows the amount of CO2 (in grams) emitted per metric ton of freight and per km of transportation*[14].

Method of Transport	CO2 (in grams) emitted per metric tonne of freight and per km of transportation
Air Cargo B747	500g
Modern lorry or truck	60g to 150g
Modern train	30g to 100g
Modern ship (sea freight)	10g to 40g

9 Source: 2018 UK Greenhouse Gas Emissions, Department for Business, Energy & Industrial Strategy
10 Source: Dartmouth University - Materials: Benoit Cushman-Roisin
11 Source: https://www.carbontrust.com
12 Source: Dartmouth University - Trees: Benoit Cushman-Roisin
13 Source: 2018 UK Greenhouse Gas Emissions, Department for Business, Energy & Industrial Strategy
14 Source: European Environment Agency: CO2 emissions from transport

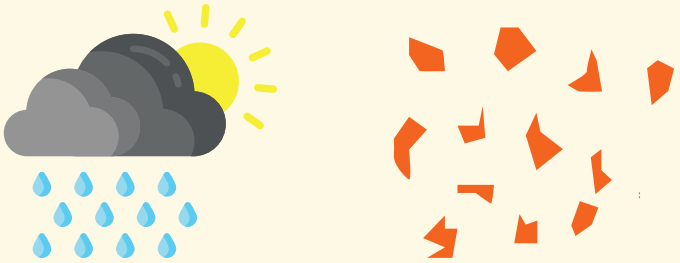
What does biodegradable really mean?

Degradable materials do not require living organisms to break down. Instead, chemical additives are used to make it crumble / fragment into smaller pieces more quickly than traditional plastic when exposed to the natural elements (sunlight, air & water).

Biodegradable simply means the breakdown of organic matter by micro-organisms, such as bacteria and fungi[15] over time into elements that are found in nature, such as CO2, water and biomass, which is true for most materials on the planet.

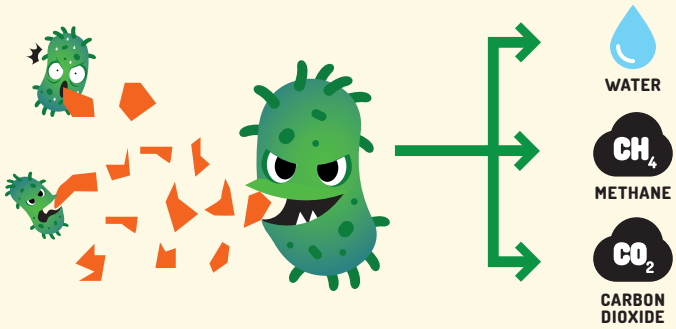
DEGREE OF MATERIAL BREAKDOWN

DEGRADATION



Degradation happens with exposure to natural elements

BIODEGRADATION



Biodegradation needs micro-organisms

Biodegradable material is simply food for micro-organsims

"The degree to which 'biodegradable' packaging actually biodegrades in the natural environment is subject to intense debate. In most cases it is the temperature and microbial activity which determines the rate and level of (bio)degradation[16]."

Biodegradable products are not an easy fix for our environmental litter issues. Products must be tested in the intended 'end of life economy environment', not the 'leaked natural environment'. If biodegradable packaging ends up as litter on land or in water, it can be just as destructive and harmful as conventional packaging and may only fragment over time by exposure to sunlight and air.

Green Alliance are concerned about evidence that *'people are more likely to discard material described as 'biodegradable' in the environment, which would make pollution on land and at sea even worse[17].'*

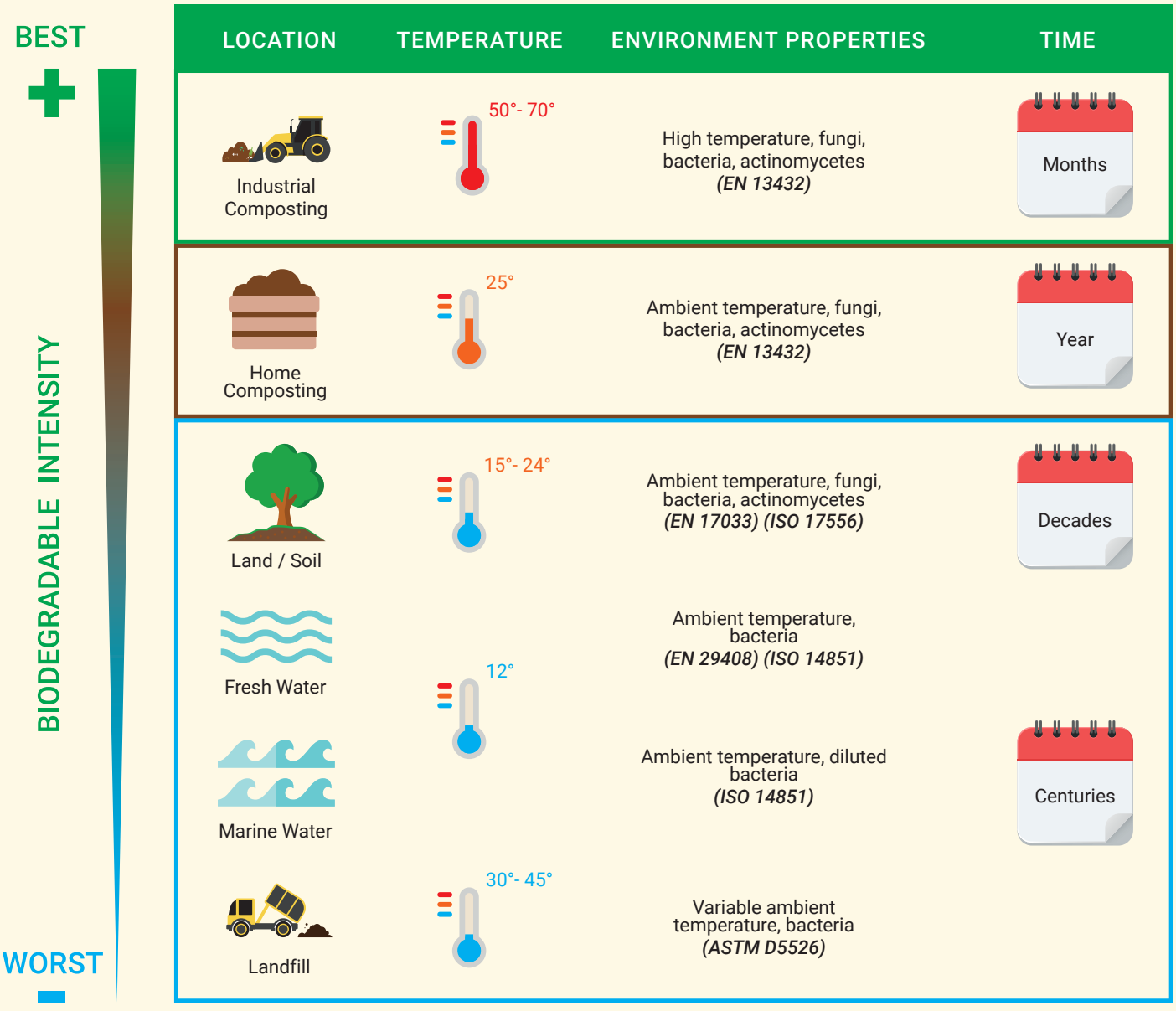
15 Source: https://en.wikipedia.org/wiki/Biodegradation
16 Source: Biodegradable Plastics and Marine Litter. Misconceptions, concerns and impacts on marine environments. United Nations Environment Programme (UNEP 2015)
17 Source: Green Alliance Trust

Limitations of using the word biodegradable

As pointed out by European Bioplastics, "'biodegradable" by itself is not more informative than the adjective "tasty" used to advertise food products[18]. The current use of the term 'biodegradable' does not contain any information on[19]:

- Location of the 'end of life' environment.
- Timescale.
- Temperature & environmental properties.
- Extent of the decomposition process.

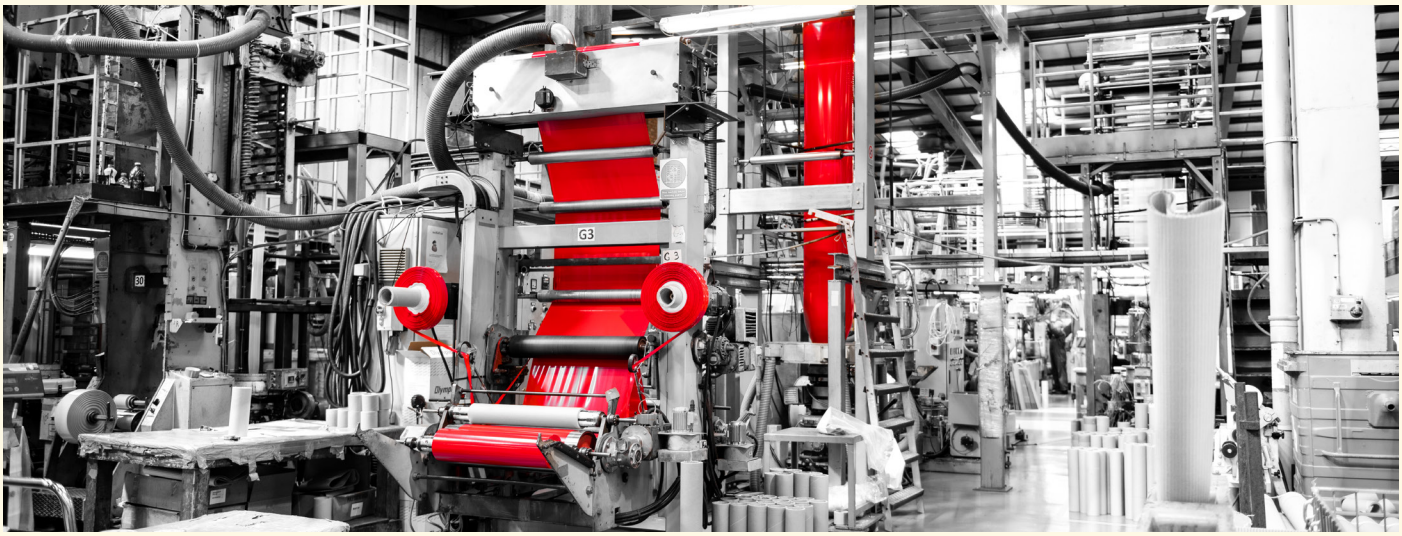
In terms of location, composting is considered as the most aggressive environment (but only under the right conditions), while landfill is considered as the least aggressive environment.



'Composting' is enhanced biodegradation under managed conditions, predominantly characterised by forced aeration and natural heat production resulting from the biological activity taking place inside the material. Sarah Greenwood, University of Sheffield, has quoted "there is a perception with compostable packaging that it turns into compost, but it does not. It turns into carbon dioxide, water or methane with a tiny amount of biomass left behind[20]."

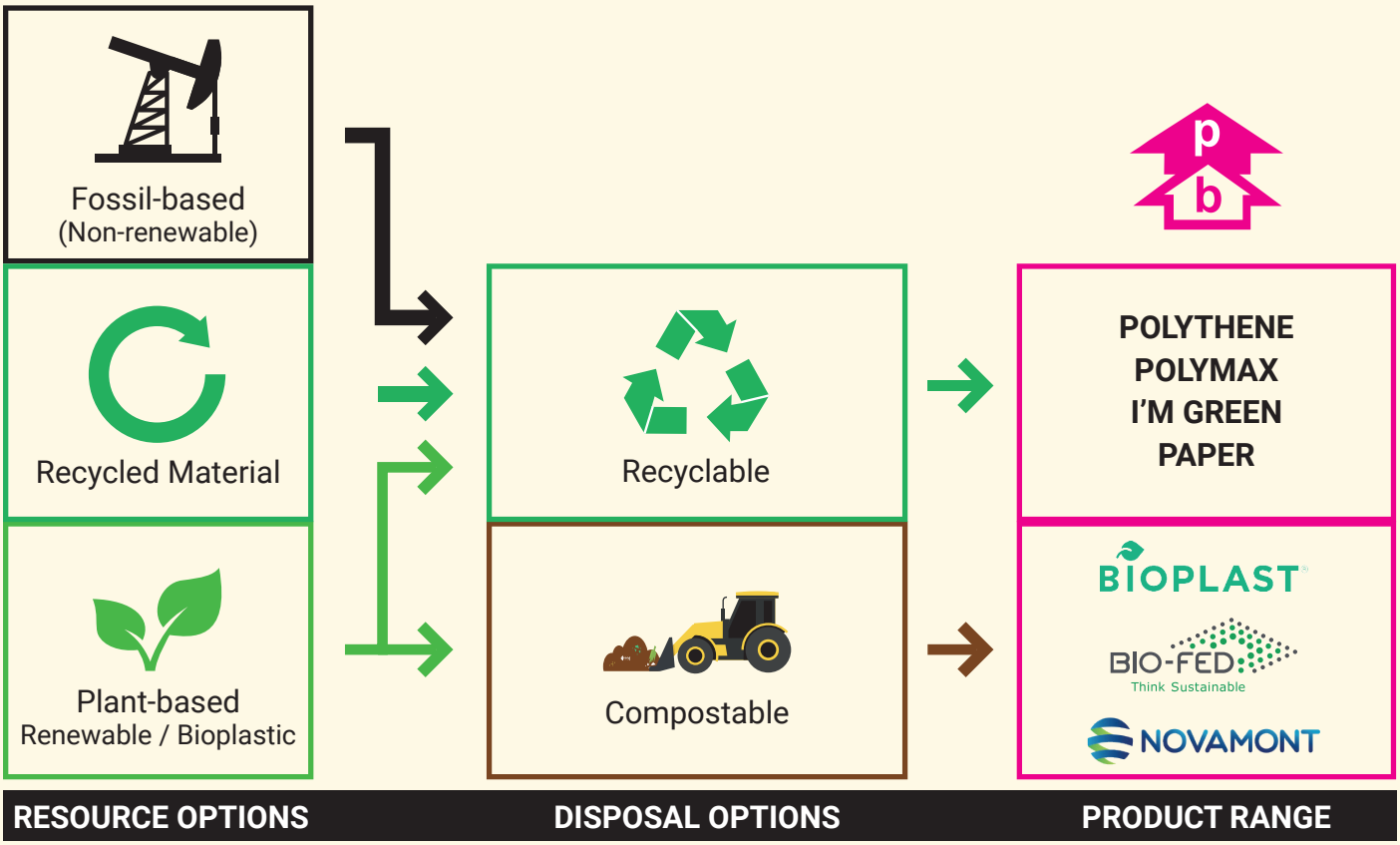
18 World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, The New Plastics Economy — Rethinking the future of plastics
19 Source: Biodegradability standards, Royal Society Open Science 2018
20 Source: Sarah Greenwood, University of Sheffield

Polybags – Resource Efficient Packaging



Polybags have a wide range of products that enable customers to protect and transport their goods efficiently. Our commitment to working towards a 'Circular Economy' for flexible packaging is ongoing and evolving as advances in technology create new eco-friendly / sustainable opportunities. We firmly believe that production can be done in a socially responsible way and are actively promoting recycling and composting of our packaging in both the UK and Europe.

We are constantly developing renewable source blends that have been designed around a 100% recycling principle of either being mechanical or biologically recycled (Composting). Products can be defined by 'Raw Material Resource' and 'Disposal Option' which then correspond with our portfolio of brands and product ranges.



Internally we operate a 100% Recycling Target

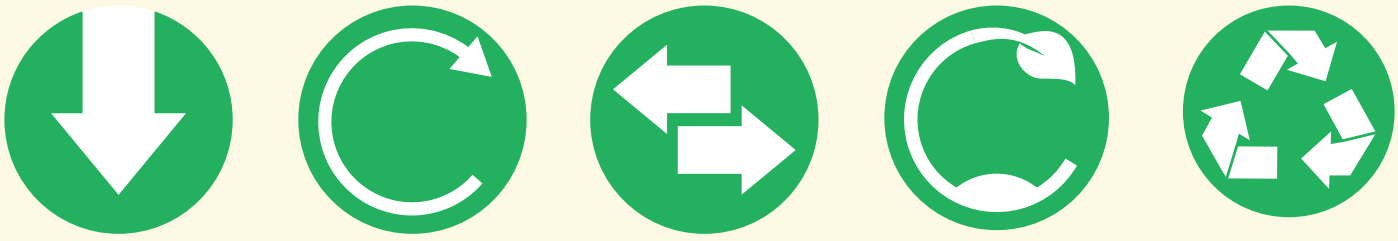
We have invested in state of the art in-house recycling technology to further reduce the environmental impact caused by collection and transportation of recyclable material. In reality we reuse nearly all of our waste plastic products and are able to recycle with minimal energy output. This means that wherever recycling plastic waste is more energy efficient than disposal we will recycle. Polybags also encourage the recycling of post-industrial and post-consumer materials and introduce them into our manufacturing processes where possible.

Helping to make an informed choice

Polybags is constantly improving product information, labelling and guidance for disposal options with the guiding principle of our materials are either reusable, recyclable or compostable. We are currently developing a Carbon Footprint Calculation guide for all our products based on published calculations. Categorisation includes:

1. **Raw material information.** (Highlighting Recycled & Plant-Based content)
2. **Carbon foot-print calculations.** (Benchmarked against traditional polythene)
3. **Optimal disposal.** (Recycle or Compost)

Polybags can help you optimise your packaging consumption and minimise your environmental impact by applying the following 5-Rs principle:



REDUCE

Reduce consumption without affecting functionality through modern lightweight material blends

RE-USE

Whenever possible reuse or have a secondary use

REPLACE

With eco-responsible alternatives rather than fossil fuel based resources.

RENEW

Use renewable plant-based packaging manufactured from natural materials

RECYCLE

Encourage recycling to give packaging a second lease of life and minimise landfill waste

Get in contact with the sales team to discuss in more detail on *0345 200 2828*.

Portfolio	DESCRIPTION	FOSSIL BASED		
		POLYETHYLENE	POLYMAX	OXO-DEGRADABLE
PRODUCTION IMPACT	RENEWABLE SOURCE	✖	✖	✖
	CARBON FOOTPRINT	👣	👣	👣
	WATER USAGE	💧	💧	💧
	ENERGY USAGE	⏻	⏻	⏻
	LAND USAGE	🌱	🌱	🌱
	TRANSPORTATION COST	£🚚	£🚚	£🚚
	COST	£	££	££
USE	FOOD SAFE	🍴	🍴	🍴
	SHELF LIFE	+10 YEARS	+10 YEARS	1 YEAR
DISPOSAL	OPTIMUM DISPOSAL	♻ RECYCLE	♻ RECYCLE	COMPOST
BRANDS		TOTAL, sabic, DOW	TOTAL Metallocene	d2w, epi
INFORMATION		LDPE, MDPE, HDPE	Extra Strong, Lightweight, Reduces transport costs	Not a solution for ocean / marine litter
BEST USED		When flexibilty & moisture resistance are needed to protect contents		Carrier Bags

RECYCLED	PLANT BASED RECYCLABLE		PLANT BASE COMPOSTABLE
	GREEN POLYTHENE	PAPER	
✗	✓	✓	✓
👣	👣	👣👣👣	👣
💧	💧💧💧	💧💧💧	💧💧💧
⏻	⏻⏻	⏻⏻	⏻⏻
🌱	🌱🌱🌱	🌱🌱🌱	🌱🌱🌱
£	£	£	£
£	£ £ £	£ £ £	£ £ £
✗	🍴	🍴	🍴
+10 YEARS	+10 YEARS	+10 YEAR	1 YEAR
RECYCLE	RECYCLE	RECYCLE	COMPOST
pb	Braskem	mondi	BIOPLAST BIO-FED Think Sustainable NOVAMONT
Clarity reduces as recycled content increases	CO2 is absorbed during the growing process	Easily recylced in UK	Not a solution for ocean / marine litter. Best when contents remain after use. CO2 is absorbed during the growing process
Mailing Bags Clothing Bags Carrier Bags Waste Bags	Looks & feels like traditional polythene	Carrier Bags Mailing Bags	Confectionary bags, fruit & vegetable bags, carrier bags with second use of food waste caddy liner, biowaste bags

Disposal / End of Life Options

It is largely the responsibility / actions of the consumer which decides how packaging is ultimately disposed of. The bin chosen really matters.

Each type of alternative packaging normally has an optimal disposal route, but it might not be the actual route that is available at the time of disposal. Therefore, gaining insights on available disposal routes for the end user will ensure that you evaluate the most appropriate packaging solution.

The packaging waste that is most difficult to recycle is the material collected from households. Households generate relatively small quantities of a huge number of different types of material, and the quality of the material collected is variable. Average dustbin contents by weight[21]:

- Paper and board (newsprint, magazines, mail, tissues) 23%
- Packaging (glass & plastic bottles, metal cans, plastic film, paper wrapping, boxes) 25%
- Kitchen and garden waste 32%
- Other (shoes, plant pots, drinking glasses, coat hangers, furnishings, DIY waste) 20%

'Recycling and other recovery' was the most common final waste treatment type in the UK, accounting for 104 million tonnes (48.5%) in 2016. Landfill is second with 24.4% (52.3 million tonnes) of waste disposed of at landfill in 2016[22].

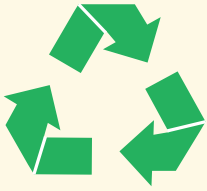
While some are best disposed of through composting, others are better recycled, but there is not necessarily a perfect solution. For example, is it more sensible to use a plant-based renewable plastic that fits into existing infrastructure than to switch to biodegradable options where composting infrastructure is unavailable?

21 Source: www.incpen.org/facts-about-packaging/
22 Source: UK Statistics on Waste March 2019 - DEFRA

Current UK Disposal Options

Landfill

Compost



Recycle

Incineration

Landfill

No packaging should be put into landfill. Currently 22% of all plastic in the UK still goes into landfill[23]. Landfills are not designed to promote biodegradation. Biodegradable or compostable materials do not properly break down in landfill, thus a biodegradable product will probably sit there just as long as other packaging. Biodegradable materials need an environment rich in oxygen to break down properly. Without this, they break down anaerobically by microbes into methane, which is one of the most harmful greenhouse gases in our atmosphere.

Compost

The composting process produces a nutrient-rich fertiliser which reduces the need for chemical fertilizers on future crops. In order for compostable packaging to compost, it ideally needs to go through a commercial composting process, usually for a minimum of 12 weeks. The slight downside is that aerobic processes produce CO2 as a waste product. Nevertheless, composting is a highly desirable clean source recycling alternative to landfill. Strictly in terms of energy efficiency, you're not gaining or saving energy by composting, but you're offsetting the energy needed to convert new plant based materials into new packaging.

Recycle

Recyclable products help reduce the need for new raw materials and the amount of waste sent to landfills and incinerators. From an energy perspective, recycling probably wins against composting. Paper products should always be recycled first before composting (assuming they are clean and dry). This gives them another 'go' around the system. According to recent research, One tonne of recycled paper saves 4,100 Kwh of energy, 9 barrels of oil, 54 million BTUs of energy, 27kgs of air pollutants from being released, 31,800 litres of water, 6.8 cubic metres of landfill space and 17 trees. One ton of recycled plastic saves 5,774 Kwh of energy, 16.3 barrels of oil, 98 million BTUs of energy, 22.9 cubic metres of landfill space, and 1.4 tonnes of CO2[24].

Incineration

Currently, the only alternative when recycling or composting is not an option, that does not involve landfill, is incineration. The calorific value of plastic packaging is significantly higher than coal, which makes a highly-efficient source of energy recovery by generating electricity. However, the UK lags behind other European countries in embracing this technology. In 2012, Sweden's energy from waste plants produced heat for 810,000 households and electricity for 250,000 houses[25]. There is hope that, in the future, chemical recycling techniques will be able to reduce the need for incineration, but this technology is very much in its infancy, and thus unable to play a serious part in any short-term waste strategy[26].

23 Source: Conversion Report: Post-consumer Plastic Waste Management in European Countries (2016)
24 Source: Department of Energy Resources Engineering: Stanford University
25 Source: The Swedish Recycling Revolution
26 Source: UK Waste Strategy: DEFRA 2018

Material Options - Which is best?

- There is no unique magic material when it comes to sustainable packaging.
- There is also no perfect way to measure the sustainability of a material.
- There isn't a single "best" material for all products – just appropriate ones for a quantity of a particular product in a particular application.

Traditional Plastic - Studies agree that plastic bags are by far the least costly (i.e. carry the smallest ecological footprint) to produce[27]. Still, there is no way around the fact that plastic is derived from petroleum. Petroleum is a finite resource and, as it becomes increasingly limited, obtaining it becomes increasingly damaging to the environment.

Plant-based Plastic - Polymers derived from renewable resources offer the opportunity to benefit society and the environment by reducing demands on fossil resources. Sugars, oils and other compounds in renewable feed-stocks can be converted into chemicals and polymers using conversion processes similar to those employed by the petrochemical industry. Currently, it is a tiny percent of the overall plastics market, but is growing rapidly. *Plant-based plastics are a promising segment, but viability at scale still needs to be proven*[28].

Paper - Best when functional benefits of plastic aren't needed (flexibility, moisture resistance). Paper packaging typically has a higher carbon footprint than plastic. According to a UK Environment Agency report, it takes at least three reuses of a paper bag to neutralize its environmental impact, relative to a plastic bag[29].

Recycled content - Since there are only limited opportunities to use recycled plastics in food packaging. The most promising markets for them are in non-food packaging, and when slight quality degradation of recycled plastic is acceptable. The use of recycled plastics in packaging can add significantly to the cost. For example, using recycled plastics as the middle layer of a co-extrusion 'sandwich' in non-food contact packs can cost 50% more than virgin polymer. For paper and some plastics, more material may be needed to produce the same strength than if virgin material was used. The resultant weight increase may sometimes more than cancel out any environmental gain from using the recycled material[30].

Disposal Options - Which is best?

Compost - Best when contents remain in packaging after use eg food packaging that is likely to be coated in food at the time it is discarded. Avoid when not packaging food or organic materials, and when users don't have access to industrial composting. Remember compostable products don't biodegrade in landfill, the ocean or as litter. A plastic bag will still look like a jellyfish to a sea turtle, whether it's certified biodegradable or not – and biodegradable does not mean digestible.

27 Source: The Environment Agency Report SC030148
28 Source: The New Plastics Economy: Rethinking the future of plastics. World Economic Forum
29 Source: The Environment Agency 2011
30 Source: www.incpen.org/packaging-from-recycled-materials/

Recycle - Best for packaging formats that require long-term resistance to moisture and air permeability and have high rates of recycling. All things equal recycling is preferred over composting for end of life. The process of recycling has its own environmental burden in using energy, materials and water to collect, sort and clean. Physical and chemical contamination may also preclude cost-effective recycling, since it needs cleaning processes which are economically and environmentally costly.

Litter

Plant-based materials are not the solution to our ocean / marine pollution crisis. Ultimately consumers need to understand how to optimally dispose of packaging, where it can be reused or recycled through constantly improving waste management systems and creating stronger markets for recycled plastic. Currently the 'Circular Economy' process in the UK is still in the development stage. Systems and technology must evolve to embrace this ideology in which packaging never becomes a waste product. Where packaging is essential, as a society we must ensure that it is kept within a circular economy and does not leak into the natural environment.

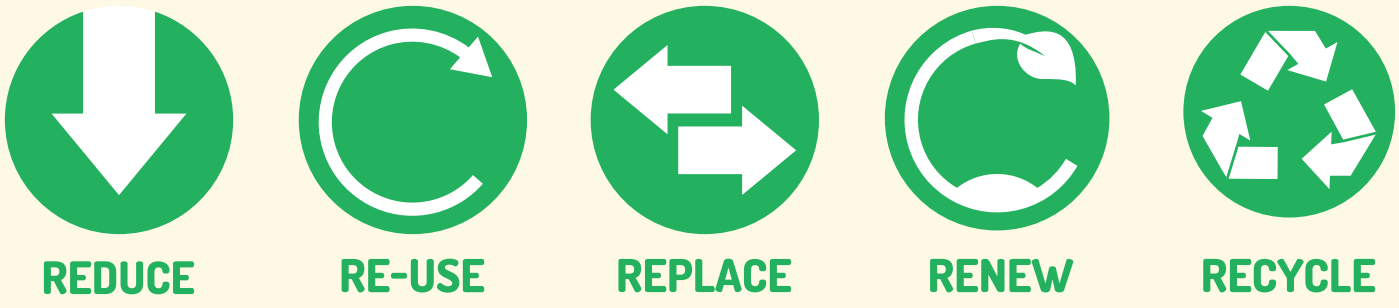
To quote Anne-Marie Bonneau, "we don't need a handful of people doing zero-waste perfectly. We need millions of people doing it imperfectly."

Conclusion - Which is the best?

It's a question that is virtually impossible to answer! Which bag is the most "sustainable"? It really depends on how many times it is used, especially with plastic, and how carefully it is disposed of.

Overall, it is about better end-of-life recovery and about minimising energy use, so probably the smartest choice is simply choosing the type of bag you're most likely to reuse the most, or one that has a secondary-use application such as a waste bin liner.

Polybags can help you optimise your packaging consumption and minimise your environmental impact by applying the following 5-Rs principle:



Our website is a useful reference for best-practice options based on current scientific research papers.

Hopefully the information and guidance provided by Polybags can help guide you to find the optimal and most eco-friendly packaging solution based on your own unique circumstances.

More info on the website

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