Considerations for packaging classification

Internal paper prepared for the Technical Working Groups of the CAP-SEA project in partner countries

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Contents

List of Figures . . . 4
List of Tables . . . 4
List of Abbreviations . . . 4

Executive Summary . . . 5

Background . . . 7

1 The Function . . . 8
2 The Supply Chain . . . 10
3 The Material . . . 12
4 The Reuse . . . 14

Guiding Questions . . . 16

Bibliography . . . 22

List of Figures

Figure 1:	Maximizing the utility while minimize the environmental footprint	7
Figure 2:	Packaging functions	8
Figure 3:	Producer, supplier and consumer perspective to packaging	9
Figure 4:	Packaging waste along the supply chain until use	10
Figure 5:	Sectoral shares of 'to go'-waste for Germany, 2017	11
Figure 6:	Advantages and disadvantages of packaging material types	13
Figure 7:	Prevalence of different plastic polymer types in Germany	22

List of Tables

Table 1:	Main plastic polymer (resin) types, their application in packaging (uses), characteristics, world market share and environmental performance	15

List of Abbreviations

BMU	German Federal Ministry for the Environment
CAP SEA	Collaborative Action for Single-Use Plastic Prevention in Southeast Asia
DRS	Deposit Return Scheme
EPR	Extended Producer Responsibility
(E)PS	(Expanded) PolySterene
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HD-/LD-PE	High Density / Low Density PolyEthylene
PET	PolyETylene
PP	Polypropylene
PVC	PolyVinylChloride

About the Export Initiative for Green Technologies

The GIZ global project **"Support of the Export Initiative for Green Technologies"** contributes to solving key environmental problems on behalf of the German Federal Ministry for the Environment (BMU). The **BMU Export Initiative** aims to export know-how available in Germany and support sustainable development worldwide. It includes topics such as poor waste management, air and water pollution or supporting infrastructures for sustainable urban development. Partner countries are Egypt, Jordan, India, Thailand, Malaysia, Indonesia and Ukraine. Project measures focus on building up technical and institutional know-how as well as laying the groundwork for the introduction and use of environmental and climate protection technologies "Made in Germany".

The project component CAP SEA, which stands for Collaborative Action for Single-Use Plastic Prevention in Southeast Asia, focusses on the prevention of single-use plastic (SUP) and reusable packaging systems in Thailand, Malaysia, and Indonesia. For more information on CAP SEA project activities, please download the factsheet **here**.

Executive Summary

Packaging has **important functions**, ranging from product transport and storage to consumer information. At the same time, packaging waste has become a **global environmental problem**. A classification of packaging helps in understanding the demand, the problem and possible solutions.

We propose to analyse (1) the function, (2) the supply chain, (3) the material and (4) the possibilities for reuse.

The Function

The function is the reason why packaging is needed in the first place. Packaging is needed for

- **marketing** and for providing **information** (consumer or primary packaging).
- for the **hygienic and safe product transport, storage** and **conservation**. Secondary packaging is used for the transport of small volumes, while industrial (tertiary) packaging is used for large volumes.

The aim to reduce packaging waste, must be accompanied by an identification of alternatives with the same or similar function(s) and lower environmental impact.

The Supply Chain

Packaging waste is generated at different stages of the supply chain, by **industry** (large, similar quantities) and by **households** (smaller quantities, diverse mixture). With the growing **e-commerce**, industrial waste streams have reached households and need to be considered.

Another growing category of waste is the **'to-go'-service packaging**, like food trays, bakery bags and coffee cups. To-go packaging turns into waste at different locations, being disposed into public waste bins, at home or, in the worst case, into the environment as littler.

While planning policy interventions, it is important to identify those parts of the supply chain where maximum impact in terms of resource conservation can be achieved.

The material

Taking more sustainable packaging decisions requires awareness about material options and their environmental implications.

The most common packaging materials are **glass, metal, plastic, cardboard, paper** and other renewable materials like **cotton** or **bamboo**.

Plastic is the most diverse packaging material in terms of types and compositions. The recycling rate of plastic packaging is far below its potential and a large share of it is downcycled to a lower quality and functionality. Bio-based plastics and biodegradable plastics are **not** suitable alternatives for fossil-based plastics. What is important is the actual **recyclability** and **reuse**.

The reuse

The environmental performance of a packaging type strongly depends on the **number of reuses** and the **quality of its recycling**. A reused glass bottle is preferable to a single-use glass bottle. However, reusable packaging may be more resource intensive in its production (more elaborate and thicker), requiring a certain number of reuses until it evinces a better environmental performance than the single-use alternative (e.g. a reusable cotton bag versus a single-use polythene-bag). Non-branded **standardized containers** for reuse, embedded in a **deposit return scheme**, are a good option to guarantee many reuses and to prevent early downcycling, incineration or littering of packaging materials. Thus, please weigh and define the options carefully and ask: under which circumstances reusable options will yield expected environmental benefits?

In conclusion, legislative measures and standards, aiming at the reduction of packaging, will be more effective if they consider the function, the supply chain, the material options and the potential for reuse of the various packaging types.

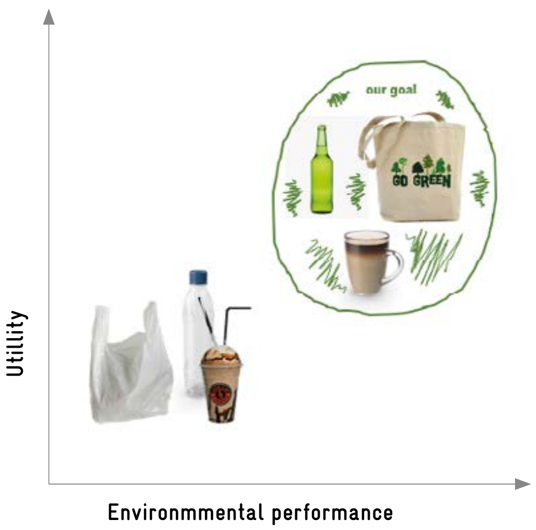
Background

Globally, packaging waste has increasingly become an environmental problem. The problem is the large volume, the high resource intensity in production, the low recycling and recovery rates and the extent of litter caused by packaging.

But packaging is, of course, not meant to be a 'waste'. In the first place, it has important functions and is very useful e.g. for product transport, storage and for consumer information. Primarily, packaging is made up of valuable resources and does not have to reach its end-of life after a single use.

So, how can we keep the positive aspects (utility) while solving the packaging waste problem? How to maximize utility and material efficiency, while decreasing the environmental footprint of packaging, as illustrated in Figure 1.

Figure 1: Maximizing the utility while minimize the environmental footprint



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Many countries have started implementing strategies to counter the packaging waste problem. They are developing new legislative instruments and standards for supporting a transition towards a reduction and proper management of waste. In this paper, a few aspects for an appropriate packaging classification are described with the aim to support the national implementing partners of the project "Collaborative Action for Single-Use Plastic Prevention in Southeast Asia (CAP-SEA)" in defining the scope and entry points for interventions targeting packaging waste prevention, with an emphasis on plastic packaging. There are several perspectives that need to be kept in mind when it comes to defining entry points towards the implementation of measures for greater utility and less packaging waste:

- The function: what is the exact demand or requirement?
- The supply chain: who uses it? Where does the resource typically turn into waste? How is this waste treated typically?
- The material: what is it made of?
- The possibility for reuse: single-use vs reusable packaging.

1 The Function

The function is the reason why we need packaging in the first place. The main functions are:

1. **Marketing** and providing information (consumer packaging also called primary packaging)
2. **Hygienic transport, storage and conservation** (also primary packaging e.g. for food and beverages)
3. Safe delivery during transport for
   a) small volumes (secondary packaging: holding several individual product units; outer packaging for improved handling)
   b) large volumes (e.g. industrial packaging, also called tertiary packaging) or

Figure 2: Packaging functions

Source: Öko-Institut e.V., CC-BY 3.0

For producers and suppliers, packaging typically needs to be lightweight, inexpensive and preserve or increase the value of their products. Consumers appreciate convenience in identifying, carrying and storing the acquired products until these are used up or consumed.

The attempt to prevent a specific kind of packaging waste should thus be accompanied by the commitment to find alternatives with the same or similar function(s) and lower environmental impact.

Figure 3: Producer, supplier and consumer perspective to packaging

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For example: plastic bottles are popular beverage containers. They are lightweight, hygienic, the content is generally visible, they do no break and often go into the trash bin. However, many plastic beverage bottles are not reused or recycled, and end up as littler in the environment, in landfills or are burnt for energy recovery. Reusable glass or thick-walled plastic bottles fulfil many of the same functions and may be an environmental friendlier alternative, but only if they are indeed reused several times and if transport distances (reverse logistics) are short. Alternatively, a deposit and return system for reusable plastic bottles and a closed-loop recycling system for bottle-to-bottle recycling can reduce the plastic bottle waste, without compromising consumer comfort.

2 The Supply Chain

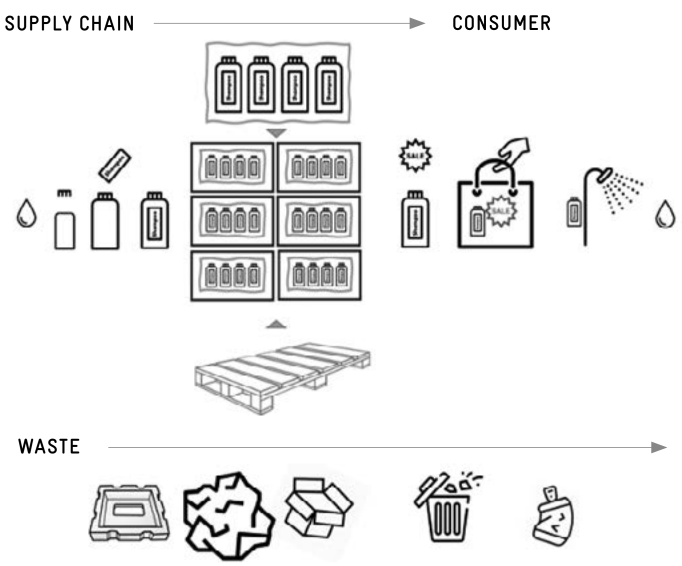
According to their function, packaging waste occurs at different points of the production chain as well as right before, during or after consumption, as illustrated in Figure 4.

We may differentiate between industrial packaging and household packaging, since the waste streams are fundamentally different: **industrial packaging** often generates large amounts of similar, uncontaminated waste like plastic foils, wooden pallets and cardboard boxes. Reuse, sorting, collection and recycling is always easier when handling the same type of material.

By contrast, **household packaging** is complex, mixed and often designed for single use. Diverse plastic materials often end up mixed with food waste, paper and metal. Since mixed waste is very hard to separate, source segregation of dry waste from wet organic waste and hygiene waste is key for an efficient resource recovery.

Due to the growing volume of e-commerce, new waste streams have reached households: large carboard boxes, plastic wrapping and filling material. These materials are similar to industrial packaging waste, constituting an opportunity to re-merge these two waste resource streams in order to achieve higher recycling rates. For instance, e-commerce packaging waste could be collected e.g. by the same or a second fleet of the existing delivery service providers.

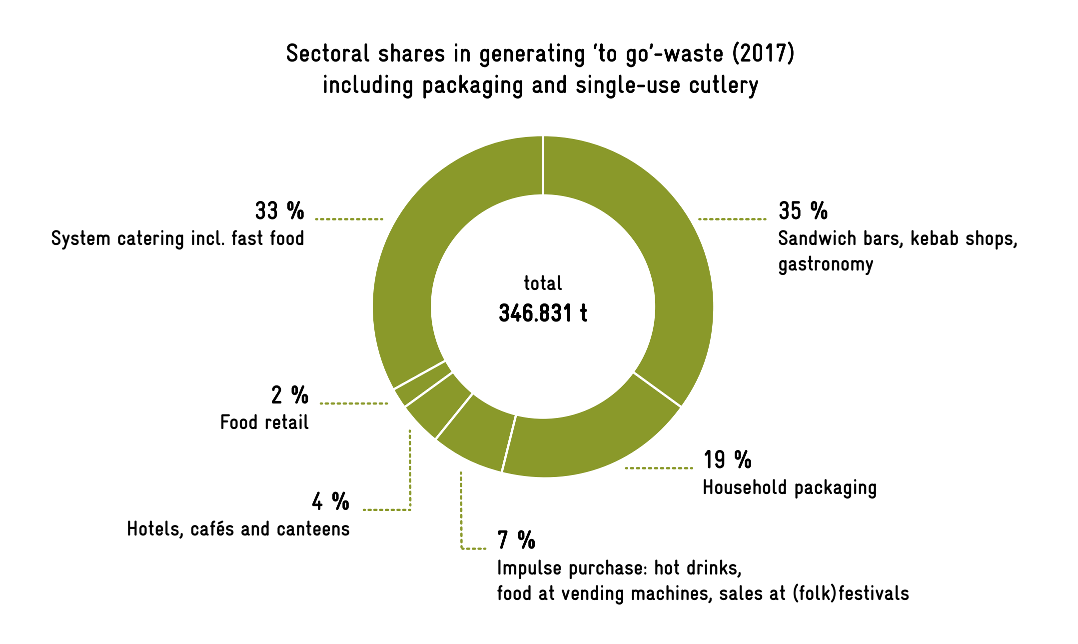
Figure 4: Packaging waste along the supply chain until use



Source: Öko-Institut e.V., CC-BY 3.0

Another challenge (and opportunity) lies with the growing volume of 'to-go'-service packaging. Examples are bakery bags, disposable snack-trays in fast-food restaurants, carrier bags or coffee-cups. In Malaysia for instance, there is a 'bunkrus' or 'ta-pau'-culture of take away food with large volumes of associated packaging waste (WWF-Malaysia 2020). In Germany, 350'000 tons of waste are generated every year by 'to-go' food and beverage-packaging (NABU 2018), see also Figure 5 on the sectoral shares of the 'to-go'-waste.

Figure 5: Sectoral shares of 'to go'-waste for Germany, 2017



Source: translated from NABU (2018)

The 'to go'-packaging turns into waste at different locations, possibly being disposed into public waste bins, household waste or, in the worst case, ending up as litter in the environment. Reusable to-go options with a deposit are a solution to keep the functionality of the packaging as well as the consumer comfort.

Consumer comfort and perception is an important driver of consumption choices. Material variety is part of marketing, but many different packaging materials fulfill the same function. We thus may question whether the material diversity and complexity is necessary (a real function or demand)? A large product differentiation may be reached by a few material types in different forms and sizes. An ecofriendly design (*Design-for-Recycling*) will help in avoiding unnecessary waste. 'Keeping it simple' in terms of recyclable material types are fundamental principles towards a better resource management.

Once the waste has been generated, waste segregation is key to recovering resources. A possible element to stimulate better packaging resource management are (material) **recycling targets** for different packaging types. Recycling targets ask for a certain share of the total amount of a material placed on the market to be recycled. Another option is to set shares for recycled input material for particular goods, packaging or product components, also referred to as **recycled content targets**. Further information on Design-for-Recycling and Recycled Content can be found in the respective two pre-studies prepared by the Oeko-Institute.

Take-away questions: Think about at what stage of the supply chain a particular type of waste is being generated. How can the waste be avoided? What are the challenges and concrete entry points for reuse and a better recovery of the different packaging material types?

3 The Material

Speaking of material types, we have reached another central puzzle piece of the packaging challenge. Taking more sustainable packaging decisions requires awareness about material options and their environmental implications. The most common packaging material categories are glass, metal, plastic, cardboard and paper as well as other renewable materials like cotton or bamboo.

Each of the material has advantages and disadvantages, as listed in Table 1.

Example: a bakery may sell their products in paper bags (lightweight, environmentally friendly appearance) with an integrated plastic foil `window` for visibility (for the consumer and the cashier to recognize and account for the contents). As mentioned above, composite (tightly combined) materials are difficult to recycle but may be necessary to ensure a specific function or demand. Efficient recycling depends on clean, single (=mono) materials or choosing easily recyclable material combinations in order to preserve the original utility of the material and to avoid the loss of quality and functionality (downcycling).

Plastic is the most diverse packaging material in terms of types and compositions. Annex 1 displays an overview of the different basic plastic types, their symbol, their use and environmental performance. As you may have noticed when inspecting a plastic packaging item, there are numbered symbols (1-7) e.g. on the bottom of a water bottle or printed on a plastic wrap. The numbers refer to the so-called Resin Identification Code (RIC) system, helping to differentiate the main plastic polymer types. Today, globally, many plastic products evince this polymer code, with the aim to facilitate the recycling of post-consumer plastics. While the prevalence may differ between countries and regions, Annex 2 exemplarily summarizes the share of different plastic (polymer) types for Germany (2017).

Figure 6: Advantages and disadvantages of packaging material types

	+	–
Glass	Stable, hygienic, good recyclability	Heavy weight, requires careful handling
Metal	Strong, lightweight (aluminum, tin, steel), food-safe: long shelf-life, good recycla-bility	Raw materials sourced through mining, it can rust, not-transparent containers (contents invisible)
Plastics	High diversity of materials and compounds: different durability, shapes, colors, hard-ness. Especially mono-materials like PET bottles evince a high recyclability.	Raw material: mostly fossil fuels; diver-sity of compounds (poly-material plastics like laminates and food 'to-go'-packaging are difficult to recycle)
Paper / Cardboard	Lightweight, hygienic, reusable, sturdy, flexible, renewable material source, certification options, high recycling rate globally	Poor performance in waterproofing, not suitable for heavy products, may get deformed
Other renewable resources	Lightweight, biodegradable, hygienic, reus-abel, sturdy, flexible, renewable material source, certification options	Cultivation in monocultures may imply large environmental footprint, which also depends on the times of reuse.

Source: Öko-Institut e.V., CC-BY 3.0

Talking about sustainability and material choices, many companies currently advertise bio-based or bio-degradable plastics as an environmentally friendly alternative to fossil-based plastics. This claim cannot be substantiated. The environmental impact does not improve significantly if the raw materials are bio-based instead of fossil-based. The impacts rather shift: While conventional fossil-based plastics release more climate-impacting CO_2, bio-based plastics cause acidification, eutrophication and take away valuable land and food (e.g. maize or sugarcane) resources. Biodegradable packaging options mostly do not degrade fast enough in home composts, or under ambient conditions in the environment. Depending on the conditions, full decomposition might take several years or even decades. In recycling processes, biodegradable polymers are incompatible with many other polymers and can have a significantly detrimental effect on fossil-based plastics recycling efforts. Biodegradable bags do make sense, though, if they are used to collect organic waste to boost source separation of wet waste.

Back from plastics to the full range of packaging materials, it is also the reuse potential that is decisive for the environmental performance of the different packaging types.

4 The Reuse

The environmental performance of a certain packaging type does not only depend on the material choice, but on the number of reuses and the quality of its recycling.

The number of reuses may be increased by so called deposit return schemes, where. a small fee (deposit) is added e.g. on the price of a product sold – such as for beverages in cans, glass or plastic bottles, which is refunded to the consumer when they return the beverage container for reuse or recycling.

Reuse: using an item again, whether for its original purpose (conventional reuse) or to fulfil a different function (repurposing).

Recycle: to process materials (e.g. plastic, broken glass, used paper) in order to regain a material, ideally for a similar or the same purpose. The pre-study on Recycled Content prepared by the Oeko-Institute includes an overview on different characteristics of recycling systems (e.g. closed-loop, open loop, upcycling, downcycling etc.).

Example – beverage containers: A glass bottle that is reused in a deposit return scheme (DRS) has a significantly lower environmental footprint (150kg CO_2-equivalent / m³) than a glass bottle that is recycled after single use (350kg CO_2 -equivalent / m²) (DUH 2020). The same holds true for mineral water in a DRS-PET bottle (69kg CO_2 -equivalent / m³) versus a DRS glass water bottle (84kg CO_2 -equivalent / m³) and a single use PET bottle (139 kg CO_2 -equivalent / m³). Due to the better environmental performance of DRS-beverage containers, the German government decided to include all single-use beverage containers into the national deposit return scheme from 2022 onwards (BMU 2021).

Example – shopping bags: a reusable bag from cotton, jute or canvas is perceived as an environmentally friendly alternative to singe use polyethylene bags. However, due to their more elaborate production and material thickness, the reusable cotton bags have to be reused 25-32 times in order to evince a better environmental performance than the polyethylene bags. On the other hand, reusable carrier bags are also increasingly being made from plastics such as polypropylene, polyester or polyene terephthalate (PET). Reusable bags made of plastic have clear advantages over natural fibres in the provision of raw materials and in production (DUH 2021).

As you can see, there are no straight-forward answers, and several aspects need to be considered when designing policy options to reduce the environmental impact of packaging. However, it is quite clear that reusable options display a better environmental performance than single-use ones, if they are indeed reused a considerable number of times. For example, a reusable carrier bag made of polypropylene is more environmentally friendly than a disposable bag made of polyethylene after just three uses (DUH 2021). Furthermore, the greater the standardization and pooling of reusable containers, the easier it is to collect and organize the effective reuse.

Example – pooled versus individual containers: if a company marks its brand icon into a glass bottle, requiring a separate collection system, the bottles will be returned on an individual basis. This likely implies relatively long transportation routes from consumers to one of the few factories that get the containers ready for reuse. On the other hand, if a larger number of beverage manufacturers agree on only a few types of standardized bottles, that are jointly collected, treated and put back into circulation, there are large economic and environmental savings associated to the pooled transportation, treatment and reuse.

Non-branded standardized containers for reuse, embedded in a deposit return scheme, are thus a good option to prevent early downcycling of packaging materials.

Since waste management is rather costly, it does pay off to think about efficient recourse use and reuse from the beginning i.e. from the design stage of a (packaging) product as described in the *Design-for-Recycling* pre-study. In addition to eco-design options, it is important to set financial incentives and fees within Extended Producer Responsibility (EPR) schemes. The incentives must be high enough to encourage waste reduction and better recycling.

With this report, we provided different perspectives on packaging functions, the supply chain, materials and reuse options. There are many entry points for policy makers, producers and consumers towards shaping a more sustainable packaging economy. What is your role?

To guide your actions, we have summarized a few consequent guiding questions.

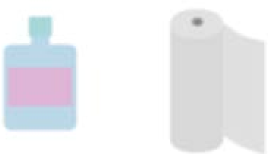
Guiding Questions

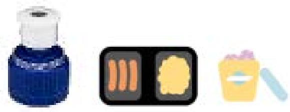
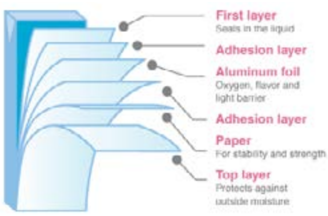
In summary of this report, here a few guiding questions, that you may ask in developing effective policy recommendations and measures, like an EPR scheme, an eco-design framework or recycling targets:

- What are the functions of the packaging types you aim to regulate?
- What are environmentally friendlier alternatives, fulfilling the same functions?
- At what part of the packaging life cycle does the resource currently turn into a waste?
- What part of the supply chain would you like to address?
- How to achieve pooling larger quantities of similar or the same materials for better collection and processing?
- What is the material type that you aim to regulate?
- How to avoid regrettable substitutions i.e. replacing one single-use with another single-use packaging type, merely shifting the problem.
- How do different packaging options compare under different reuse scenarios, i.e. under which circumstances reusable options will yield expected environmental benefits?
- How to avoid waste in the first place?
- How to best translate the above-mentioned insights into effective policy tools?

Annex I. The Main Plastic Polymer Types

Table 1 Main plastic polymer (resin) types, their application in packaging (uses), characteristics, world market share and environmental performance

Type	Uses (examples)	Characteristics How to recognize it?	World market share (%)	Environmental performance
PET / PETE Polyethylene terephthalate	 Water and soft drink bottles, salad domes, biscuit trays, salad dressing and peanut butter containers.	Clear, strong and lightweight. *Recognizable by**: Sinks in water and salt water. Flexible type of plastic.	8.5% world market share.[1]	*Highest recycling collection rate* among plastics (globally ~55%[2]). Various recycling streams: PET-bottle to PET-bottle (most preferred option) PET to fibre (fleece fabric, carpets, furniture covers)[2] Other PET-to-PET 
HDPE/ PE-HD High-density polyethylene	 Milk bottles, freezer bags, dip tubs, crinkly shopping bags, ice cream containers, juice bottles, shampoo, chemical and detergent bottles.	Stiff and hardwearing *Recognizable by*: Floats in water and salt water. HDPE-packages feel relatively hard and crinkly. The sound HDPE bags make when you crinkle them in your hands is crisp and crinkly. Think of dry leaves being squished together.	18 % world market share.[1]	*Widely recycled*, but usually downcycled (lower quality products than the original ones). Often relatively high weight per piece and less contaminated than other materials.[2] If mixed with Calcium Carbonate for greater density, it is difficult for processors to separate the HDPE from other materials such as ABS (Acrylnitril-Butadien-Styrol). Recycled HDPE is used for pipes or specialized pallets. 
PVC polyvinylchloride	 Cosmetic containers, commercial cling wrap	Can be rigid or soft, depending on plasticizers	Makes up a small amount of packaging materials (5% globally,[3] 10% Europe[1]).	*Often not recyclable* due to chemical properties. Sets free dioxins and furans when burnt openly. May contaminate other plastic recycling processes e.g. even at concentrations of just 0.005% by weight, PVC can form acids that break down PET[2]. Polyethylene foam or LDPE can replace PVC cap liners; for labels PE and PP substitutes are available.
LDPE Low-density polyethylene	 Squeeze bottles, cling wrap, shrink wrap, rubbish bags	Light-weight, low-cost, versatile, fails under mechanical or thermal stress. *Recognizable by*: Floats in water and salt water. LDPE feels soft and smooth. If you rub it together, it will make a soft swishing sound, as opposed to a crinkling, harsher sound.	20 % world market share.[1]	*Only about* 14% of LDPE packaging is recycled. Failure under stress and food waste contamination make it hard to recycle LDPE.

Type	Uses (examples)	Characteristics How to recognize it?	World market share (%)	Environmental performance
PP Polypropylene 5 PP	 Bottle toppers, microwave dishes, ice cream tubs, potato chip bags, dip tubs, flower pots	Tough and resistant; effective barrier for water and chemicals *Recognizable by*: It is firm, stiff and does not stretch. At some point it simply rips and tears. It floats in water.	27% world market share1.	Overall low recycling rate even though there is a potential for recycling (PP items are often separable and the market share is high). Recycled PP-toppers often turned into flower pots or buckets 
PS Polystyrene 6 PS 비닐류 PS	 CD cases, water station cups, plastic cutlery, imitation 'crystal glassware', video cases	Lightweight, inexpensive, structurally weak, glues, sands, cuts and paints well *Recognizable by*: Sinks in water, but floats in salt water. Breakable sound.	3% of global plastic packaging market2.	*Technically recyclable*, but rarely practiced due to common food contamination and unfavorable weigh-to-volume ratio (bulky to collect). Littering problem: often blown away by wind, due to light weight and large volume
EPS Expanded polystyrene 6 EPS	 Foamed polystyrene hot drink cups, hamburger take-away clamshells, foamed meat trays, protective packaging for fragile items			
7 OTHER Like polycarbonate (PC), polyamide (PA), Acrylnitril-Butadien-Styrol (ABS), Polymethylmethacrylate (PMMA), Polylactide (PLA),	 Water cooler bottles, flexible films, multi-material packaging	Diverse in nature with various properties. Also bio-based and bio-degradable polymers are grouped within this RIC-category. *Recognizable by*: PA: sinks in water ABS: sinks in water, example LEGO toys		Diversity of materials risks contamination of recycling.
Laminates / combined materials Layers of paper or cardboard and plastics and/ or aluminum 84 C/PAP 90 C/LDPE プラ				Because of their poor recyclability, most multilayer plastic packaging materials are at best converted to refuse derived fuels (RDF) but mostly incinerated or landfilled (Kaiser et al. 2018).

Type	Uses (examples)	Characteristics How to recognize it?	World market share (%)	Environmental performance
Biodegradable plastics The term is oftentimes also (incorrectly) used in reference to bio-based plastics.	    Compostable trash bags, agricultural mulch films, drinking straws, coffee capsules. Most of the applications have a short or very short in-use phase.	Biodegradable plastics can be manufactured from both fossil as well as renewable sources. **Biodegradable plastics** degrade under certain temperatures, oxygen availability and humidity, and in the presence of certain microorganisms. **Compostable plastics** are a sub-category, indicating a breakdown into natural elements in a compost environment. The breakdown usually takes several days, yielding CO_2, water, inorganic compounds and biomass without toxic residues. All compostable products are biodegradable, but not all biodegradable products are compostable. We further distinguish between industrially and home compostable plastics: **Industrially compostable** plastics are designed to biodegrade in the conditions of an industrial composting plant or an industrial anaerobic digestion plant with a subsequent composting step. **Home compostable** plastics are designed to biodegrade in the conditions of a well-managed home composter at lower temperatures than in industrial composting plants. Most of them also biodegrade in industrial composting plants. *Recognizable by*: Often thin, soft-feeling, green/grey colored films		The conditions for degradation or industrial composting are typically not fulfilled during conventional composting or under ambient conditions in the natural environment, so that biodegradable and industrially compostable plastics become a contaminant in household compost or natural environment. When in the same waste stream as other plastics, they are difficult to detect and contaminate the conventional recycling process, too. However, biodegradable bags could be useful in schemes, where organic household waste is collected for specialized composting. Offering a separate collection scheme for organic waste is extremely important, so that food waste does not (or only minimally) contaminate other waste streams like those for paper, cardboard or plastics.

Type	Uses (examples)	Characteristics How to recognize it?	World market share (%)	Environmental performance
Biobased plastics OK biobased e.g. starch blends, PLA, bio-PET and bio-PE, PHA	 Biobased PLA plastic is commonly used in food packaging like for plastic bottles, cups, utensils and textiles. Biobased PHA is often used in medical devices like sutures and cardiovascular patches.	Biobased plastics are fully or partly made from biological raw materials, e.g. corn or sugarcane as opposed to the fossil raw material (oil) used in conventional plastics. *Recognizable by*: Not (sufficiently) distinct from PET or PLA. Often just branded differently (colour, symbols).		Biobased plastics are not necessarily biodegradable or compostable and do not have a better environmental footprint than conventional plastics (as described in Section 3 on materials).
Oxo-fragmentable plastic 100% Oxo-dégradable 	 Shopping bags, agricultural mulch films, plastic bottles	Oxo-degradable plastics are conventional plastics, for example Polyethylen (PE), Polypropylen (PP), Polystyrol (PS) and Polyethyleneterephtalat (PET), but "oxo-degradable" means that the plastic material includes additives which, through oxidation, lead to the fragmentation of the plastic material into micro-fragments or to chemical decomposition. Characterized by a fast fragmentation after usage. Not biodegradable.		The fragmented plastic particles in the environment remain as microplastics litter and contribute to environmental degradation. Thus, it is highly recommended not to use these plastics for any application; or even to ban them.

* other methods for identifying plastics are compression or flame tests (in a fume cupboard), Infrared or Nuclear Magnetic Resonance Spectroscopy. The sink-or-float and the … test are emphasized in Table 1, since they do not require special precautions or equipment.

1 Plastics Europe 2015 and Plastics Europe 2018.

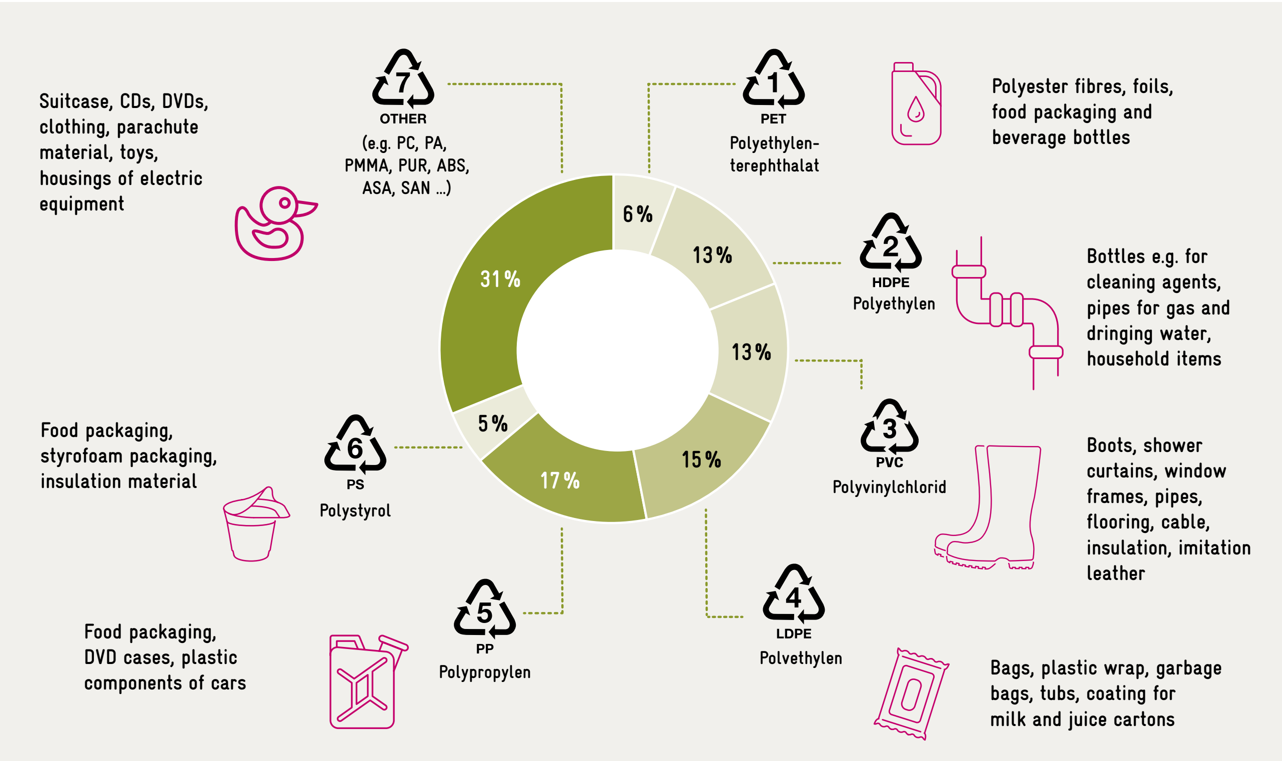
2 WWF-Malaysia 2020.

3 World Economic Forum & Ellen Macarthur Foundation 2016.

Source: Öko-Institut e.V.,

AnnexII. The Prevalence of Plastic Polymer Types (Germany – 2019)

Figure 7: Prevalence of different plastic polymer types in Germany



Source: Heinrich-Böll Foundation, Friends of the Earth Germany (BUND 2019), translated by C.Löw (2020)

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