ECR AUSTRIA
EFFICIENT CONSUMER RESPONSE

# EVALUATION OF THE RECYCLABILITY OF PACKAGING

A RECOMMENDATION OF THE
ECR AUSTRIA WORKING GROUP
“CIRCULAR PACKAGING DESIGN”

# EVALUATION OF THE RECYCLABILITY

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**CONCEPT AND TEXT**

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# DISCLAIMER

The information in this methodology description for the recyclability of packaging is based on the Circular Packaging Design Guideline of FH Campus Wien. The FH Campus Wien guideline is available to stakeholders along the entire value chain as a technically sound framework for packaging development. The team at the Packaging and Resource Management unit of the Department of Applied Life Sciences at FH Campus Wien conducts research in the areas of sustainable packaging development, circular design, and methods for assessing the **sustainability** and safety of packaging. The guideline deline is constantly updated and adapted to technical or legal changes in the collection, sorting, and recycling systems. The ECR Recommendation for the Assessment of Recyclable Packaging aims to harmonize the assessment methods.

methods and thus represents the unity

The overall evaluation of packaging in Austria is taking center stage. For the concrete evaluation of individual packaging solutions, a clear data basis (e.g., technical specifications) is a basic prerequisite.

An assessment can therefore only be made in individual cases. be taken.

## Innovations and ongoing updates

This text should not be understood as an obstacle to innovations (e.g. developments in sorting and recycling technology, further developments in evaluation methods, etc.), because new technologies can lead to an improvement in ecological performance and

Each of these must be analyzed separately. Technical and legal changes in collection, sorting, and recycling systems, as well as future material developments, will be further monitored during the further development of the FH Campus Wien Circular Packaging Design Guideline.

## Product-specific requirements

This recommendation can be applied to products from the food, near-food, and non-food segments. The assessment methodology is therefore also applicable to all primary, secondary, and tertiary packaging, provided that product-specific **Packaging unit** regulations complied with become.

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# 1. TECHNICAL RECYCLABILITY

The method presented here allows the calculation of the technical recyclability of a packaging unit at the material level and is based on data from the Circular Packaging Design Guideline of FH Campus Wien, the Packaging Design for Recycling Guideline of ECR and the recommendations of the RecyClass Guidelines.

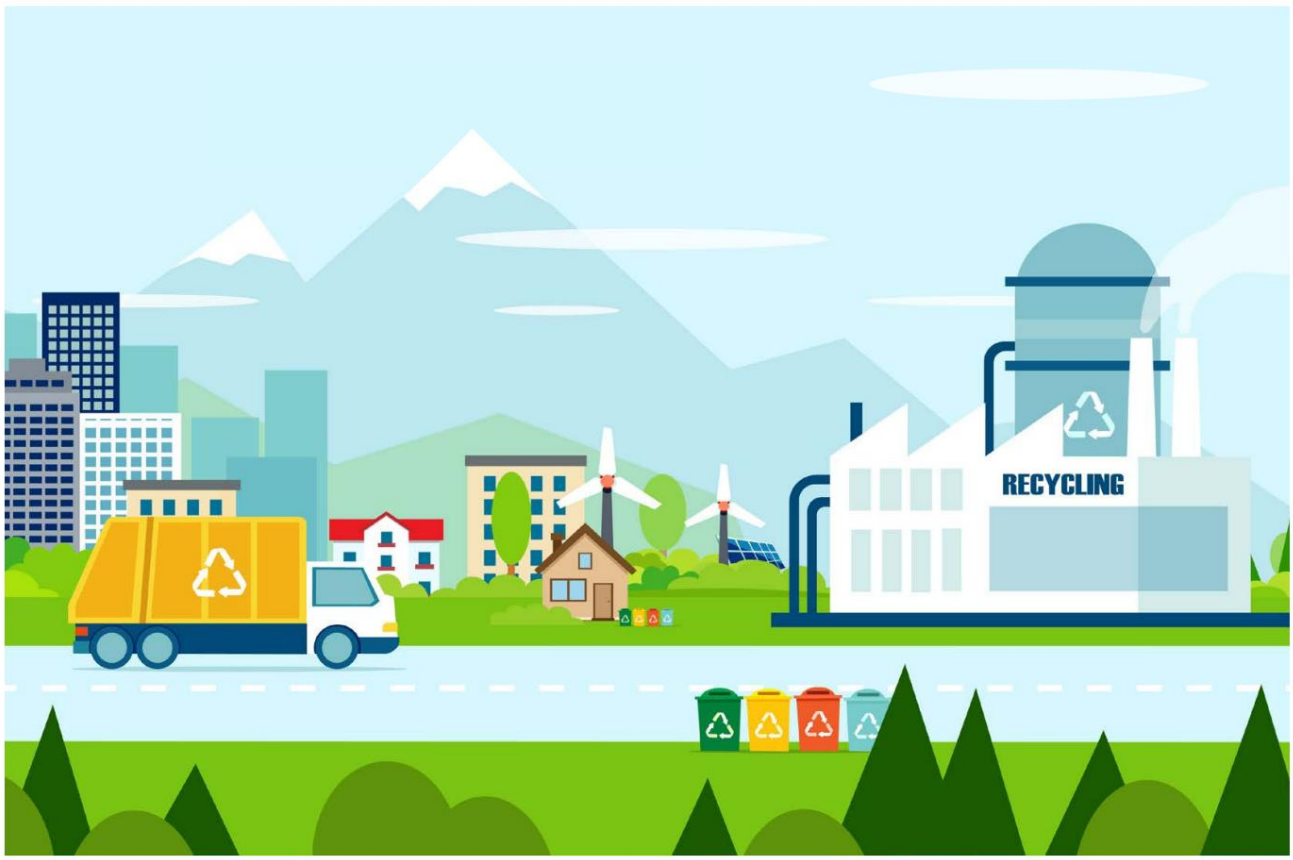
This method calculates the **technical recyclability** of a **packaging unit .** A material in a packaging unit is considered technically recyclable if the following four conditions are met:

- A collection and sorting structure for the material exists in the selected country.
- It can be sorted into defined material streams in accordance with the state of the art technology available on the market in the respective country.
- The material can be recycled into **recyclate** in a material recycling process .
- The resulting recyclate has market potential to be used as a substitute for identical raw materials.

A distinction must be made between the technical recyclability of:

- **the recycling rate / actual**
  **Recyclability:** The recycling rate describes the relationship between the
  Quantity of materials placed on the market and quantity of materials recycled.

- **the recycling potential / theoretical recyclability:**
  The recycling potential or theoretical recyclability is defined analogously to the technical recyclability, but the lack of collection and sorting infrastructure in the selected country and the lack of market potential are ignored.



# 2. DEFINITION OF DISPOSAL UNITS

Before materials can be evaluated according to their recycling stream, the disposal units are defined. It is generally assumed that each **packaging unit** represents a single disposal unit.

## DISPOSAL UNIT = PACKAGING MATERIAL + PACKAGING AID


It is possible that packaging components arise as separate disposal units and are therefore assessed separately in terms of the collection, sorting and recycling infrastructure.
The following 3 cases are typical:

**1. Irreversible separation through consumption or use:**
The packaging component is irreversibly separated from the main body by consumption or use and disposed of separately (e.g. tear strip of a flexible packaging)

**2. Separation during disposal/recycling:**
The packaging component separates from the main body during the disposal/recycling process and is therefore considered a separate disposal unit (e.g. various slip lids, loose cardboard inserts in a plastic tray)

**3. Separation by consumers:**
The packaging component is actively separated by consumers and thus falls into a separate disposal category. This classification is only permissible if empirical data on this separation process is available or if there is clear labeling and a design for easy separation (e.g., double perforation).

A separation of the packaging component can also be proven by empirical surveys.

# 3. DETERMINATION OF RECYCLING STREAMS

Once the disposal units have been defined, the respective recycling streams of the disposal units are determined. These depend on the collection and sorting infrastructure in the respective country. Interference factors that affect sorting must be taken into account (e.g., a plastic bottle dyed black with carbon black). Details can be found in the Circular Packaging Design Guidelines of FH Campus Wien and ECR Packaging Design for Recycling.

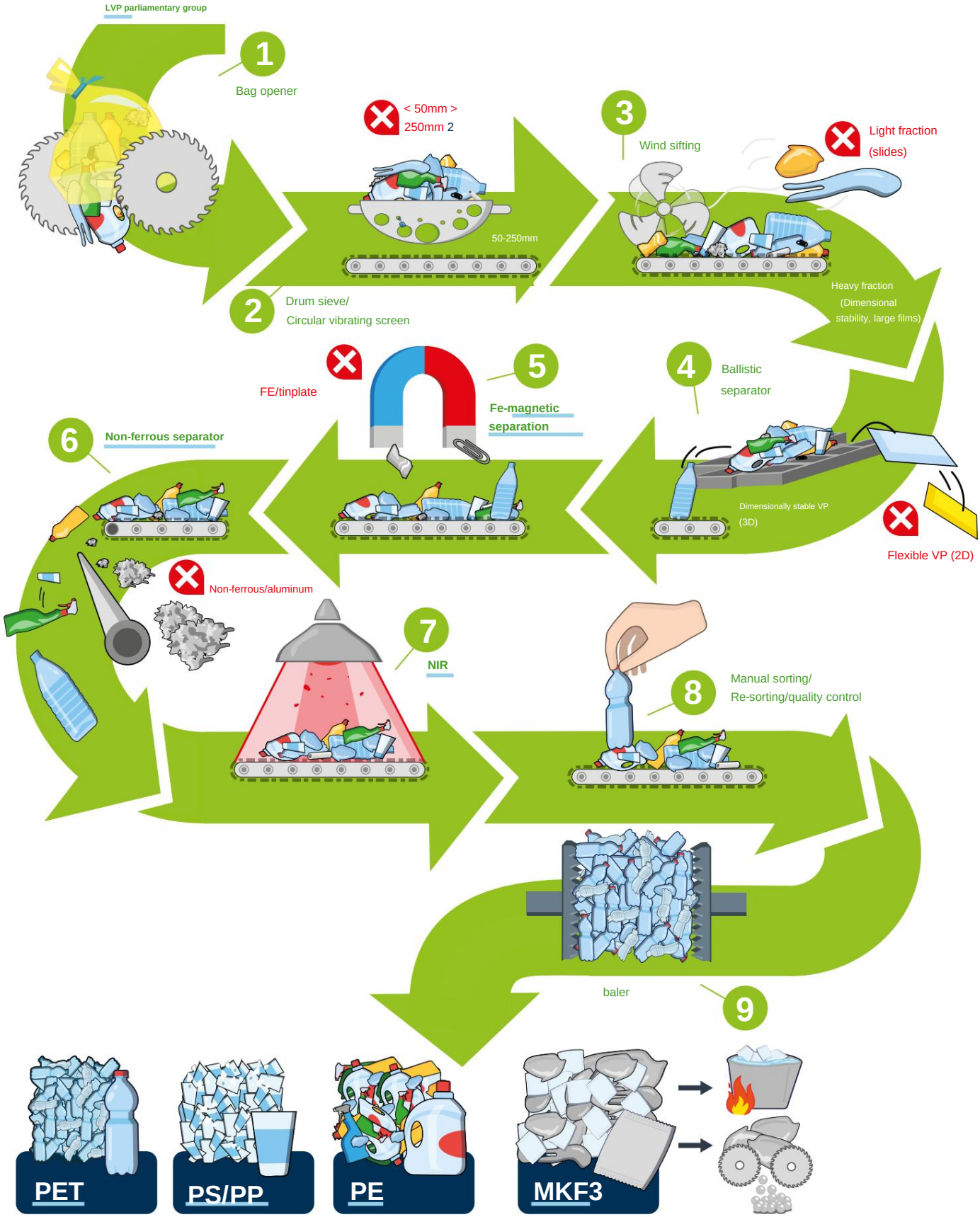
If a material stream can be assigned to the disposal unit, the materials in the disposal unit are evaluated in the context of that material stream. If no material stream can be assigned to the disposal unit, it is considered non-recyclable.

- Recording structure available
- Recycling possible to a limited extent
- no separate recording structure exists

Current material flows in Austria and Germany (as of May 2023):

| PACKAGING WASTE STREAM | | AUSTRIA | GERMANY |
|---|---|---|---|
| DRINK CARTON | | ✓ | ✓ |
| PAPER | | ✓ (also applies to single-sided coated paper) | ✓ (also applies to single-sided coated paper) |
| ALUMINUM | | ✓ | ✓ |
| TIN PLATE | | ✓ | ✓ |
| GLASS | | ✓ | ✓ |
| PS | rigid | ✓ | ✓ |
| | flexible | ✗ | ✗ |
| PVC | rigid | ✗ | ✗ |
| | flexible | ✗ | ✗ |
| PE | rigid | ✓ | ✓ |
| | flexible | ✓ | ✓ |
| PP | rigid | ✓ | ✓ |
| | flexible | ✓ | ✓ |
| PET | stretch blow molded | ✓ | ✓ |
| | thermoformed | ~ | ✗ |
| | flexible | ✗ | ✗ |

# 3.1 SORTING PROCESS LIGHTWEIGHT PACKAGING GROUP FOR FORM-STABLE PACKAGING1 :

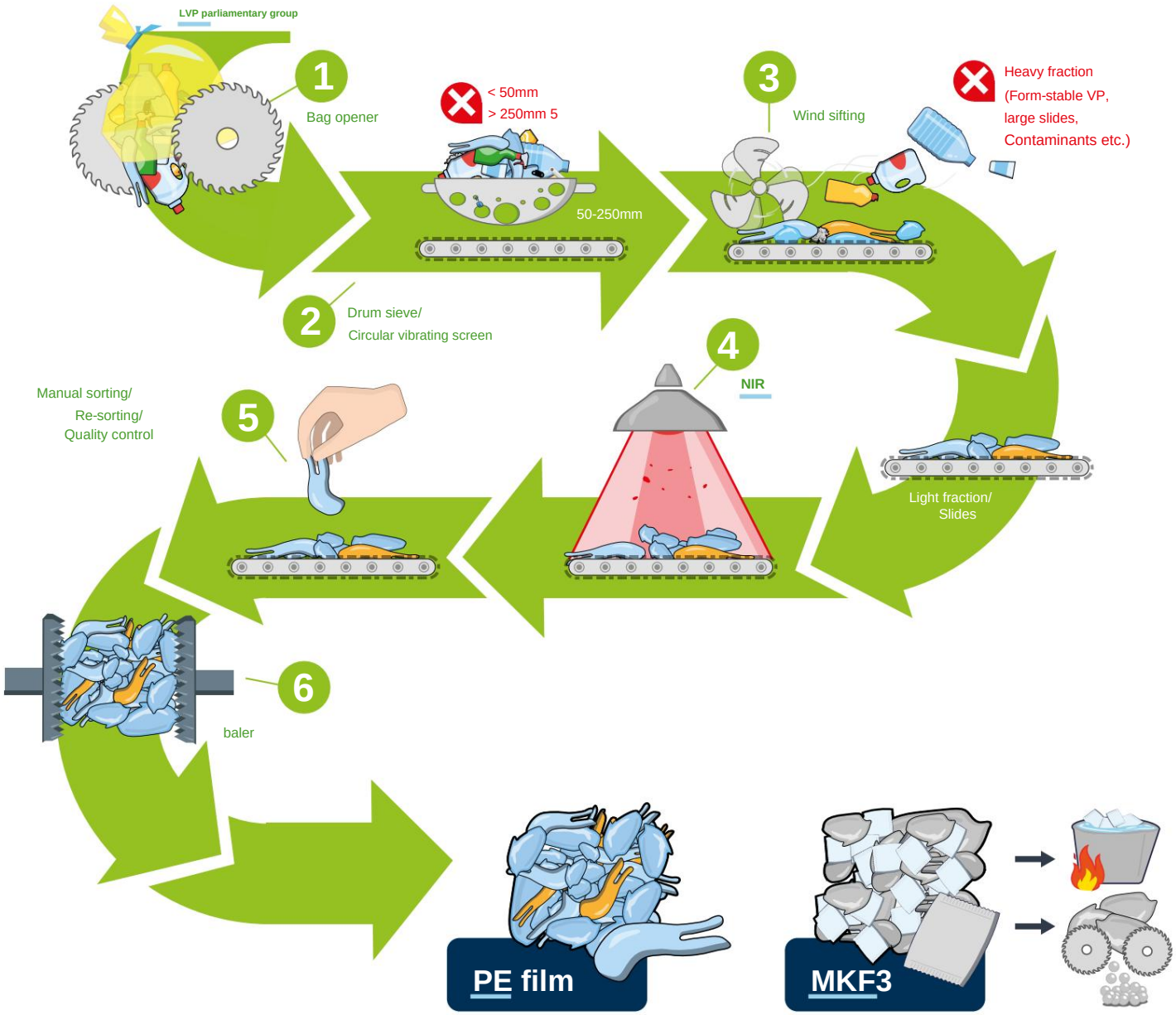



[1] only for Austria

2 Germany: <20mm / >220mm 3 is thermally recycled

**Source:** Federal Waste Management Plan 2023 - Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology

# 3.2 SORTING PROCESS LIGHTWEIGHT PACKAGING FLEXIBLE PACKAGING GROUP4:




[1] only for Austria

2 Germany: <20mm / >220mm

3 is thermally recycled

**Source:** Federal Waste Management Plan 2023 - Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology

# 4. EVALUATIONS OF THE MATERIALS

If the disposal unit can be assigned to a material stream, each material in the disposal unit is assessed according to its recyclability within this material stream using the following scheme:

| EVALUATION | DEFINITION |
|---|---|
| A | The material can be recycled in the incoming material stream and the recyclate can be used for material-identical, high-quality applications. In this case, it can generally be assumed that the resulting recyclate is suitable for circular applications. |
| B | The material can be recycled in the incoming material stream, but The quality of the recycled material is impaired. In addition, the quality of the recycled material other materials in the disposal unit. The resulting recyclate is primarily used for downcycling applications. |
| C | The material cannot be recycled in the incoming material stream, but the recyclability and recycled quality of other materials in the packaging unit is not affected. |
| D | The material cannot be recycled in the incoming material stream and potentially negatively impacts the recyclability and recyclate quality of other materials in the disposal unit. This can downgrade the application areas of recovered recyclate from other materials from circular applications to downcycling. |
| X | The material cannot be recycled in the incoming material stream and leads to contamination of the disposal unit. All materials of the disposal unit, that are recycled with this material during the recycling process are considered contaminated and therefore not recyclable. This rating is also assigned when packaging bodies are incorrectly sorted (significant loss of recyclability) or when disposal units are immediately assigned to the thermal fraction due to their size. |

# EVALUATION OF RECYCLE QUALITY

The quality of the recycled material depends on the initial assessment of the materials within the material stream and the negative influence of other materials within the material stream. Materials rated B or D and

Recycling with materials rated A reduces the recyclate quality. This reduces a material rated A to B. This does not change the material's fundamental technical recyclability.

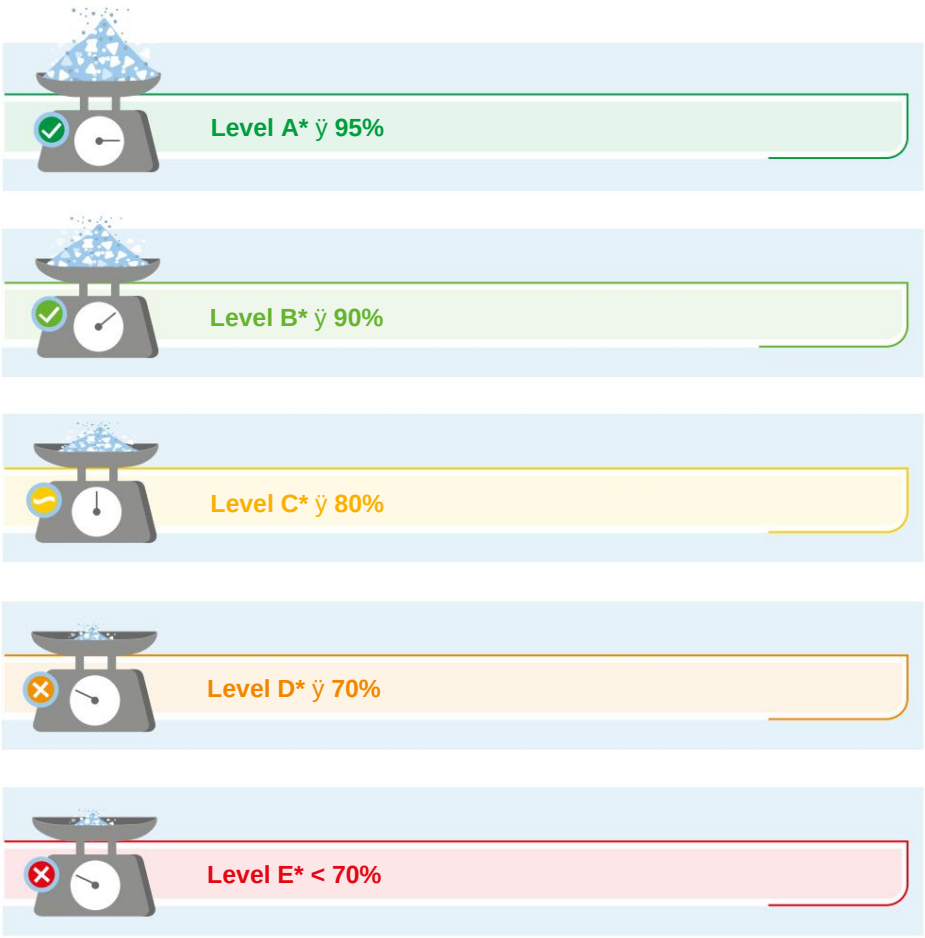
# 5. CALCULATION OF THE TECHNICAL RECYCLABILITY

To calculate technical recyclability, the mass fractions of the materials in a **packaging unit** that were rated A and B are divided by the total mass of the packaging unit and multiplied by 100.

$$\frac{\text{(Weight of components (A+B))}}{\text{(Total weight of packaging unit)}} \times 100 = \text{Recyclability in \%}$$

The calculated recyclability in % then leads to the following classification:

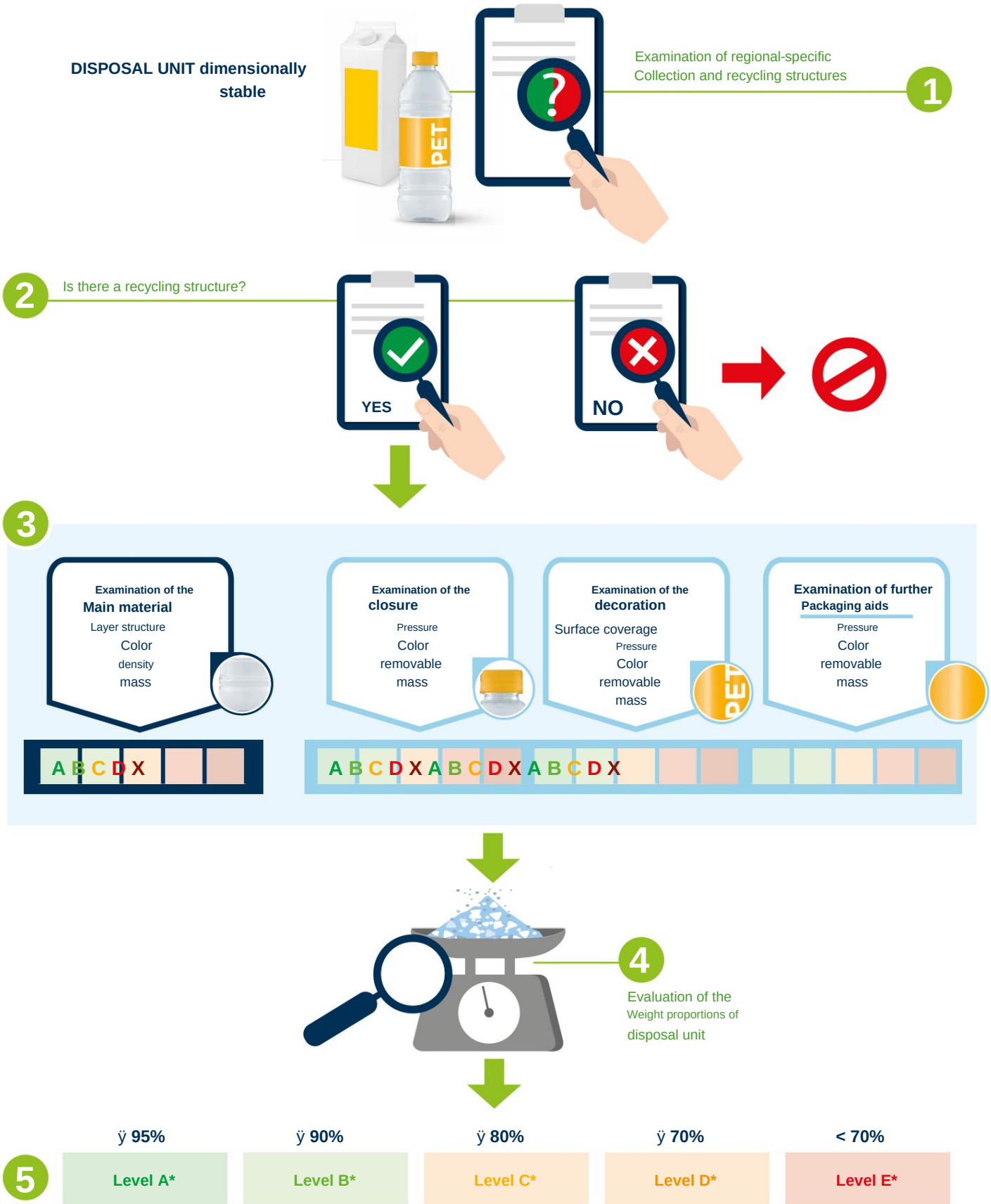
## OVERALL RECYCLABILITY RATING




*Recycling levels AE correspond to the European Commission's proposal for a Regulation on Packaging and Packaging Waste (PPWR).

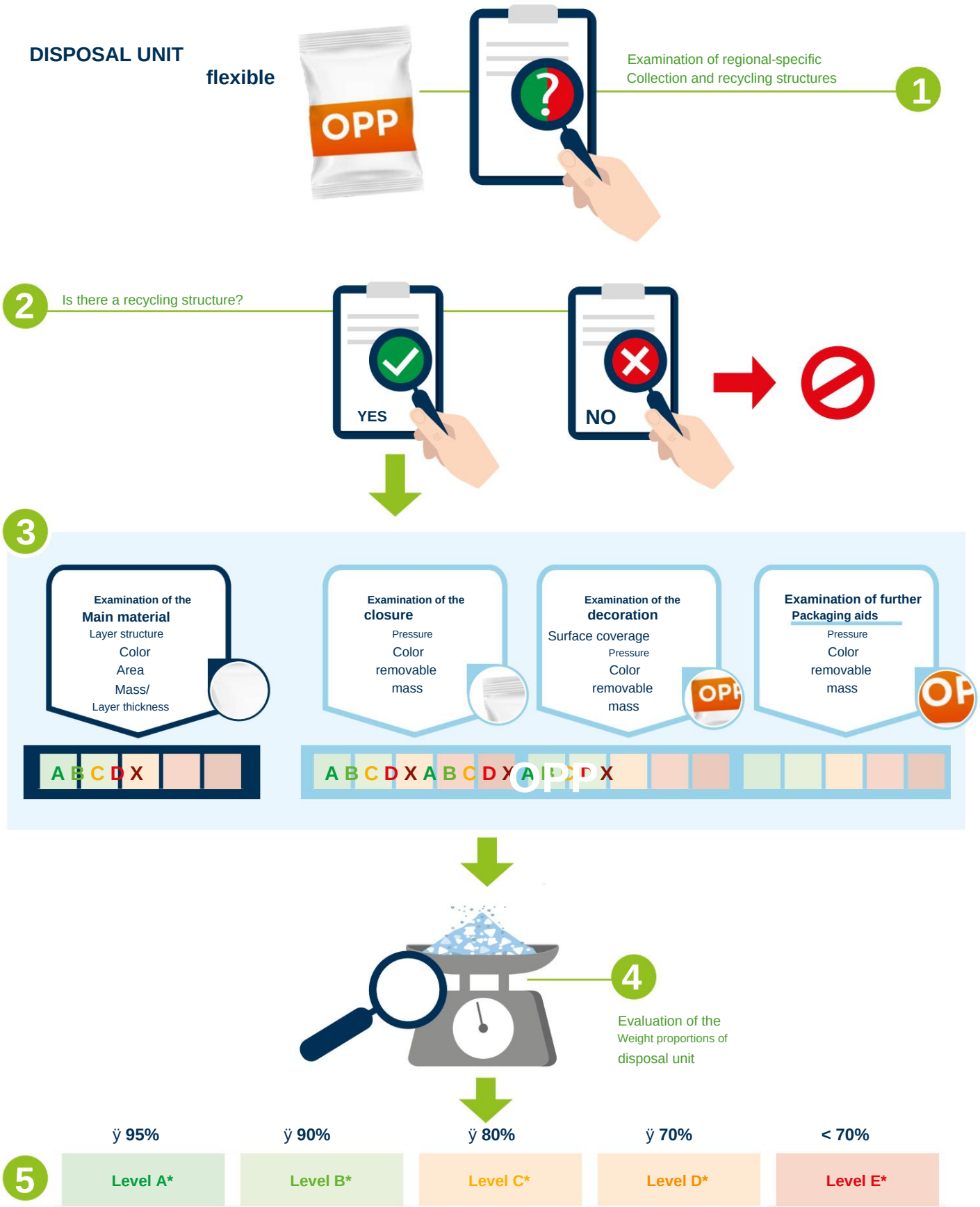
# 5.1 EVALUATION SCHEME RECYCLABILITY

## – dimensional stability packaging:




* The recyclability levels used here correspond to the European Commission's proposal for a Regulation on Packaging and Packaging Waste (PPWR).

# 5.2 EVALUATION SCHEME RECYCLABILITY – FLEXIBLE PACKAGING:




* The recyclability levels used here correspond to the European Commission's proposal for a Regulation on Packaging and Packaging Waste (PPWR).

# 6. ATTACHMENT: CALCULATION EXAMPLES

# 6.1 CALCULATION EXAMPLE 1


## Structure of PET bottle (0.5l):

| Component | Material | Color | G | % by weight | Classification | Rating |
|---|---|---|---|---|---|---|
| Bottle | PET | Colorless, transparent | 25 | 86.81 | A | The PET bottle stream is a high-quality recycling stream. The alkaline hot wash can remove adhesive<br><br>Remains of the banderol are removed. |
| banderol | Printing ink | Light colored opaque | 0.1 | 0.35 | D | The printing ink is not recyclable and reduces the quality of the recycled material because it is colored gray. |
| | LDPE | White, opaque | 1.6 | 5.56 | B | Polyolefin (PP/PE) components can be skimmed off from the PET bottle stream and recycled. However, this is a mixed stream of inferior quality.<br><br>The printing also reduces the quality. |
| Screw connection ending | PP | Dark colored, opaque | 2.1 | 7.29 | B | See banderol |
| **sum** | | | **28.8** | | | |

**Recyclability =** $\frac{(25+1.6+2.1)}{28.8} \times 100 = 99.65\%$

## 6.1.2 Calculation example 1: PET bottle (0.5 l)


**Recyclability: 99.65%**

**(corresponds to level A)**

[7] Color sorting is done based on the bottle colors.

# 6.2 CALCULATION EXAMPLE 2

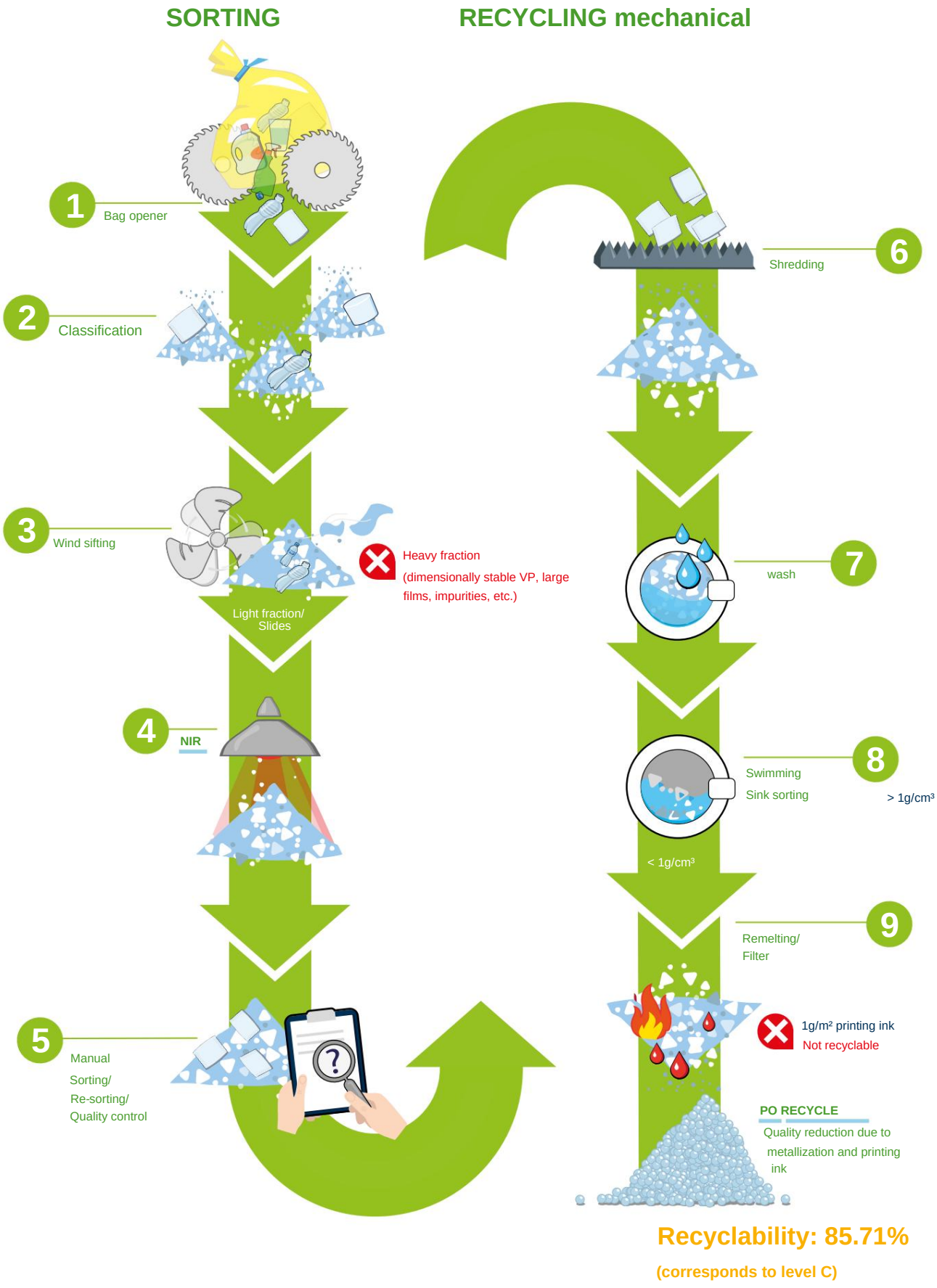

## CONSTRUCTION OF THE TUBE BAG (A4 / 300 g):

| material | g/m2 | % by weight | Classification | Rating |
|---|---|---|---|---|
| Top coat | 0.5 | 1.17 | C | The topcoat does not interfere with the OPP recycling process. However, it cannot be recycled and is therefore rated C. |
| Printing ink | 1 | 2.34 | D | The OPP layers are rated D due to the printing, which turns the material grey during the recycling process. |
| OPP | 18.3 | 42.86 | B | The OPP layers are rated B due to the metallization and printing, as these turn the material grey during the recycling process. |
| Laminating glue | 4.6 | 10.77 | C | The laminated adhesive used does not interfere with the OPP recycling process.* However, it cannot be recycled and is therefore rated C. |
| OPP (metallized) | 18.3 | 42.86 | B | The OPP layers are metallized and printed with a<br><br>B because they turn the material grey during the recycling process. |
| | **= 42.7** | | | |

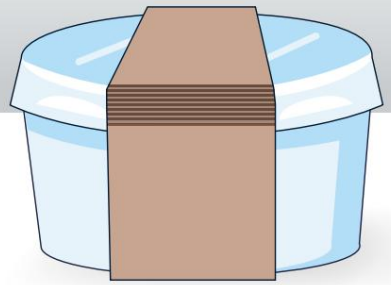
**Recyclability =** $\frac{(18.3+18.3)}{42.7} \times 100 = 85.71\%$

* The influence of different laminating glues on the recycling process may need to be determined or tested by experts.

## 6.2.2 Calculation example 2: Tubular bag (300 g)



# 6.3 CALCULATION EXAMPLE 3

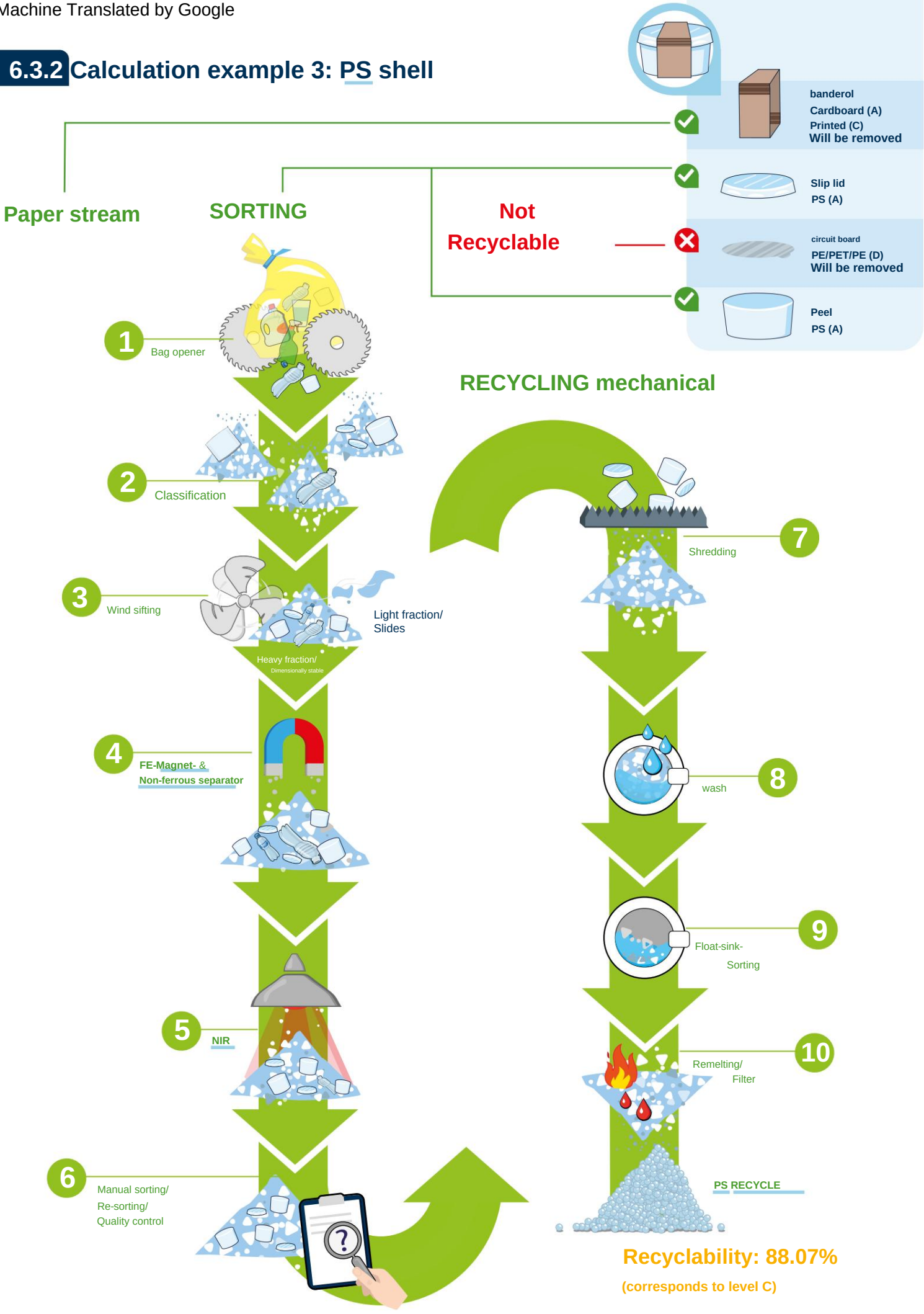


## PS bowl (150g):

| Component | Material | Color | G | % by weight | Classification | Rating |
|---|---|---|---|---|---|---|
| Peel | PS | Colorless, transparent | 8.6 | 51.81 | A | The PS bowl is unprinted and can be fed into a pure current. |
| circuit board | PE/PET/PE | Colorless, transparent | 1.1 | 6.63 | D | The multi-layer structure of PET and PE causes cross-contamination, thus preventing potential recycling of the circuit board. However, it is disposed of separately and thus does not interfere with the recycling of the other components. |
| Slip lid PS | | Colorless, transparent | 5.4 | 32.53 | A | The PS slip lid is unprinted and can be supplied with a pure current. |
| banderol | Top coat | Transparent 0.5 | | 3.01 | C | The paper band must be removed before consumption and is disposed of separately. It is easily recyclable in the paper stream because inks and varnishes can be removed in deinking processes. |
| | Printing ink | Light colored, opaque | 1 | 6.02 | C | |
| | Solid cardboard (bleached) | White, opaque 5.2 | | 31.33 | A | |
| **sum** | | | **21.8** | | | |

$$\text{Recyclability} = \frac{(8.6+5.4+5.2)}{21.8} \times 100 = 88.07\%$$

## 6.3.2 Calculation example 3: PS shell



# 7. GLOSSARY

## Waste hierarchy

The five-stage waste hierarchy regulated in the Circular Economy Act sets out a basic order of priority for measures for the treatment and recycling of waste:
1. Prevention, 2. Preparation for reuse,
3. Recycling, 4. Other recovery, in particular energy recovery and backfilling, 5. Disposal

## Waste Framework Directive (2008/98/EC)

Directive 2008/98/EC of 19 November 2008 on waste, the Waste Framework Directive, is a directive of the European Community and sets the legal framework for the waste legislation of the Member States.
Link: https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32008L0098

## Additive

Additives (also called auxiliary materials or additives) are substances that are added to products in small quantities to achieve or improve certain properties. In the case of plastics, this occurs during the compounding process. Examples of additives include plasticizers, dyes, fillers, and stabilizers.

## Ballistic separator

The ballistic separator separates the 2D fraction (flexible packaging) from the lightweight packaging fraction.
the 3D fraction (dimensionally stable packaging).

## EPS

EPS (extruded polystyrene) is a tough, solid foam produced by the chemical extrusion of polystyrene and is primarily known under the trade name Styrofoam.

## Flexible packaging

Packaging that significantly changes its shape even under minimal stress during intended use. For example, bags and sacks. Definition according to ÖNORM A 5405: 2009 06 15

## HDPE, LDPE, MDPE, LLDPE

Based on the different densities, there are 4 main types of polyethylene **(PE):**
**HDPE** – high-density polyethylene: polyethylene with high density
**MDPE** – medium-density polyethylene: polyethylene with medium density
**LDPE** – low-density polyethylene: polyethylene with low density
**LLDPE** – linear, low-density polyethylene: linear low-density polyethylene

## plastic granulate

This is the common delivery form of thermoplastics for the plastics processing industry. The plastic is heated/melted in extruders, formed into strands via nozzles, cut into sections a few millimeters long, and cooled. The resulting granulate can be easily transported as bulk material.

## Magnetic separator

Magnetic separation is a technology for separating and sorting waste. Overbelt magnets or magnetic drums remove ferromagnetic material (primarily ferrous materials) from material streams transported by a conveyor belt.

## MFK

MFK is the abbreviation for mixed fraction.

## sustainability

Sustainability, or sustainable development, means meeting the needs of the present without compromising the opportunities of future generations. It is important to consider the three dimensions of sustainability—economic efficiency, social equity, and ecological sustainability—equally.

### Non-ferrous separator

The non-ferrous (NE) separator, also known as an eddy current separator, is used in the sorting of packaging waste and is designed to separate non-magnetic but electrically conductive materials such as aluminum and copper from a material stream. In the eddy current separator, these materials are repelled by a complex electromagnetic process.

### Non-ferrous metals

Abbreviation for non-ferrous metals. This includes all metals except iron, as well as metal alloys in which iron is not the main element or does not exceed 50%. Examples include copper, aluminum, and brass.

## NIR

Near-infrared refers to a light spectrum in a range invisible to humans, between 760 and 2,500 nm.
NIR spectrometers are used in the recycling process to detect and sort plastics and are based on the principle of transmission and reflection of radiation.

## LVP

In Austria, lightweight packaging (LVP) is collected in the yellow bag or yellow bin. This category includes plastic bottles for beverages, personal care products, detergents and cleaning products, composite beverage cartons, plastic cups, carrier bags, lids and closures, tubes, canisters, cups, and nets. Blister packs, EPS packaging, jute sacks, and wooden crates also fall into this category.[1]

## OPP

OPP is an axially (longitudinally) stretched polypropylene. It is often used as a packaging material for bags.

## PA

Polyamide (PA) is a plastic based on peptide bonds, meaning it is chemically related to protein molecules. It is characterized by high toughness and strength, as well as good barrier properties. A well-known example is nylon. In the packaging sector, PA is mainly used in the form of films.
used.

## PC

Polycarbonate (PC) is a transparent, very strong plastic used for kitchen appliances, drinking bottles, and microwaveable dishes. However, due to the presence of **bisphenol A** (suspected of endocrine disrupting effects), its use in the food industry is declining.

## PE

Polyethylene (PE) is one of the most widely used plastics and is resistant to oils, fats, alcohols, and diluted acids and alkalis. It is also highly cold-resistant and weldable. It is also produced in various grades (see **HDPE, LDPE, MDPE).** Depending on the grade/ type, PE is used for freezer bags and carrier bags, among other things, and as an inner coating on **beverage cartons .**

1 ARA – Altstoff Recycling Austria: Correct separation - lightweight packaging

## PET

Polyethylene terephthalate (PET) is a typically transparent plastic that is particularly stable and has good barrier properties. PET also boasts high aroma density and good grease resistance.
It is mainly used for the production of bottles for carbonated drinks, but also for salad bowls, clear cups and for film production.

## PETG

It is a glycol-modified PET characterized primarily by its high viscosity and is used in injection molding, extrusion, and blow molding. Due to its good sealing properties, PETG is also used in multilayer films (PET-GAG).

## PET-GAG structure

Refers to a three-layer film in which the outer layers are made of PET-G (glycol-modified PET) and the inner layer is made of the less expensive PET-A (amorphous PET). The material exhibits good barrier properties and is also sealable. Recycled material can also be used for the inner layer.

## PE-X

PE-X means “cross-linked polyethylene” and is a non-melting and therefore thermally more resilient plastic.

## PLA

Polylactic acid (PLA) is a plastic derived from renewable raw materials (starch) and is potentially biodegradable. It is a clear plastic characterized by a good aroma barrier.
PLA is mainly used for the production of films, but also as a coating for cardboard cups and for the production of fibers.

## polymer

Plastics consist of polymers. Polymers are chemical compounds composed of chain or branched molecules (macromolecules), which in turn consist of a large number of identical or similar units, called monomers. They can have linear, branched, or cross-linked structures. Polymers are classified according to the degree of cross-linking of the macromolecules into thermoplastics, **thermosets ,** and elastomers.

## PO

Refers to the plastics group of polyolefins (PO). The most important representatives include polyethylene **(PE)** and polypropylene **(PP).**

## POM

Polyoxymethylene (POM) is a colorless, highly rigid thermoplastic. The material is primarily processed into molded parts by injection molding or extrusion blow molding and is used in packaging, for example, for spray bottles.

## PP

Polypropylene (PO) is a plastic that is similar to chemical polyethylene, but is stronger and more temperature-resistant.
It exhibits good barrier properties against grease and moisture and is also one of the most widely used plastics for food packaging. Examples include bottle caps, trays, and films.

## PPWR

On November 30, 2022, the European Commission published a proposal for a Regulation on Packaging and Packaging Waste (PPWR). The regulation is intended to repeal the current Packaging and Packaging Waste Directive (Directive 94/62/EC). Link: **https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022PC0677**

## PS

Polystyrene (PS) is a plastic with relatively high gas and water vapor permeability, which is very dimensionally stable and clear. Depending on the intended use, it can be processed by injection molding, thermoforming, or foaming. Typical applications include yogurt cups, plastic cutlery, and CD cases.

## PVC

Polyvinyl chloride (PVC) is a plastic with a wide range of applications, especially in the non-food sector. It is typically very hard and brittle, but becomes more malleable with the addition of plasticizers. PVC is used, for example, as shrink wrap for transport or for the manufacture of pipes. However, when it comes into contact with food, there is a risk that the added plasticizers will migrate into the food.

### Recycled material

Plastic granules made from recycled plastic.

## Rigid packaging

Packaging which does not change its shape and form under stress when used as intended.
For example, a glass bottle. Definition according to ÖNORM A 5405: 2009 06 15

## Packaging components/packaging aids

Packaging typically consists of several components. These can be divided into packaging materials and packaging aids, and consist of different packaging materials. A packaging material is the component that forms the main part of the packaging and encloses or holds the packaged goods (contents) together. It forms the base, so to speak. This can be, for example, a bottle, a tray, or a bag. Packaging aids are those components that enable additional functions such as closing, labeling, handling, and removal.

These include staples, sealing foils, adhesive tapes, labels, bands, sleeves, closures, pull-on tapes, and cushioning materials. Packaging materials and packaging aids together make up the packaging.

## Packaging unit

A packaging unit includes both the primary (contains the contents), the secondary (combines primary packaging) and the tertiary (transportable unit) packaging.

## Material recycling

Material recycling is defined as the utilization of waste or previously used products, which seeks to utilize their material properties and produce secondary raw materials from them. This includes both mechanical and chemical recycling.

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