Gesellschaft für Verpackungsmarktforschung

Material Efficiency of Packaging in Comparison

On behalf of:
IK Industrievereinigung Kunststoffverpackungen e.V.

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Research Objectives, Methodology

1. Objectives

> The goal of the study is to compare the material efficiency of plastic packaging with that of other packaging materials.

2. Reference Year

> Reference year of this study is 2021.

3. Population

> The results relate to the volume of packaging consumption from private end-users in Germany.

> Single-use beverage packaging in the deposit and return system is also included.

> Consumption hereby refers to the amount of packaging filled and placed on the market in Germany (also referred to as market volume).

4. Packaging Materials

> The analysis includes the five following groups of packaging material:

- Glass,
- Paper, carton, and cardboard,
- Plastic,
- Ferrous metals,
- Aluminium

> The composite fractions are assigned to the group of the respective main material. It means, for example, that paper-based composites and beverage carton packaging are included in paper, carton, and cardboard material group.

> Packaging made of wood and other materials are not included in the study.

5. Material Efficiency, Indicator of Material Efficiency

> Material efficiency describes how much packaging material is required to pack a certain quantity of goods.

> The material efficiency is given here in grams of packaging material per kilogram of goods filled (or product packed):

$$\text{Material efficiency} = \frac{\text{Packaging material (Gram)}}{\text{Goods filled (Kilogram)}}$$

6. Closures, Auxiliary Packaging Material

> Material efficiency is indicated without taking into consideration closures and auxiliary packaging (e.g., labels, spouts, handling aids, inner bags, outer wraps, etc.).

> This approach is somewhat favourable to glass material, because the wide-neck closures on jars are usually heavier than other closures.

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7. Weighted-Mean of Nominal Fill Size

> Arithmetic mean of nominal fill sizes will not be used.

> That means, in the calculation of material efficiency, the market shares of each packaging variant and fill size are included in the mean value.

> The resulting mean value is therefore a weighted-mean.

> The same is applied in evaluating the impact of substituting plastic packaging with other packaging materials on the amount of waste. Weighted-mean based on market importance is also used in calculating the amount of plastic packaging to be substituted and of the substitute packaging materials.

8. Conversion and Standardization of Product Unit

> Around 1.400 products segments are depicted in GVM's database.

> The units of the nominal fill sizes of the individual products vary. The unit in which the product quantity placed on the market per packaging is usually indicated corresponds to the nominal fill size.

> Common product units are (selection): liter, kilogram, piece, pair, meter, square meter.

> Therefore, the product units have been converted to kilograms for standardisation.

> This work was carried out in a simplified procedure (primarily for the fast-moving consumer goods).

9. Examples for Material Efficiency

> The results are supplemented by examples of comparisons between plastic packaging and alternatives made from other materials.

> Examples of packaging that were placed on the market in Germany in 2023 were selected.

> All examples represent important market segments.

> Two following dimensions are given for each of the example.

- Packaging weight (in grams per package)
- Material efficiency (in grams per kilogram of packed product)

> This enables comparability between the packaging materials, even if the fill sizes are different in individual cases.

> Also in the case studies, only the weight of the container or main packaging material is taken into consideration. Closures and other ancillary components are not included in the specified dimensions.

10. Calculation of Substitution Amount

> In order to show the effects of the substitution of plastic packaging on the amount of packaging waste, substitution calculations for three case scenarios were carried out.

> In all three scenarios, it was assumed that 10% of the plastic packaging consumption of private end-user has to be replaced by single-use packaging made of other materials. Another assumption is that all plastic packaging of private end user will be substituted equally.

> Calculation was made for the following scenarios:

	Proportion of substitute materials used to replace plastic packaging		
	Case scenario A	Case scenario B	Case scenario C
Glass	25%	15%	20%
Paper, carton, cardboard	25%	45%	35%
Ferrous metals	25%	20%	10%
Aluminum	25%	20%	35%

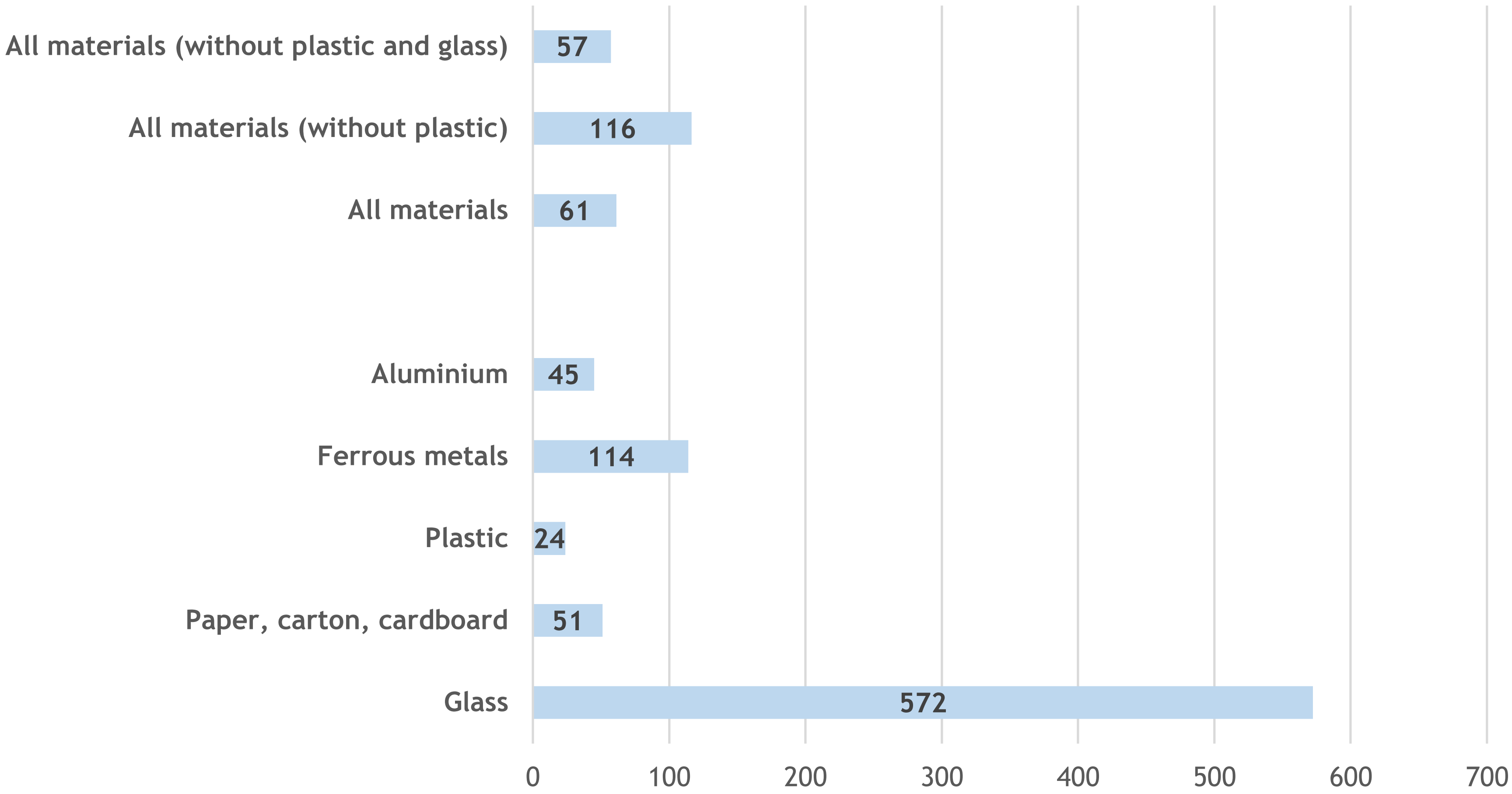
Results

Material efficiency of different packaging materials in comparison (private end-user consumption)

Glass	572	g/kg packed product
Paper, carton, cardboard	51	g/kg packed product
Plastic	24	g/kg packed product
Ferrous metals	114	g/kg packed product
Aluminium	45	g/kg packed product

All materials	**61**	**g/kg packed product**
All materials (without plastic)	**116**	**g/kg packed product**
All materials (without plastic and glass)	**57**	**g/kg packed product**

Material efficiency of different packaging materials in g/kg of packed product in comparison (private end-user consumption)



Examples

Example 1: Vinegar

Packaging for Vinegar

Plastic Packaging	**Glass Packaging**
Fill Size: 1,000 ml	Fill Size: 750 ml
Packaging weight (grams): 23.5	Packaging weight (grams): 406.9
Material efficiency (g/l packed product): 23.5	Material efficiency (g/l packed product): 542.5

The glass bottle for 1 liter of vinegar is approximately 23 times heavier than the plastic bottle.

Example 2: Soft Drink

Packaging for Soft Drinks

Plastic Packaging

Fill Size: 500 ml

Packaging weight (grams): 12.3

Material efficiency (g/l packed product): 24.6

Aluminium Packaging

Fill Size: 500 ml

Packaging weight (grams): 15.6

Material efficiency (g/l packed product): 31.2

The aluminium can is about 1.3 times heavier than the PET bottle.

Example 3: Spaghetti

Packaging for Spaghetti

Plastic Packaging	**Carton Packaging**
Fill Size: 500 g	Fill Size: 500 g
Packaging weight (grams): 3.6	Packaging weight (grams): 16
Material efficiency (g/kg packed product): 7.1	Material efficiency (g/kg packed product): 32.1

The box made of cardboard for pasta is about five times heavier than the plastic bag.

Example 4: Sauerkraut

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Packaging for Sauerkraut

Plastic Packaging

Fill Size: 400 g
Packaging weight (grams): 8.7
Material efficiency (g/kg packed product): 21.9

Tinplate Packaging

Fill Size: 400 g
Packaging weight (grams): 48.7
Material efficiency (g/kg packed product): 121.8

The tin can is about 6 times heavier tan the plastic stand-up pouch.

Example 5: Red Cabbage

Packaging for Red Cabbage

Plastic Packaging	Glass Packaging
Fill Size: 400 g	Fill Size: 350 g
Packaging weight (grams): 6.8	Packaging weight (grams): 181.6
Material efficiency (g/kg packed product): 17.1	Material efficiency (g/kg packed product): 518.9

The canning jar for one kilogram of red cabbage is around 30 times heavier than the stand-up plastic bag.

Example 6: Chocolate

Packaging for Chocolate

Plastic Packaging

Fill Size: 100 g
Packaging weight (grams): 1.4
Material efficiency (g/kg packed product): 13.9

Carton Packaging

Fill Size: 100 g
Packaging weight (grams): 9.7
Material efficiency (g/kg packed product): 97.0

The folding box from carton is about seven times heavier than the plastic bag.

Example 7: Chocolate Biscuits with Milk Cream Filling

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Packaging for Chocolate Biscuits

Plastic Packaging	**Carton Packaging**
Fill Size: 154 g	Fill Size: 176 g
Packaging weight (grams): 1.6	Packaging weight (grams): 25.6
Material efficiency (g/kg packed product): 10.4	Material efficiency (g/kg packed product): 145.6

The folding box from carton is about 14 times heavier than the plastic bag.

Example 8: Cat Food

Packaging for Cat Food

Plastic Packaging	Aluminium Packaging
Fill Size: 85 g	Fill Size: 85 g
Packaging weight (grams): 2.9	Packaging weight (grams): 8.7
Material efficiency (g/kg packed product): 34.0	Material efficiency (g/kg packed product): 102.6

The aluminium can is approximately three times heavier than the plastic stand-up pouch.

Conclusions with regard to the Prevention Targets in the Proposal of EU-Packaging Regulation

Prevention targets in the Proposal for EU-Packaging Regulation

	Proposal for EU Packaging and Packaging Waste Regulation (published on 30.11.2022) *All Packaging Materials (per capita)*	Proposal for Amendments from EU-Parliament or Proposal from Rapporteur of EU-Parliament (Ries-Report) *Only Plastic Packaging (per capita)*
by 2030	**5 % lower than in 2018**	**10 % lower than in 2018**
by 2035	**10 % lower than in 2018**	**15 % lower than in 2018**
by 2040	**15 % lower than in 2018**	**20 % lower than in 2018**

Estimated Amount of Substitution

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	Proportion of substitute materials used to replace plastic packaging		
	Case scenario A	Case scenario B	Case scenario C
Glass	25%	15%	20%
Paper, carton, cardboard	25%	45%	35%
Ferrous metals	25%	20%	10%
Aluminum	25%	20%	35%
Decrease in plastic	-10%	-10%	-10%
Increase in substitute materials	+25%	+18%	+21%
Increase in private end-user consumption volume - all materials	**+17%**	**+12%**	**+13%**

Case scenarios differ in the assumptions regards the proportion of packaging materials used to replace plastic packaging.

Scenario assumption: 10% of plastic packaging needs to be replaced

Results: the effects on the amount of sales packaging consumed by private end consumers

The amount of household-generated packaging would increase from 10% to 20% if 10% of plastic packaging had to be replaced by other packaging materials.

Conclusion

- The **prevention targets** specified in Art. 38 of the Proposal for EU-Packaging Regulation **cannot be achieved**, if a significant amount of lightweight plastic packaging is replaced by heavier packaging materials.
- If the market share of plastic packaging is reduced by 10 percentage points by 2030, the total volume of packaging consumption will increase (ceteris paribus).
- The extent to which the volume of packaging consumption increases depends on the materials with which plastic packaging is replaced.
- The results presented here show: **that the amount of household-generated packaging would increase from 10% to 20% if 10% of plastic packaging had to be replaced by other packaging materials.**
- As a result, there is a pronounced **goal conflict** between the targets of “reducing the amount of plastic packaging” and “reducing the amount of packaging waste”.

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