# Characterisation and material flows of non-packaging plastics in municipal solid waste streams: a case study from Vienna

Supplementary-file

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## Abbreviations

| | |
|---|---|
| FTIR | Fourier transform infrared spectroscopy |
| NPW | Non-packaging plastic waste |
| MSW | Municipal solid waste |
| LPW | Lightweight packaging waste |

# S1. Introduction

N.D.

# S2. Materials and methods

## S2.1 Material flows of NPW in Vienna

### S2.1.1 Scope

### S2.1.2 Material flow analysis of NPW

## S2.2 Sampling and characterisation of NPW

Through the following link, pictures of the analysed samples in mixed MSW and LWP can be accessed:
https://zenodo.org/records/17131030?token=eyJhbGciOiJIUzUxMiJ9.eyJpZCI6IjQ3ZGY3MjM4LTYwNGEtNGZmNC1iMzYxLWJjNThiMTg2M2NmYyIsImRhdGEiOnt9LCJyYW5kb20iOiJiZGM0NTg4Y2VhMDZkMjQ2OWQ4NTU4NWE1NmM0ZjBkNiJ9.dH9lKTHE8foeyOQSeVcsozUO0usUd8KgcI7fQDNw9Jg8nj_arjOX5kN_WiqwdiaI2GhiE95S9zFoL4PtKKcp3g

### S2.2.1 Waste sampling and pre-sorting

N.D.

## S2.2.2 Conducted characterisation of NPW

### *S2.2.2.1 Sorting catalogue*

*Table S1: Sorting catalogue for non-packaging plastics, distinguished on three levels with additional product examples. An area of application (I) is mostly composed of various product types (II and III).*

| (I) Area of application | (II) Sub-level 1 | (III)Sub-level 2 | Product examples |
|---|---|---|---|
| **1. Building and construction** | 1.1 Building and construction material | 1.1.1 Pipes | - |
| | | 1.1.2 Tubes | - |
| | | 1.1.3 Building supplies | Cable ties, paint roller kit |
| | 1.2 Sanitary engineering equipment | - | Toilet seat, sanitary fittings |
| **2. Transport** | - | - | Windscreen wipers, car mat |
| **3. Electronics** | 3.1 Cables and printed circuit boards | - | - |
| | 3.2 Electrical appliance accessories | - | Toothbrush head, trimmer attachment |
| | 3.3 Mobile phone and tablet cases | - | - |
| **4. Furniture** | - | - | Plastic recliner |
| **5. Agriculture and gardening** | - | - | Plant pots |
| **6. Medicine** | 6.1 Disposable gloves | - | - |
| | 6.2 Condoms | - | - |
| | 6.3 Syringes | - | - |
| | 6.4 Other medical equipment | - | Urinary beakers, COVID-19 home test kit |
| **7. Household** | 7.1 Household cleaning | 7.1.1 Sponges | - |
| | | 7.1.2 Sponge cloths | - |
| | | 7.1.3 Brooms, brushes, scrubbers | - |
| | | 7.1.4 Hanging toilet fresheners | - |
| | | 7.1.5 Reusable gloves | - |
| | 7.2 Kitchen-use products | 7.2.1 Kitchen utensils | Spatulas, cutting boards, containers |
| | | 7.2.2 Beverage bottles and cups | - |
| | | 7.2.3 Single-use plastics | Straws, disposable cutlery and plates |
| | 7.3 Miscellaneous household items | 7.3.1 Coat-hangers | - |
| | | 7.3.2 Buckets and baskets | - |
| | | 7.3.3 Bathroom accessories | Soap dish, shower mat |
| | | 7.3.4 Decorative items | Fake plants |
| **8. Others** | 8.1 Leisure | 8.1.1 Toys | - |
| | | 8.1.2 Balloons | - |
| | | 8.1.3 Festive articles | Gift ribbons, confetti shooters |
| | | 8.1.4 Pet supplies | Dog leash |
| | | 8.1.5 Analogue media | CD's, DVD's, videocassettes |
| | | 8.1.6 Accessories | Jewellery, sunglasses, hair clips |

| | | | |
|---|---|---|---|
| | 8.2 Office supplies | 8.2.1 Folders | - |
| | | 8.2.2 Stationary | Pens, rulers |
| | 8.3 Body cleansing and personal care | 8.3.1 Toothbrushes | - |
| | | 8.3.2 Dental floss sticks | - |
| | | 8.3.3 Shavers | - |
| | | 8.3.4 Hair combs and brushes | - |
| | | 8.3.5 Misc. cosmetic products | Shower puff |
| | 8.4 Miscellaneous products | 8.4.1 Gift and membership cards | |
| | | 8.4.2 Product accessories | Baby formula measuring spoons/cups |
| | 8.5 Non-assignable product type | 8.5.1 Black plastics | - |
| | | 8.5.2 Grey plastics | - |
| | | 8.5.3 White plastics | - |
| | | 8.5.4 Transparent plastics | - |
| | | 8.5.5 Coloured plastics | - |
| | | 8.5.6 Rubbers | - |
| | | 8.5.7 Foam materials | - |
| | | 8.5.8 Non-identifiable or assignable | - |

#### *S2.2.2.2 FTIR-spectroscopy*

During the analysis a total of four different spectra databases with various entries were active:

- "D-ATR plastics abf.lib" with 44 entries
- "Agilent Elastomer Oring and Seal handheld ATR Library.lib" with 771 entries
- "Agilent Polymer handheld ATR Library.lib" with 186 entries
- "ATR Demo Library.lib" with 55 entries

The analysis was conducted with two sample interfaces (lenses). The Diamond ATR Sample Interface penetrates the first 2 – 3 µm while the Germanium ATR Sample Interface only reaches the first 0.5 – 2 µm and is therefore suitable for highly absorbent samples (Agilent Technologies, s.a.). The latter sample interface was used for black plastics or rubbers. To record environmental conditions (e.g. humidity) and avoid anomalies during the scanning process, a background scan was conducted every 10 minutes. Additionally, the respective measurement points of the sample as well as the sample interface were cleaned with ethanol before each measurement. When a scan produced ambiguous spectra, the scan was repeated until a match of the aforementioned 70 % was accomplished. The resolution of the FTIR was set to 4 $cm^{-1}$ with an accepted error margin of ± 1 $cm^{-1}$. A total of 32 scans per conducted measurement were conducted. The laser was calibrated using a NIST SRM 1921 polystyrene film.

### S2.2.3 Presentation of results

N.D.

# S3. Results and discussion

## S3.1 Material flows of goods subgoods

N.D.

## S3.2 Areas of application and product types of NPW in Vienna

NPW <5cm / not analysed also include medical equipment that has been excluded from further analysis due to hygienic and safety reasons (e.g. used syringes). Where present, the share of <5cm and not analysed items is indicated using brackets.

*Table S2: Composition of non-packaging plastics in mixed MSW and LPW according to areas of application in weight percent (w%, dry matter basis).*

| Waste streams / Areas | Mixed MSW | LPW |
|---|---|---|
| | w% | w% |
| 1. Building and Construction | 17.8% | 4.1% |
| 2. Transport | 0.2% | 6.6% |
| 3. Electronics | 2.8% | 1.8% |
| 4. Furniture | 0.5% | 9.1% |
| 5. Agriculture and Gardening | 2.6% | 1.9% |
| 6. Medicine | 16.7% | 0.9% |
| 7. Household | 26.1% | 27.6% |
| 8. Others | 24.8% | 45.3% |
| <5cm / not analysed | 8.4% | 2.7% |

*Table S3: Distribution of NPW-product type samples in mixed MSW and LPW according to sub-level 1 of Household and Others (w%, dry matter basis).*

| Areas of application | Waste streams / Sub-level 1 | Mixed MSW | LPW |
|---|---|---|---|
| | | w% / (<5 cm / not analysed) | w% / (<5 cm / not analysed) |
| 7. Household | 7.1 Household cleaning | 75.5% | 24.5% |
| | 7.2 Kitchen-use products | 23.6% | 76.3% |
| | 7.3 Misc. household items | 58.2% / (0.1%) | 41.2% / (0.5%) |
| 8. Others | 8.1 Leisure | 34.8% / (9.2%) | 55.3% / (0.7%) |
| | 8.2 Office supplies | 73.1% / (3.7%) | 20.6% / (2.6%) |
| | 8.3 Body cleansing and personal care | 56.5% / (7.2%) | 36.3% |
| | 8.4 Misc. products | 32.8% / (5.1%) | 57.3% / (4.8%) |
| | 8.5 Non-assignable product type | 21.7% / (1.2%) | 75.3% / (1.7%) |

*Table S4: Distribution of NPW-product type samples in mixed MSW and LPW according to sub-level 1 of Building and construction, Transport, Electronics, Furniture, Agriculture and gardening and Medicine (w%, dry matter basis).*

| Areas of application | Waste streams / Sub-level 1 | Mixed MSW | LPW |
|---|---|---|---|
| | | w% / (<5 cm / not analysed) | w% / (<5 cm / not analysed) |
| 1. Building and construction | 1.1 Building and construction material | 64.6% / (0.4%) | 34.7% / (0.3%) |
| | 1.2 Sanitary engineering equipment | 94.6% | 5.4% |
| 2. Transport | / | 2.8% | 97.2% |
| 3. Electronics | 3.1 Cables and printed circuit boards | 76% / (0.9%) | 17.9% / (5.1%) |
| | 3.2 Electrical appliance accessories | 41.1% / (1.7%) | 57.2% |
| | 3.3 Mobile phone and tablet cases | 30.2% | 69.8% |
| 4. Furniture | / | 4.4% | 95.6% |
| 5. Agriculture and gardening | / | 51.2% / (0.8%) | 48% |
| 6. Medicine | 6.1 Disposable gloves | 93.6% | 6.4% |
| | 6.2 Condoms | 88.6% | 11.4% |
| | 6.3 Syringes | 84.8% | 15.2% |
| | 6.4 Other medical equipment | 55.5% | 44.5% |

*Table S5: Distribution of NPW-product type samples in mixed MSW and LPW according to sub-level 2 (w%, dry matter basis).*

| Sub-level 1 | Waste streams / Sub-level 2 | Mixed MSW | LPW |
|---|---|---|---|
| | | w% / (<5 cm / not analysed) | w% / (<5 cm / not analysed) |
| 1.1 Building and construction material | 1.1.1 Pipes | 85.2% | 14% / (0.9%) |
| | 1.1.2 Tubes | 49% / (0.6%) | 50.4% |
| | 1.1.3 Building supplies | 86.7% / (0.4%) | 12.9% |
| 7.1 Household cleaning | 7.1.1 Sponges | 89.5% | 10.5% |
| | 7.1.2 Sponge cloths | 97.5% | 2.5% |
| | 7.1.3 Brooms, brushes, scrubbers | 59.8% | 40.2% |
| | 7.1.4 Hanging toilet fresheners | 84.8% | 15.2% |
| | 7.1.5 Reusable gloves | 45.4% | 54.6% |
| 7.2 Kitchen-use products | 7.2.1 Kitchen utensils | 26.7% | 73.2% |
| | 7.2.2 Beverage bottles and cups | 6.5% | 93.5% |
| | 7.2.3 Single-use plastics | 91.9% | 8.1% |
| 7.3 Other household items | 7.3.1 Coat-hangers | 24.7% | 73.9% / (1.4%) |
| | 7.3.2 Buckets and baskets | 63.9% | 35.7% / (0.4%) |
| | 7.3.3 Bathroom accessories | 92% / (1.3%) | 6.6% |
| | 7.3.4 Decorative items | 0% | 100% |
| 8.1 Leisure | 8.1.1 Toys | 30.8% / (11.9%) | 56.4% / (0.9%) |
| | 8.1.2 Balloons | 33.2% / (3.1%) | 63.6% |
| | 8.1.3 Festive articles | 100% | 0% |

| | | | |
|---|---|---|---|
| | 8.1.4 Pet supplies | 46.6% | 53.4% |
| | 8.1.5 Analogue media | 46.4% | 53.4% / (0.2%) |
| | 8.1.6 Accessories | 44.1% / (20%) | 35.8% |
| 8.2 Office supplies | 8.2.1 Folders | 73.5% | 26.5% |
| | 8.2.2 Stationary | 72.6% / (9.1%) | 12% / (6.3%) |
| 8.3 Body cleansing and personal care | 8.3.1 Toothbrushes | 60.7% / (5.6%) | 33.6% |
| | 8.3.2 Dental floss sticks | 0% / (100%) | 0% |
| | 8.3.3 Shavers | 84.6% | 15.4% |
| | 8.3.4 Hair combs and brushes | 21.2% | 78.8% |
| | 8.3.5 Other cosmetic products | 76.2% | 23.8% |
| 8.4 Other products | 8.4.1 Gift and membership cards | 49.7% | 50.3% |
| | 8.4.2 Product accessories | 28% / (6.6%) | 59.2% / (6.2%) |
| 8.5 Non-assignable product type | 8.5.1 Black plastics | 13.5% / (1.9%) | 82.2% / (2.4%) |
| | 8.5.2 Grey plastics | 7.7% / (1%) | 87.2% / (4.1%) |
| | 8.5.3 White plastics | 31% / (0.7%) | 67.3% / (1%) |
| | 8.5.4 Transparent plastics | 19.8% / (0.6%) | 78.1% / (1.5%) |
| | 8.5.5 Coloured plastics | 5.7% / (3%) | 89.5% / (1.8%) |
| | 8.5.6 Rubbers | 9.3% / (0.7%) | 89.1% / (0.8%) |
| | 8.5.7 Foam materials | 0% | 100% |
| | 8.5.8 Non-identifiable or assignable | 52.1% / (0.2%) | 47.3% / (0.4%) |

## S3.3 Polymer composition and material flows of NPW in Vienna

### S3.3.1 Presence of Resin Identification Code (RIC) in analysed samples

Table S6 and S7 demonstrate that the share of NPP without a RIC outweighs the share of NPP with a RIC by weight and number of objects. However, the small amount of NPP with RIC contributed to around a quarter of the total mass because these articles were of larger size or not fragmented, enabling the location of a RIC.

*Table S6: Share of RIC found on NPP in mixed MSW and LPW in w% (dry matter basis).*

| | RIC present (w%) | RIC absent (w%) |
|---|---|---|
| **Mixed MSW** | 29 % | 71 % |
| **LPW** | 24 % | 76 % |

*Table S7: Share of RIC found on NPP in mixed MSW and LPW in relation to the number of articles.*

| | RIC present (number of objects) | RIC absent (number of objects) |
|---|---|---|
| **Mixed MSW** | 81 | 1,501 |
| **LPW** | 119 | 704 |

### S3.3.2 Detailed breakdown of other polymers

Table 8 and 9 list the various types of other polymers found in the analysed waste streams. Polymers with a share of less than 1 w% are summarized under “<1 w%”. Polymers with a Resin Identification Code 7 (Others) were not further analysed. In total 47 different other polymers were identified. It should be emphasized that the polymers below are only to be seen as exemplary findings. The FTIR-analysis did not always enable the exact polymer detection, as can be seen with dioctyl phthalate, which is only a commonly used plasticizer but not the polymer of the object itself (National Library of Medicine, 2025). It should further be noted that the large share of nitrile rubber in mixed MSW can mainly be traced back to disposable gloves from a dental clinic.

*Table S8: Listing of other polymer types found in NPP in mixed MSW (w%, dry matter basis). Share of other polymers in mixed MSW = 45 %.*

| Mixed MSW | |
|---|---|
| **Polymers** | **Share of Other polymers** |
| Nitrile rubber | 38.4 % |
| PUR | 13.3 % |
| ABS/PS | 12.8 % |
| Aramide | 7.1 % |
| Latex | 4.6 % |
| Polyester urethane rubber | 4.4 % |
| PC | 4.2 % |
| Dioctyl phthalate | 3.1 % |
| PTFE | 1.9 % |
| ABS/PP/PS | 1.6 % |
| PA | 1.3 % |
| Hypalon | 1.3 % |
| <1 w% | 5.9 % |

*Table S9: Listing of other polymer types found in NPP in the separate LPW collection. Share of other polymers in separate LPW collection = 41 %.*

| LPW | |
|---|---|
| **Polymers** | **Share of Other polymers** |
| PA | 14.9 % |
| PC | 14.8 % |
| Dioctyl phthalate | 11.2 % |
| Nitrile rubber | 6.3 % |
| Polyacrylate | 4.6 % |
| PMMA | 4.5 % |
| Ethylene propylene rubber | 3.7 % |
| Chlorbutyl | 3.5 % |
| PUR | 3.4 % |
| ABS | 3.3 % |
| Epoxy | 3.1 % |
| Polyester urethane rubber | 3.0 % |
| Fluorine rubber | 2.8 % |
| Styrene Copolymer | 2.6 % |
| ABS/PC | 2.2 % |
| EPDM rubber | 2.1 % |
| PP/EPDM rubber | 1.9 % |
| Other | 1.8 % |
| HNBR | 1.5 % |
| PAM | 1.4 % |
| Latex | 1.3 % |
| <1 w% | 6.2 % |

### S3.3.3 Polymer content per area of application and product type

Figure S1 – S6 and Table S10- S16 show the contents of polymers per product type (sub-level 1 and 2) in mixed MSW and LPW as well as the extrapolated and rounded tons per year per product type. Areas of application, where no further distinction into sub-levels was conducted are not depicted in the following figures. The data assumes that the NPP analysed consisted of monopolymers.

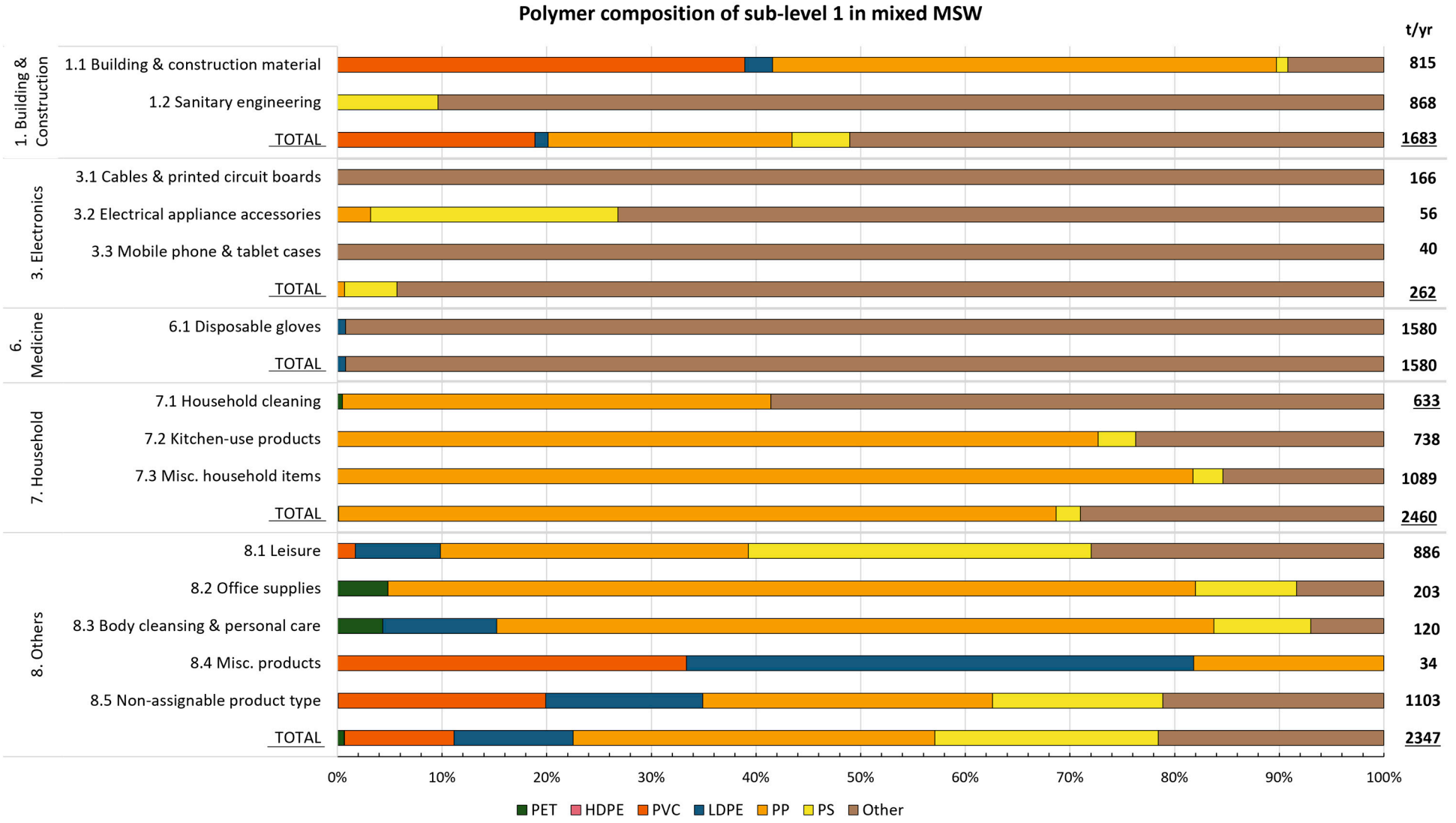



*Figure S1: Content and amount of polymers per sub-level 1 in mixed MSW in w% and t/yr of sub-level 1 plastic products, on a dry matter basis (values rounded). Data does not include share of <5cm/not analysed.*

*Table S10: Content and amount of polymers per sub-level 1 in mixed MSW in w% and t/yr of sub-level 1 plastic products, on a dry matter basis.*

| | | PET | HDPE | PVC | LDPE | PP | PS | Other | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | t/yr |
| **1. Building and Construction** | 1.1 Building and construction material | - | - | 38.9% / 317.4 t/yr | 2.6% / 21.6 t/yr | 48.1% / 392.3 t/yr | 1.1% / 9.1 t/yr | 9.2% / 74.7 t/yr | 815.2 t/yr |
| | 1.2 Sanitary engineering equipment | - | - | - | - | - | 9.6% / 83.4 t/yr | 90.4% / 784.1 t/yr | 867.5 t/yr |
| | **TOTAL** | - | - | 18.9% / 317.4 t/yr | 1.3% / 21.6 t/yr | 23.3% / 392.3 t/yr | 5.5% / 92.6 t/yr | 51% / 858.8 t/yr | 1682.7 t/yr |
| **3. Electronics** | 3.1 Cables and printed circuit boards | - | - | - | - | - | - | 100% / 166.2 t/yr | 166.2 t/yr |
| | 3.2 Electrical appliance accessories | - | - | - | - | 3.2% / 1.8 t/yr | 23.6% / 13.1 t/yr | 73.2% / 40.7 t/yr | 55.6 t/yr |
| | 3.3 Mobile phone and tablet cases | - | - | - | - | - | - | 100% / 40.2 t/yr | 40.2 t/yr |
| | **TOTAL** | - | - | - | - | 0.7% / 1.8 t/yr | 5% / 13.1 t/yr | 94.3% / 247.1 t/yr | 262 t/yr |
| **6. Medicine** | 6.1 Disposable gloves | - | - | - | 0.8% / 12.4 t/yr | - | - | 99.2% / 1567.4 t/yr | 1579.8 t/yr |
| | **TOTAL** | - | - | - | 0.8% 12.4 t/yr | - | - | 99.2% / 1567.4 t/yr | 1579.8 t/yr |
| **7. Household** | 7.1 Household cleaning | 0.5% / 3 t/yr | - | - | - | 40.9% / 258.9 t/yr | - | 58.6% / 370.7 t/yr | 632.7 t/yr |
| | 7.2 Kitchen-use products | - | - | - | - | 72.7% / 536.7 t/yr | 3.6% / 26.5 t/yr | 23.7% / 175 t/yr | 738.2 t/yr |
| | 7.3 Misc. household items | - | - | - | - | 81.8% / 890.6 t/yr | 2.9% / 31.2 t/yr | 15.4% / 167.4 t/yr | 1089.3 t/yr |
| | **TOTAL** | 0.1% / 3 t/yr | - | - | - | 68.5% / 1686,3 t/yr | 2.3% / 57.7 t/yr | 29% / 713.1 t/yr | 2460.1 t/yr |
| **8. Others** | 8.1 Leisure | - | - | 1.7% / 15 t/yr | 8.2% / 72.3 t/yr | 29.4% / 260.8 t/yr | 32.8% / 290.4 t/yr | 28% / 247.9 t/yr | 886.4 t/yr |
| | 8.2 Office supplies | 4.8% / 9.8 t/yr | - | - | - | 77.1% / 156.4 t/yr | 9.7% / 19.6 t/yr | 8.3% / 16.9 t/yr | 202.7 t/yr |
| | 8.3 Body cleansing and personal care | 4.2% / 5.2 t/yr | - | - | 10.9% / 13.1 t/yr | 68.5% / 82.6 t/yr | 9.3% / 11.2 t/yr | 7% / 8.4 t/yr | 120.5 t/yr |
| | 8.4 Misc. products | - | - | 33.4% / 11.5 t/yr | 48.5% / 16.7 t/yr | 18.2% / 6.3 t/yr | - | - | 34.5 t/yr |
| | 8.5 Non-assignable product type | - | 0.1% / 1 t/yr | 19.8% / 218.7 t/yr | 15% / 165.5 t/yr | 27.7% / 305.3 t/yr | 16.3% / 179.4 t/yr | 21.1% / 233.1 t/yr | 1103 t/yr |
| | **TOTAL** | 0,6% / 15.1 t/yr | 0.04% / 1 t/yr | 10.4% / 245.2 t/yr | 11.4% / 267.7 t/yr | 34.6% / 811.3 t/yr | 21.3% / 500.6 t/yr | 21.6% / 506.3 t/yr | 2347.1 t/yr |

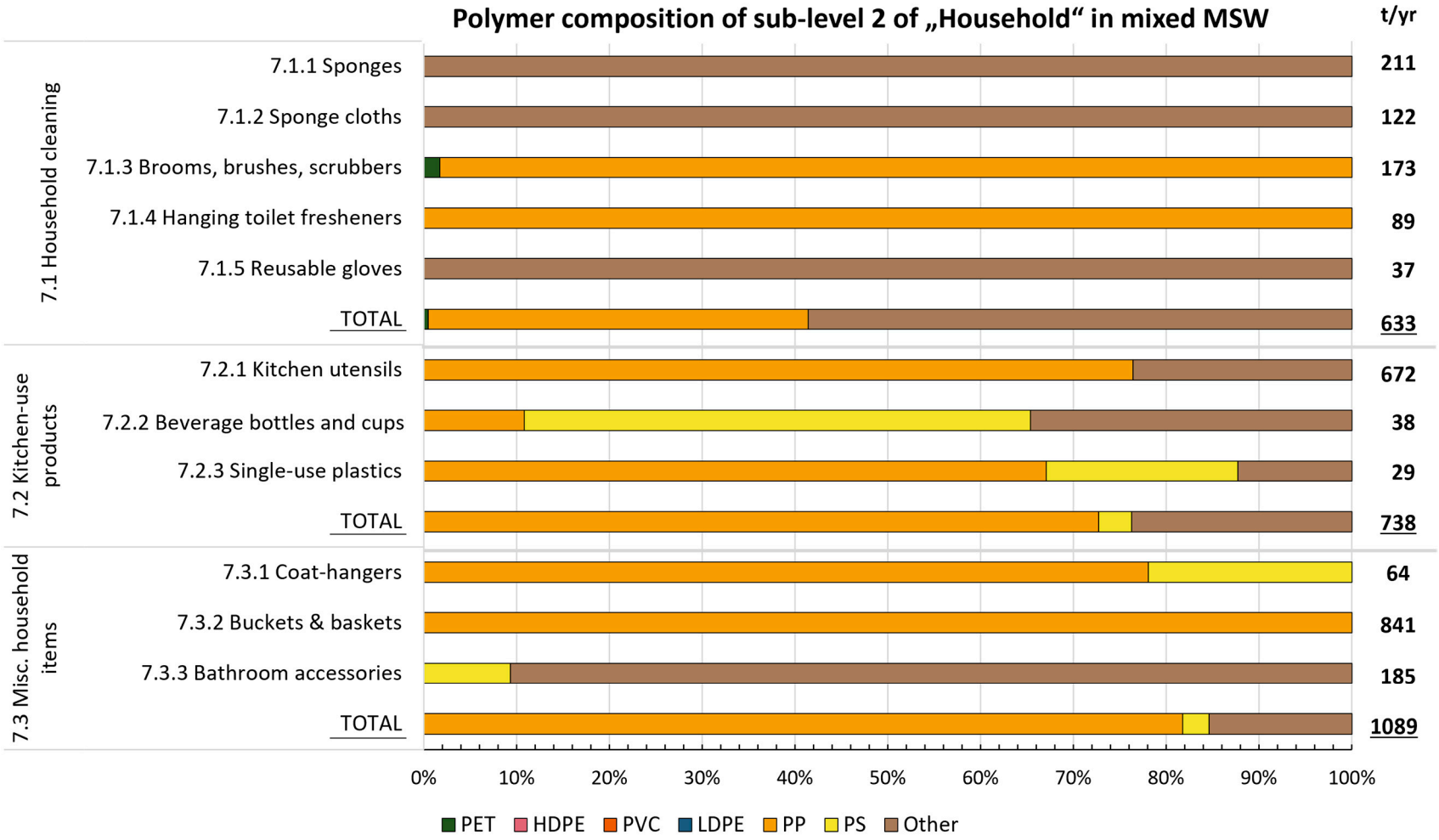



*Figure S2: Content of polymers per sub-level 2 of "Household" in mixed MSW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis (values rounded). Data does not include share of <5cm/not analysed.*

*Table S11: Content of polymers per sub-level 2 of "Household" in mixed MSW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis.*

| | | PET | HDPE | PVC | LDPE | PP | PS | Other | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | t/yr |
| **7.1 Household cleaning** | 7.1.1 Sponges | - | - | - | - | - | - | 100% / 211 t/yr | 211 t/yr |
| | 7.1.2 Sponge cloths | - | - | - | - | - | - | 100% / 122.5 t/yr | 122.5 t/yr |
| | 7.1.3 Brooms, brushes, scrubbers | 2% / 3 t/yr | - | - | - | 98.3% / 169.8 t/yr | - | - | 172.8 t/yr |
| | 7.1.4 Hanging toilet fresheners | - | - | - | - | 100% / 89.2 t/yr | - | - | 89.2 t/yr |
| | 7.1.5 Reusable gloves | - | - | - | - | - | - | 100% / 37.3 t/yr | 37.3 t/yr |
| | **TOTAL** | 0.5% / 3 t/yr | - | - | - | 40.9% / 258.9 t/yr | - | 58.6% / 370.7 t/yr | 632.7 t/yr |
| **7.2 Kitchen-use products** | 7.2.1 Kitchen utensils | - | - | - | - | 76.4% / 513.4 t/yr | - | 23.6% / 158.4 t/yr | 671.8 t/yr |
| | 7.2.2 Beverage bottles and cups | - | - | - | - | 10.8% / 4.1 t/yr | 54.5% / 20.6 t/yr | 34.6% / 13.1 t/yr | 37.7 t/yr |
| | 7.2.3 Single-use plastics | - | - | - | - | 67.1% / 19.2 t/yr | 20.6% / 5.9 t/yr | 12.3% / 3.5 t/yr | 28.7 t/yr |
| | **TOTAL** | - | - | - | - | 72.7% / 536.7 t/yr | 3.6% / 26.5 t/yr | 23.7% / 175 t/yr | 738.2 t/yr |
| **7.3 Misc. household items** | 7.3.1 Coat-hangers | - | - | - | - | 78.1% / 49.8 t/yr | 21.9% / 14 t/yr | - | 63.8 t/yr |
| | 7.3.2 Buckets and baskets | - | - | - | - | 100% / 840.8 t/yr | - | - | 840.8 t/yr |
| | 7.3.3 Bathroom accessories | - | - | - | - | - | 9.3% / 17.3 t/yr | 90.7% / 167.4 t/yr | 184.7 t/yr |
| | **TOTAL** | - | - | - | - | 81.8% / 890.6 t/yr | 2.9% / 31.2 t/yr | 15.4% / 167.4 t/yr | 1089.3 t/yr |

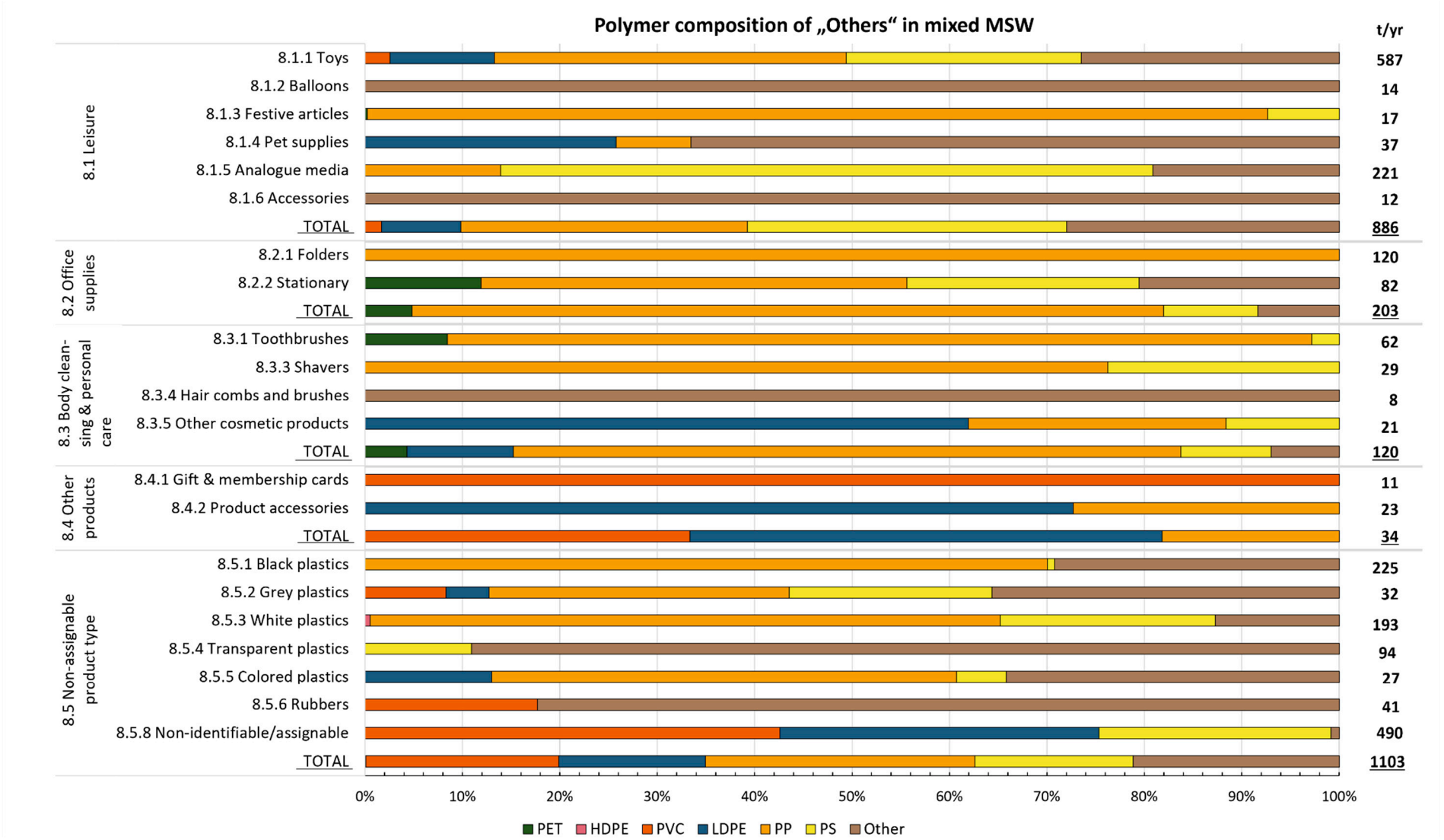



*Figure S3: Contents of polymers per sub-level 2 of "Others" in mixed MSW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis (values rounded). Data does not include share of <5cm/not analysed.*

*Table S12: Content of polymers per sub-level2 of "Others" in mixed MSW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis.*

| | | PET | HDPE | PVC | LDPE | PP | PS | Other | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | t/yr |
| **8.1 Leisure** | 8.1.1 Toys | - | - | 2.6% / 15 t/yr | 10.7% / 62.9 t/yr | 36.1% / 211.9 t/yr | 24.1% / 141.4 t/yr | 26.5% / 155.4 t/yr | 586.6 t/yr |
| | 8.1.2 Balloons | - | - | - | - | - | - | 100% / 14.2 t/yr | 14.2 t/yr |
| | 8.1.3 Festive articles | 0.2% / 0,04 t/yr | - | - | - | 92.4% / 15.4 t/yr | 7.4% /1.2 t/yr | - | 16.7 t/yr |
| | 8.1.4 Pet supplies | - | - | - | 25.8% / 9.5 t/yr | 7.7% / 2.8 t/yr | - | 66.5% / 24.5 t/yr | 36.8 t/yr |
| | 8.1.5 Analogue media | - | - | - | - | 13.9% / 30.7 t/yr | 66.9% / 147.4 t/yr | 19.1% / 42.2 t/yr | 220.6 t/yr |
| | 8.1.6 Accessories | - | - | - | - | - | - | 100% / 11.5 t/yr | 11.5 t/yr |
| | **TOTAL** | - | - | 1.7% / 15 t/yr | 8.2% / 72.3 t/yr | 29.4% / 260.8 t/yr | 32.8% / 290.4 t/yr | 28% / 247.9 t/yr | 886.4 t/yr |
| **8.2 Office supplies** | 8.2.1 Folders | - | - | - | - | 100% / 120.4 t/yr | - | - | 120.4 t/yr |
| | 8.2.2 Stationary | 11.9% / 9.8 t/yr | - | - | - | 43.7% / 36 t/yr | 23.8% / 19.6 t/yr | 20.6% / 16.9 t/yr | 82.3 t/yr |
| | **TOTAL** | 4.8% / 9.8 t/yr | - | - | - | 77.1% / 156.4 t/yr | 9.7% / 19.6 t/yr | 8.3% / 16.9 t/yr | 202.7 t/yr |
| **8.3 Body cleansing and personal care** | 8.3.1 Toothbrushes | 8.5% / 5.2 t/yr | - | - | - | 88.7% / 54.6 t/yr | 2.8% / 1.7 t/yr | - | 61.5 t/yr |
| | 8.3.3 Shavers | - | - | - | - | 76.2% / 22.3 t/yr | 23.8% / 7 t/yr | - | 29.3 t/yr |
| | 8.3.4 Hair combs and brushes | - | - | - | - | - | - | 100% / 8.4 t/yr | 8.4 t/yr |
| | 8.3.5 Misc. cosmetic products | - | - | - | 61.9% / 13.1 t/yr | 26.5% / 5.6 t/yr | 11.6% / 2.5 t/yr | - | 21.2 t/yr |
| | **TOTAL** | 4.3% / 5.2 t/yr | - | - | 10.9% / 13.1 t/yr | 68.5% / 82.6 t7yr | 9.3% / 11.2 t/yr | 7% / 8.4 t/yr | 120.5 t/yr |
| **8.4 Misc. products** | 8.4.1 Gift and membership cards | - | - | 100% / 11.5 t/yr | - | - | - | - | 11.5 t/yr |
| | 8.4.2 Product accessories | - | - | - | 72.7% / 16.7 t/yr | 27.3% / 6.3 t/yr | - | - | 23 t/yr |
| | **TOTAL** | - | - | 33.4% / 11.5 t/yr | 48.5% / 16.7 t/yr | 18.2% / 6.3 t/yr | - | - | 34.5 t/yr |
| | 8.5.1 Black plastics | - | - | - | - | 70.1% / 157.7 t/yr | 0.8% / 1.7 t/yr | 29.2% / 65.7 t/yr | 225 t/yr |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **8.5 Non-assignable product type** | 8.5.2 Grey plastics | - | - | 8.3% / 2.7 t/yr | 4.4% / 1.4 t/yr | 30.8% / 9.9 t/yr | 20.8% / 6.6 t/yr | 35.6% / 11.4 t/yr | 32 t/yr |
| | 8.5.3 White plastics | - | 0.5% / 1 t/yr | - | - | 64.7% / 124.7 t/yr | 22.1% / 42.6 t/yr | 12.7% / 24.5 t/yr | 192.8 t/yr |
| | 8.5.4 Transparent plastics | - | - | - | - | - | 10.9% / 10.3 t/yr | 89.1% / 84 t/yr | 94.3 t/yr |
| | 8.5.5 Coloured plastics | - | - | - | 13% / 3.6 t/yr | 47.7% / 13.1 t/yr | 5.1% / 1.4 t/yr | 34.2% / 9.4 t/yr | 27.4 t/yr |
| | 8.5.6 Rubbers | - | - | 17.7% / 7.3 t/yr | - | - | - | 82.3% / 34.1 t/yr | 41.4 t/yr |
| | 8.5.8 Non-identifiable/assignable | - | - | 42.6% / 208.7 t/yr | 32.8% 160.5 t/yr | - | 23.8% / 116.8 t/yr | 0.8% / 4 t/yr | 490.1 t/yr |
| | **TOTAL** | - | 0.1% / 1 t/yr | 19.8% / 218.7 t/yr | 15% / 165.5 t/yr | 27.7% / 305.3 t/yr | 16.3% / 179.4 t/yr | 21.1% / 233.1 t/yr | 1103 t/yr |

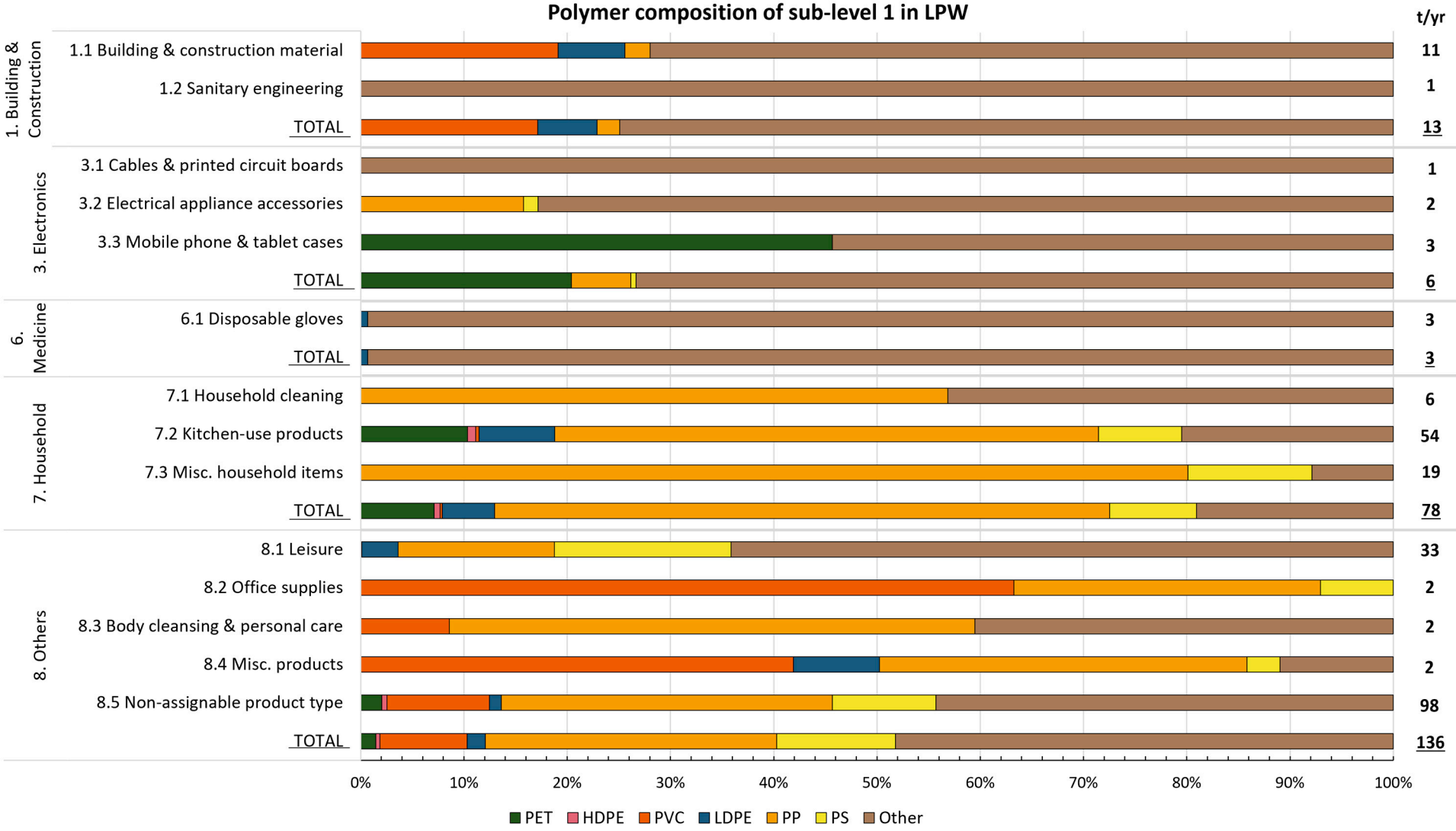



*Figure S4: Content of polymers per sub-level 1 in LPW in w% and t/yr of sub-level 1 plastic products, on a dry matter basis (values rounded). Data does not include share of <5cm/not analysed.*

*Table S13: Content and amount of polymers per sub-level 1 in LPW in w% and t/yr of sub-level 1 plastic products, on a dry matter basis.*

| | | PET | HDPE | PVC | LDPE | PP | PS | Other | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | t/yr |
| **1. Building and construction** | 1.1 Building and construction material | - | - | 18.7% / 2.1 t/yr | 6.5% / 0.7 t/yr | 2.5% / 0.3 t/yr | - | 72.3% / 8.2 t/yr | 11.3 t/yr |
| | 1.2 Sanitary engineering | - | - | - | - | - | - | 100% / 1.3 t/yr | 1.3 t/yr |
| | **TOTAL** | - | - | 16.7% / 2.1 t/yr | 5.8% / 0.7 t/yr | 2.2% / 0.3 t/yr | - | 75.2% / 9.5 t/yr | 12.7 t/yr |
| **3. Electronics** | 3.1 Cables and printed circuit boards | - | - | - | - | - | - | 100% / 1.1 t/yr | 1.1 t/yr |
| | 3.2 Electrical appliance accessories | - | - | - | - | 15.8% / 0.3 t/yr | 1.4% / 0.03 t/yr | 82.8% / 1.7 t/yr | 2 t/yr |
| | 3.3 Mobile phone and tablet cases | 45.7% / 1.1 t/yr | - | - | - | - | - | 54.3% / 1.4 t/yr | 2.5 t/yr |
| | **TOTAL** | 20.5% / 1.1 t/yr | - | - | - | 5.7% / 0.3 t/yr | 0.5% / 0.03 t/yr | 73.3% / 4.1 t/yr | 5.6 t/yr |
| **6. Medicine** | 6.1 Disposable gloves | - | - | - | 0.7% / 0.02 t/yr | - | - | 99.3% / 2.8 t/yr | 2.9 t/yr |
| | **TOTAL** | - | - | - | 0.7% / 0.02 t/yr | - | - | 99.3% / 2.8 t/yr | 2.9 t/yr |
| **7. Household** | 7.1 Household cleaning | - | - | - | - | 56.9% / 3.1 t/yr | - | 43.1% / 2.4 t/yr | 5.5 t/yr |
| | 7.2 Kitchen-use products | 10.6% / 5.7 t/yr | 0.8% / 0.4 t/yr | 0.4% / 0.2 t/yr | 7.3% / 3.9 t/yr | 52.6% / 28.2 t/yr | 7.8% / 4.2 t/yr | 20.5% / 11 t/yr | 53.6 t/yr |
| | 7.3 Misc. Household items | - | - | - | - | 79.9% / 15.1 t/yr | 12.2% / 2.3 t/yr | 8% / 1.5 t/yr | 18.9 t/yr |
| | **TOTAL** | 7.3% / 5.7 t/yr | 0.6% / 0.4 t/yr | 0.2% / 0.2 t/yr | 5% / 3.9 t/yr | 59.5% / 46.5 t/yr | 8.3% / 6.5 t/yr | 19.1% / 14.9 t/yr | 78.1 t/yr |
| **8. Others** | 8.1 Leisure | 0.1% / 0.03 t/yr | - | - | 3.4% / 1.1 t/yr | 15.1% / 5 t/yr | 17.4% / 5.8 t/yr | 64% / 21.2 t/yr | 33.1 t/yr |
| | 8.2 Office supplies | - | - | 63.3% / 1 t/yr | - | 29.7% / 0.5 t/yr | 7% / 0.1 t/yr | - | 1.5 t/yr |
| | 8.3 Body cleansing and personal care | - | - | 8.6% / 0.2 t/yr | - | 50.9% / 1.1 t/yr | - | 40.5% / 0.8 t/yr | 2.1 t/yr |
| | 8.4 Misc. products | - | - | 41.9% / 0.7 t/yr | 8.3% / 0.1 t/yr | 35.6% / 0.6 t/yr | 3.2% / 0.1 t/yr | 11% / 0.2 t/yr | 1.6 t/yr |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 8.5 Non-assignable product type | 2% / 2 t/yr | 0.4% / 0.4 t/yr | 10% / 9.8 t/yr | 1.1% / 1.1 t/yr | 32.1% / 31.3 t/yr | 10% / 9.8 t/yr | 44.3% / 43.4 t/yr | 97.8 t/yr |
| | **TOTAL** | 1.5% / 2 t/yr | 0.3% / 0.4 t/yr | 8.5% / 11.6 t/yr | 1.7% / 2.4 t/yr | 28.2% / 38.4 t/yr | 11.5% / 15.7 t/yr | 48.2% / 65.6 t/yr | 136.1 t/yr |

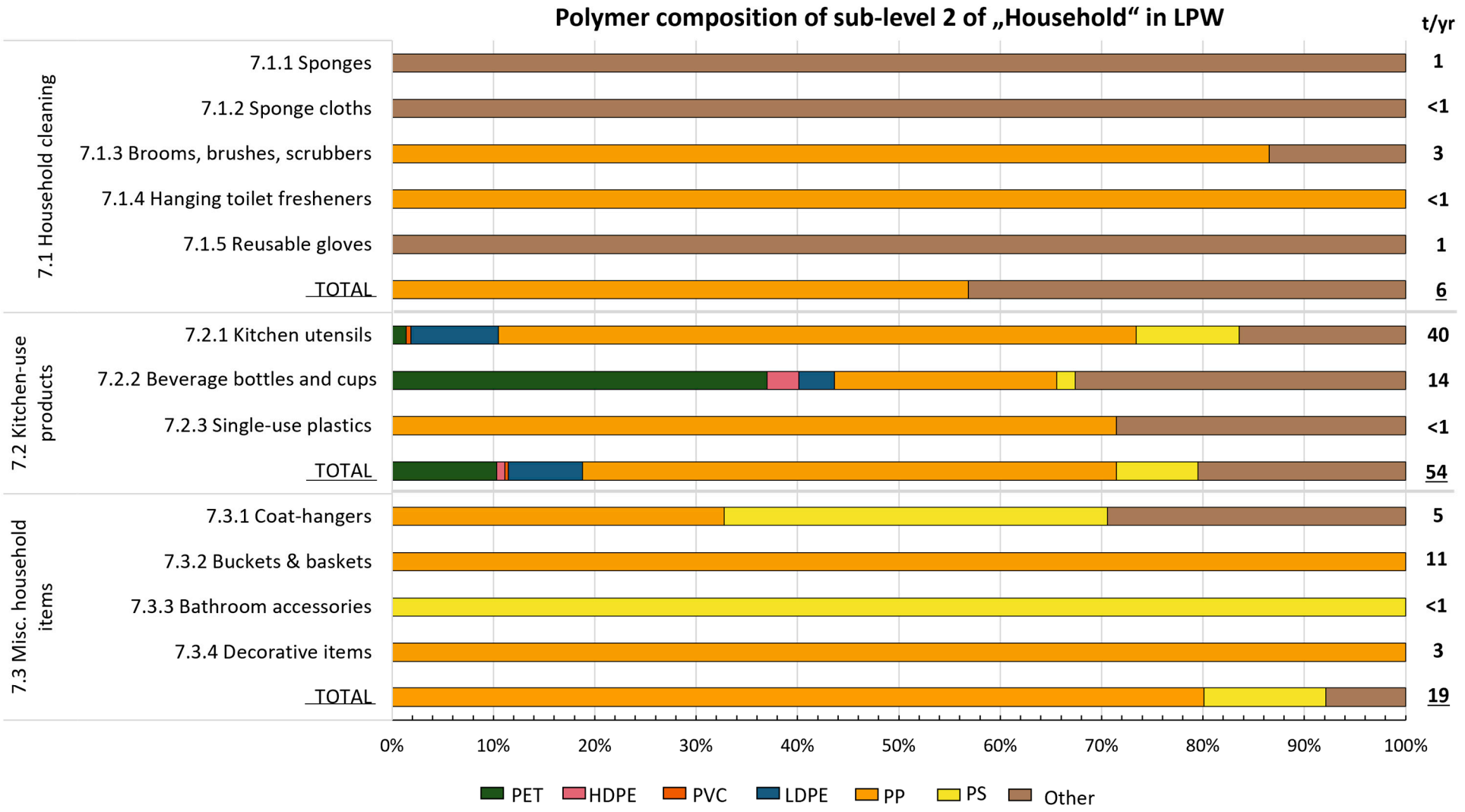



*Figure S5: Content of polymers per sub-level 2 of "Household" in LPW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis (values rounded). Data does not include share of <5cm/not analysed.*

*Table S14: Content of polymers per sub-level 2 of "Household" in LPW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis.*

| | | PET | HDPE | PVC | LDPE | PP | PS | Other | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | t/yr |
| **7.1 Household cleaning** | 7.1.1 Sponges | - | - | - | - | - | - | 100% / 0.7 t/yr | 0.7 t/yr |
| | 7.1.2 Sponge cloths | - | - | - | - | - | - | 100% / 0.1 t/yr | 0.1 t/yr |
| | 7.1.3 Brooms, brushes, scrubbers | - | - | - | - | 86.55 / 2.7 t/yr | - | 13.5% / 0.4 t/yr | 3.1 t/yr |
| | 7.1.4 Hanging toilet fresheners | - | - | - | - | 100% / 0.4 t/yr | - | - | 0,4 t/yr |
| | 7.1.5 Reusable gloves | - | - | - | - | - | - | 100% / 1.2 t/yr | 1.2 t/yr |
| | TOTAL | - | - | - | - | 56.9% / 3.1 t/yr | - | 43.1% / 2.4 t/yr | 5.5 t/yr |
| **7.2 Kitchen-use products** | 7.2.1 Kitchen utensils | 1.5% / 0.6 t/yr | - | 0.5% / 0.2 t/yr | 8.6% / 3.4 t/yr | 63.1% / 25.2 t/yr | 10% / 4 t/yr | 16.4% / 6.6 t/yr | 40 t/yr |
| | 7.2.2 Beverage bottles and cups | 37.5% / 5.1 t/yr | 3.2% / 0.4 t/yr | - | 3.5% / 0.5 t/yr | 21.6% / 2.9 t/yr | 1.5% / 0.2 t/yr | 32.7% / 4.4 t/yr | 13.6 t/yr |
| | 7.2.3 Single-use plastics | - | - | - | - | 71.3% / 0.05 t/yr | - | 28.7% / 0.02 t/yr | 0.1 tyr |
| | TOTAL | 10.6% / 5.7 t/yr | 0.8% / 0.4 t/yr | 0.4% / 0.2 t/yr | 7.3% / 3.9 t/yr | 52.6% / 28.2 t/yr | 7.8% / 4.2 t/yr | 20.5% / 11 t/yr | 53.6 t/yr |
| **7.3 Misc. household items** | 7.3.1 Coat-hangers | - | - | - | - | 32.7% / 1.7 t/yr | 37.8% / 1.9 t/yr | 29.4% / 1.5 t/yr | 5.1 t/yr |
| | 7.3.2 Buckets and baskets | - | - | - | - | 100% / 10.8 t/yr | - | - | 10.8 t/yr |
| | 7.3.3 Bathroom accessories | - | - | - | - | - | 100% / 0.4 t/yr | - | 0.4 t/yr |
| | 7.3.4 Decorative items | - | - | - | - | 100% / 2.6 t/yr | - | - | 2.6 t/yr |
| | TOTAL | - | - | - | - | 79.9% / 15.1 t/yr | 12.2% / 2.3 t/yr | 8% / 1.5 t/yr | 18.9 t/yr |

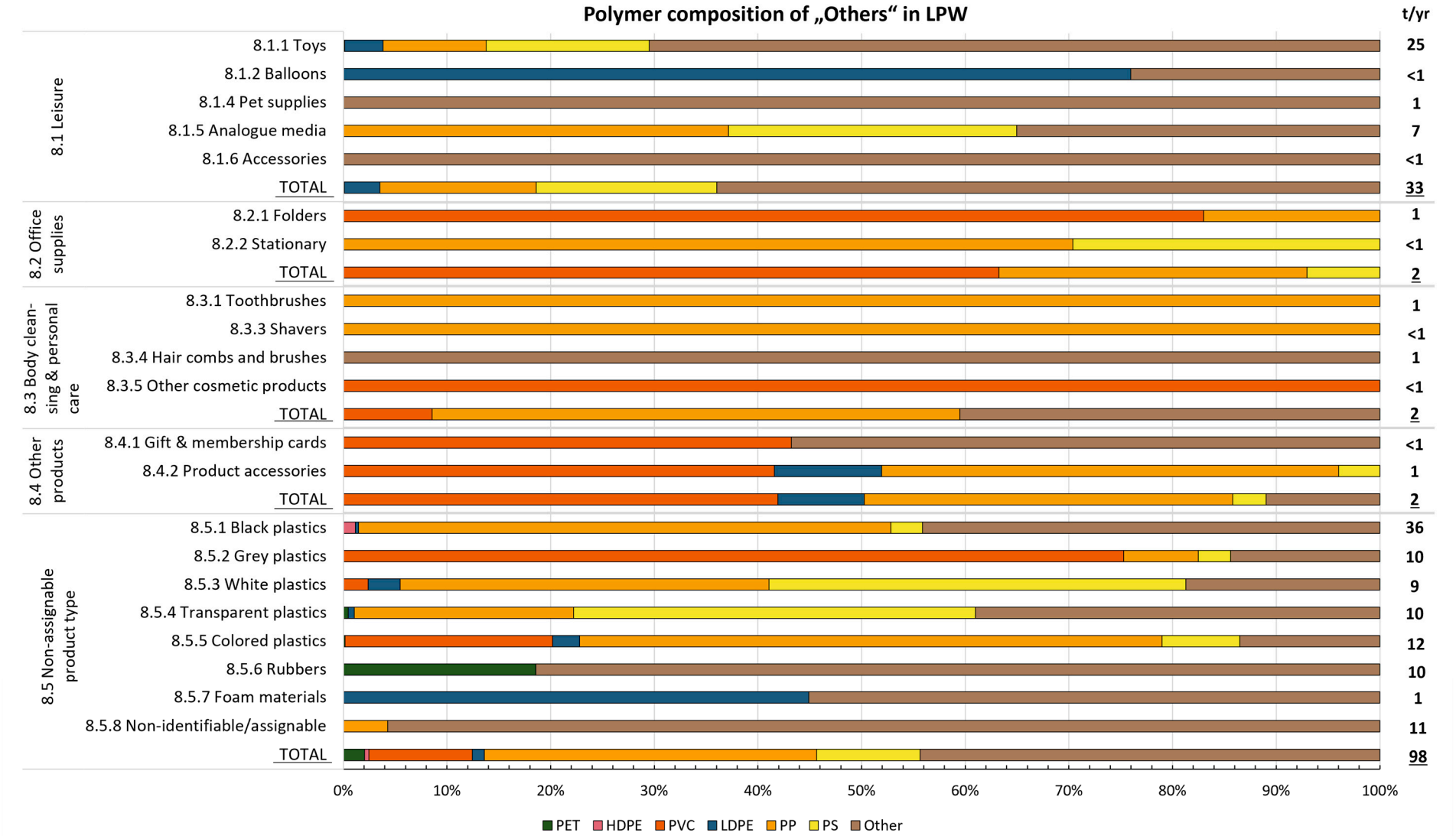



*Figure S6: Content of polymers per sub-level2 of “Others” in LPW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis (values rounded). Data does not include share of <5cm/not analysed.*

*Table S15: Content of polymers per sub-level2 of "Others" in mixed MSW in w% and t/yr of sub-level 2 plastic products, on a dry matter basis.*

| | | PET | HDPE | PVC | LDPE | PP | PS | Other | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | w% / t/yr | t/yr |
| **8.1 Leisure** | 8.1.1 Toys | 0.1% / 0.03 t/yr | - | - | 3.7% / 0.9 t/yr | 9.9% / 2.4 t/yr | 15.7% / 3.9 t/yr | 70.5% / 17.3 t/yr | 24.6 t/yr |
| | 8.1.2 Balloons | - | - | - | 76% / 0.2 t/yr | - | - | 24% / 0.1 t/yr | 0.3 t/yr |
| | 8.1.4 Pet supplies | - | - | - | - | - | - | 100% / 1.1 t/yr | 1.1 t/yr |
| | 8.1.5 Analogue media | - | - | - | - | 37.1% / 2.5 t/yr | 27.8% / 1.9 t/yr | 35.1% / 2.4 t/yr | 6.9 t/yr |
| | 8.1.6 Accessories | - | - | - | - | - | - | 100% / 0.3 t/yr | 0.3 t/yr |
| | **TOTAL** | 0.1% / 0.03 t/yr | - | - | 3.4% / 1.1 t/yr | 15.1% / 5 t/yr | 17.4% / 5.8 t/yr | 64% / 21.2 t/yr | 33.1 t/yr |
| **8.2 Office supplies** | 8.2.1 Folders | - | - | 83% / 1 t/yr | - | 17% / 0.2 t/yr | - | - | 1.2 t/yr |
| | 8.2.2 Stationary | - | - | - | - | 70.4% / 0.3 t/yr | 29.6% / 0,1 t/yr | - | 0.4 t/yr |
| | **TOTAL** | - | - | 63.3% / 1 t/yr | - | 29.7% / 0.5 t/yr | 7% / 0.1 t/yr | - | 1.5 t/yr |
| **8.3 Body cleansing and personal care** | 8.3.1 Toothbrushes | - | - | - | - | 100% / 0.9 t/yr | - | - | 0.9 t/yr |
| | 8.3.3 Shavers | - | - | - | - | 100% / 0.1 t/yr | - | - | 0.1 t/yr |
| | 8.3.4 Hair combs and brushes | - | - | - | - | - | - | 100% / 0.8 t/yr | 0.8 t/yr |
| | 8.3.5 Other cosmetic products | - | - | 100% / 0.2 t/yr | - | - | - | - | 0.2 t/yr |
| | **TOTAL** | - | - | 8.6% / 0.2 t/yr | - | 50.9% / 1.1 t/yr | - | 40.5% / 0.8 t/yr | 2.1 t/yr |
| **8.4 Misc. products** | 8.4.1 Gift and membership cards | - | - | 43.2% / 0.1 t/yr | - | - | - | 56.8% / 0.2 t/yr | 0.3 t/yr |
| | 8.4.2 Product accessories | - | - | 41.6% / 0.5 t/yr | 10.3% / 0.1 t/yr | 44.1% / 0.6 t/yr | 4% / 0.1 t/yr | - | 1.3 t/yr |
| | **TOTAL** | - | - | 41.9% / 0.7 t/yr | 8.3% / 0.1 t/yr | 35.6% / 0.6 t/yr | 3.2% / 0.1 t/yr | 11% / 0.2 t/yr | 1.6 t/yr |
| **8.5 Non-assignable product type** | 8.5.1 Black plastics | - | 1.2% / 0.4 t/yr | - | 0.3% / 0.1 t/yr | 51.4% / 18.3 t/yr | 3.1% / 1.1 t/yr | 44.1% / 15.7 t/yr | 35.7 t/yr |
| | 8.5.2 Grey plastics | - | - | 75.3% / 7.2 t/yr | - | 7.2% / 0.7 t/yr | 3.1% / 0.3 t/yr | 14.4% / 1.4 t/yr | 9.6 t/yr |
| | 8.5.3 White plastics | - | - | 2.4% / 0.2 t/yr | 3.1% / 0.3 t/yr | 35.6% / 3.3 t/yr | 40.2% / 3.7 t/yr | 18.7% / 1.7 t/yr | 9.2 t/yr |
| | 8.5.4 Transparent plastics | 0.5% / 0.05 t/yr | - | - | 0.6% / 0.1 t/yr | 21.2% / 2.1 t/yr | 38.8% / 3.8 t/yr | 39% / 3.9 t/yr | 9.9 t/yr |
| | 8.5.5 Colored plastics | 0.2% / 0.02 t/yr | - | 20% / 2.3 t/yr | 2.6% / 0.3 t/yr | 56.2% / 6.5 t/yr | 7.5% / 0.9 t/yr | 13.5% / 1.6 t/yr | 11.6 t/yr |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 8.5.6 Rubbers | 18.6% / 1.9 t/yr | - | - | - | - | - | 81.4% / 8.5 t/yr | 10.4 t/yr |
| | 8.5.7 Foam materials | - | - | - | 44.9% / 0.4 t/yr | - | - | 55.1% / 0.4 t/yr | 0.8 t/yr |
| | 8.5.8 Non-identifiable/assignable | - | - | - | - | 4.3% / 0.5 t/yr | - | 95.7% / 10.2 t/yr | 10.7 t/yr |
| | **TOTAL** | 2% / 2 t/yr | 0.4% / 4 t/yr | 10% / 9.8 t/yr | 1.1% / 1.1 t/yr | 32.1% / 31.3 t/yr | 10% / 9.8 t/yr | 44.3% / 43.4 t/yr | 97.8 t/yr |

## S3.4 Colouring and presence of impurities in NPW in Vienna

### S3.4.1 Colour composition of NPW per waste stream

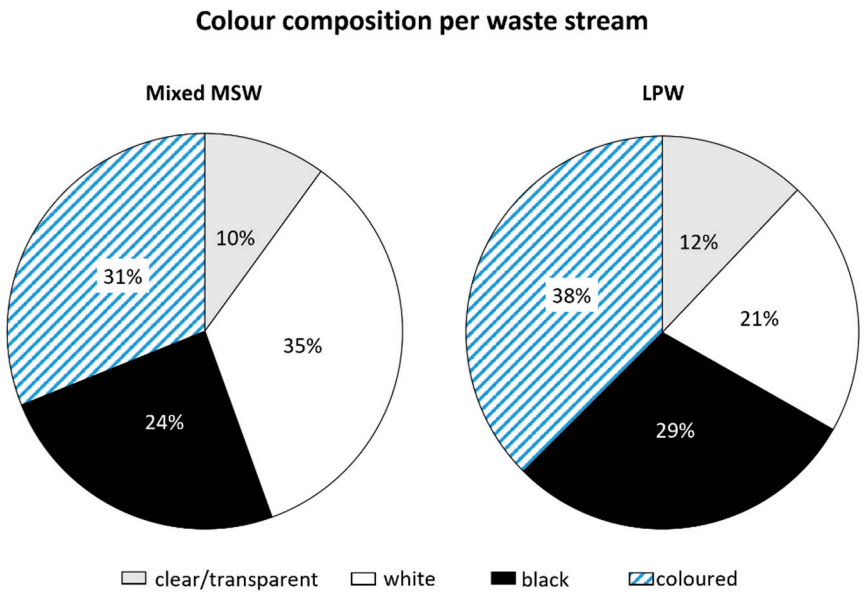



*Figure S7: Colour composition of NPP in mixed MSW and LPW in w%, on a dry matter basis.*

### S3.4.2 Colouring of NPP in analysed waste streams

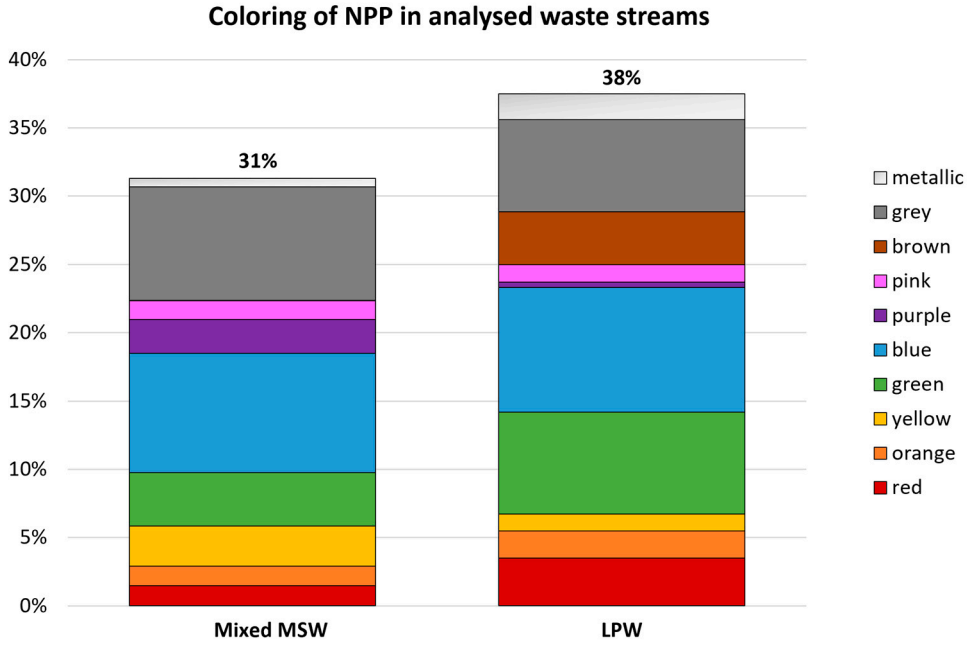



*Figure S8: Colouring of NPP in mixed MSW and LPW in w%.*

*Table S16: Breakdown of coloured NPP in mixed MSW and LPW in w%.*

| | Mixed MSW (w%) | LPW (w%) |
|---|---|---|
| red | 1.5 % | 3.5 % |
| orange | 1.4 % | 2 % |
| yellow | 2.9 % | 1.2 % |
| green | 3.9 % | 7.5 % |
| blue | 8.7 % | 9.1 % |
| purple | 2.5 % | 0.4 % |
| pink | 1.4 % | 1.3 % |
| brown | - | 3.9 % |
| grey | 8.3 % | 6.7 % |
| metallic | 0.6 % | 1.9 % |

### S3.4.3 Share of monochromatic and multi-coloured NPP per waste stream

*Table S17: Share of monochromatic and multi-coloured NPP per waste-stream and colour.*

| Mixed MSW | | |
|---|---|---|
| Colour | Monochromatic (w%) | Multi-coloured (w%) |
| Clear/transparent | 53.9 % | 46.1 % |
| White | 77.8 % | 22.2 % |
| Black | 72.8 % | 27.2 % |
| Coloured | 71.5 % | 28.5 % |

| LPW | | |
|---|---|---|
| Colour | Monochromatic (w%) | Multi-coloured (w%) |
| Clear/transparent | 58.6 % | 41.4 % |
| White | 73.2 % | 26.8 % |
| Black | 90 % | 10 % |
| Coloured | 56.7 % | 43.3 % |

### S3.4.4 Presence of impurities in NPP

N.D.

## S3.5 Research gaps of NPW and design for recycling recommendations

N.D.

# S4. Conclusion

N.D.

# S5. References

Agilent Technologies, s.a. Series 4300 Handheld FTIR Sepctrometer: Product Introduction.

National Library of Medicine, 2025. Dioctyl phthalate. https://pubchem.ncbi.nlm.nih.gov/compound/Dioctyl-phthalate (accessed 7 March 2025).