PlasticFreeDanube

WASTE MANAGEMENT IN AUSTRIA AND SLOVAKIA

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List of Abbreviations:

ABS Acrylonitrile-butadiene styrene

BMNT Federal Ministry for Sustainability and Tourism (formerly named BMLFUW)

CFRP Carbon reinforced plastic

EPS Expended polystyrene

HBCD Hexabromocyclododecane

HDPE High-density polyethylene

HIPS High impact polystyrene

ICT Information and communication technology

LDA Large domestic appliances

LWP Lightweight packaging

MA48 Municipal Department for Waste Management, Street Cleaning and Vehicle Fleet, City of Vienna

MSW Municipal solid waste

PE Polyethylene

PET Polyethylene terephthalate

PP Polypropylene

PS Polystyrene

PUR Polyurethane

PVC Polyvinylchloride

SDA small domestic appliances

SN Schlüsselnummer, national waste code according to ÖNORM S2100

UBA Umweltbundesamt (EEA, Austrian Environmental Agency)

WEEE Waste electrical and electronic equipment

WKO Austrian Chamber of Commerce

WASTE MANAGEMENT IN AUSTRIA (STUDY REGIONS VIENNA AND LOWER AUSTRIA) AND SLOVAKIA (STUDY REGIONS BRATISLAVA AND TRNAVA)

1. Introduction

Due to their growing number of applications, plastics have become indispensable to our daily lives. Whether as materials for everyday objects, insulation or packaging, life without plastic is now unimaginable. Plastic and plastic waste production is therefore increasing in Austria. Due to a relatively high calorific value and with regard to limited resources (e.g. fossil fuels), the demand of plastic waste has increased in the past (UBA, 2017). Depending on quality (plastic types, grade purities, degree of contamination) and quantity of plastic waste, different possibilities for treatment are available. According to the European waste hierarchy, recycling is the prioritized treatment option, although at the moment plastic waste is mainly used for energy recovery. In order to increase recycling, suitable plastic waste has to be available in sufficient quantities on the one hand, and there has to be a market for plastic recyclates on the other hand.

This report primary aims to give a comprehensive overview about plastic waste generation, collection, recycling and treatment in Austria and Slovakia in line with the objective of the PlasticFreeDanube project.

Figures for Austria mainly refer to the year 2015, as the current Federal Waste Management Plan (BMLFUW, 2017) and a supplementing publication of the European Environmental Agency (EEA = UBA) refers to 2015. If no suitable data was available for the year 2015, other sources and possibly years were used. Waste balance sheet declarations of waste collectors and processors were the data base of the EEA report. Pure plastic waste streams were considered as well as plastic containing waste streams and rubber waste. The shares of plastics in various waste streams were estimated according to literature and expert knowledge. In total, the EEA report identifies 223 plastic containing waste streams, whereof in 2015, waste production was announced for 133 waste streams in the electronical data management system (Appendix 16, UBA, 2017).

Figures of Slovakia mainly refer to the year 2017.

2. Waste generation and collection in Austria

2.1. Waste generation in Austria

In 2015, the Austrian overall waste generation was 59.76 million tons, including all waste streams ranging from excavation materials to industrial and municipal waste (Appendix 17) 57.10 million tons were assigned to primary waste and 2.66 million tons to secondary waste from primary waste treatment. In Austria, the total amount of plastics in primary waste was 916,360 t in 2015 (80% post-consumer waste, 20% production waste) (Table 1). Municipal solid waste (MSW) which is considered as post-consumer waste, amounted to 4,160,200 t in 2015, thereof 1,431,600 t was residual waste with an estimated plastic share of 15% (about 214,740 t).

Waste stream	Amount (t)
Overall waste generation in Austria	59,762,000
Plastics in primary waste (80% post-consumer waste, 20% production waste)	916,360
MSW (post-consumer waste)	4,160,200
Residual waste (post-consumer waste)	1,431,600
Plastic waste in residual waste (estimated with 15%[1])	214,740

Table 1: Waste generation in Austria in 2015 (UBA, 2017)

Definitions of MSW and residual waste according to Waste Management Act 2002 are explained in the following:

- **Municipal solid waste (MSW)** (in German: Siedlungsabfälle) means waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households. MSW originates from households, public institutions like schools or kinder gardens as well as from commercial and industrial enterprises, public administration, hospitals, markets, agriculture and tourism companies as far as they are connected to public waste collection or waste contracted with the municipality/ies (AWG, 2002, EC, 2012).
  (Note: Industrial and commercial waste are no particular waste types in Austria even though considerable amounts are collected (Pomberger and Eisenberger (2010). Therefore, separate figures for household and commercial waste are barely available and discussed in the following).
- **Residual waste** (in German: Restmüll) is MSW except of recyclables (e.g. plastic packaging, old textiles etc.), bio-waste, bulky waste and road sweepings.

Post-consumer waste (like MSW) has to be distinguished from **post-industrial waste** (construction waste or waste from products' distribution and merchandising such as transport packaging materials) and from **post-production waste** (waste generated during production) (Martens and Goldmann 2016, cited in Blum, 2017). In terms of origin, 80% of Austria's total plastic waste amounts are post-consumer wastes from private or commercial end users. Therefore, this study focuses on post-consumer waste. The remaining 20% are process waste, but it is assumed that residues from production are only partly included in waste streams as they are traded as by-products (UBA, 2017).

Plastic waste can either occur as pure plastic waste or mixed in certain waste streams. Therefore, it must be distinguished between:

- "**Plastic waste**" as pure plastic waste streams (e.g. separate collected plastic packaging) and
- "**Plastic containing waste**" which are waste streams like residual waste with certain shares of plastic packaging (e.g. PET in residual waste) or for example bulky waste including plastic chairs. Some waste streams like waste electrical and electronic equipment (WEEE) are composed of

[1] According estimation of UBA in 2015 (UBA, 2017)

different materials including plastics. The share of plastics in plastic containing waste streams was estimated according to literature and expert opinions (UBA, 2017) (Appendix 17).

The amount of plastics in Austrian waste was estimated at 916,360 t in 2015 (Figure 1, Appendix 1, Table 1). Thereof only 21% result from pure plastic waste streams, most importantly from plastic foils/films (SN 57119; SN = national waste code according to ÖNORM S2100), plastic packaging and containers (SN 57118), other cured plastic materials (SN 57129), polyolefin waste (SN 57128) and rubber (SN 57501). The amounts of pure plastic waste streams are listed in Table 2.

About 77% of plastics are found in plastic containing waste with varying shares of plastics, mainly in residual waste and similar commercial waste (SN 91101), lightweight-packaging (LWP=SN 91207) and bulky waste (SN 91401). More details are available in Table 3. Only 2% are amounted to plastics in colours and lacquers, cured colours and lacquers, plastic sludge and plasticizers) (UBA, 2017).

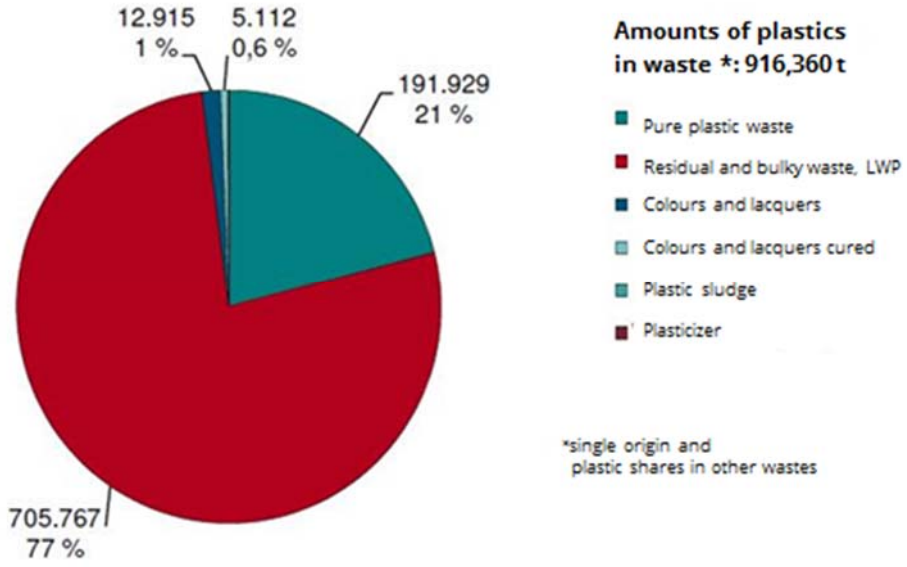


Figure 1: Plastic waste production in Austria in 2015 (translated according to UBA, 2017)

Plastic waste	Amount (t)	Share
SN 57119 plastic foils	58,774	31%
SN 57118 plastic packaging and containers	36,498	19 %
SN 57129 other cured plastics	35,563	19 %
SN 57128 polyolefin waste	25,133	13 %
SN 57501 rubber	8,468	4 %
SN 57116 PVC-waste and PVC based foams	3,839[2]	2 %
SN 57130 Polyethylene terephthalate (PET)	3,839[1]	2 %
SN 57108 Polystyrene, polystyrene foam	3,839[1]	2 %
SN 57117 plastic glass, polyacrylate and polycarbonate waste	1,919[1]	1 %
Others	12,331	7%
Total	**191,929**	**100** %

Table 2: Amounts of pure plastic waste according different waste types in 2015 in t (UBA, 2017)

Plastics in plastic containing waste streams	Amount (t)	Share
SN 91101 residual waste and similar commercial waste	303,159	43 %
SN 91207 LWP	128,358	18 %
SN 91401 bulky waste	104,988	15 %
SN 57502 scrap tires and scrap tire shreds	39,165	6 %
SN 97104 wastes which a pose a risk of infection or injury within medicine sector	21,173[3]	3 %
SN 58107 old textiles	21,173[1]	3 %
SN 35314 cables	14,115[1]	2 %
SN 18718 waste paper, paper and cardboard, uncoated	14,115[1]	2 %
SN 91206 construction waste (no demolition waste)	7,0581[1]	1 %
Others	51,928	7 %
Total	**705,767**	**100** %

Table 3: Amount of plastics (t) in plastic containing waste streams according to different waste types in 2015 (UBA, 2017)

[2] Figures were self-calculated according sum and shares (UBA, 2017)

[3] Figures were self-calculated according sum and shares

Concerning the application area, around 32% of plastic waste derives from the packaging sector. In terms of economic activity, the results show that around 51% of all plastic waste stems from households (UBA, 2017) (Table 4).

Plastic waste is also characterized according to plastic types. In residual and bulky waste, the most relevant plastic waste types are thermoplastics such as PE, PP, PS/EPS and PVC. LWP mainly consists of PET, PE and PP, in minor extends of PS/EPS. In old vehicles, rubbers, PP and PUR are of relevance, in WEEES PP, PS/EPS and ABS (Acrylonitrile-butadiene styrene). About 50,000 t of bioplastics are put on the market every year. The use of composite plastic materials is also continuously increasing.

Plastic (containing) waste sectors	**Amount of plastic in sector (t)**	**Share**
Household	467,313	51 %
Services	208,739	23 %
Production of chemical and pharmaceutical products including rubber and plastic goods	57,740	6 %
Construction (industry)	42,090	5 %
Production of electrical, electronical and optical goods; Equipment of machines and vehicles	25,057	3 %
Agriculture and forestry	20,074	2 %
Production of food and animal feed	17,761	2 %
Others	77,587	8 %
Total	**916,360**	**100** %

Table 4: Plastic in waste - generation according branches in 2015 (UBA, 2017)

The amounts of plastics in waste streams according to their origin/ area of application were estimated by UBA (2017) for the year 2015 and by Frank (2015) and Van Eygen et al. (2017) for the year 2010 (Table 5). Material flow analysis of plastic in waste in nine consumer sectors (packaging waste, medicine, household, construction, furniture, waste electrical and electronic equipment, agriculture, transport, others) pointed out that plastic packaging is the most relevant waste stream of plastic (containing) waste in Austria.

The total amount of plastics in post-consumer plastic (containing) waste was estimated 583,000 t/a in 2010 (Van Eygen et al.,2017) (Table 5) of which almost half (48%) is caused by the packaging sector Own calculations, considering total post-consumer plastic waste and an Austrian population of 8.63 million people in 2010 accounted for 67 kg/cap*a, corresponding with 66 kg/cap*a published by Blum (2017) for the year 2015 (Table 7). In 2015, the total amount of plastic waste was stated 916,360 t/a with 106.15

kg/cap*a considering a population of 8.63 million people (UBA, 2017) — much higher than the estimation for 2010.

The higher total amount of plastics can partly be attributed to an increase in some sectors (e.g. building and construction) but mainly to the fact that in contrast to the calculations in 2010, in 2015 certain plastics in residual waste and bulky waste from commercial enterprises, which are not collected by municipal waste management systems were defined as the waste stream "other applications": They origin from operational facilities (industry, commerce, agriculture etc.) and are not categorized as packaging, WEEEs, construction materials, agricultural foils or furniture (e.g., cured colours and lacquers, transportation containers, buckets, canister, foils, waste bags, plastic containing tools). All other non-assigned amounts are also included in this category. Van Eygen et al. (2017) summarized lacquers, adhesives, colouring pigments to non-plastics. As another significant difference is the category "household": whereas by Van Eygen et al. (2017) only kitchen utilities, cutlery and storage containers were assigned to "household plastic waste" and toys, sporting equipment and carpets to the category "others", UBA (2017) includes plastics of residual and bulky waste together with synthetic fibres in textile waste in the category "household.

Plastic in plastic (containing) waste according application	**Amount in 2015 (t)**	**Shares in 2015 (%)**	**Amount in 2010 (t)**	**Shares in 2010 (%)**
Packaging	294,888	32	280,000±2%	48
Building and construction	46,640	5	28,000±17%	4,8
Transport	45,755	5	54,000±10%	9,26
Electronics	27,125	3	31,000±10%	5,32
Furniture	37,678	4	19,000±20%	3,26
Agriculture	32,448	4	33,000±32%	5,66
Medicine	25,137	3	14,000±9%	2,4
Household	155,842	17	41,000±42%	7,03
Textiles	-	-	36,000±6%	6,17
Other Applications/ others	250,847	27	47,000±35%	8,06
Total amount of plastic in waste	**916,360**	**100**	**583,000**	**100**

Table 5: Plastics budget for Austria in in 2015 (UBA, 2017) and in 2010 including mean value and relative standard deviation (Van Eygen et al., 2017)

Under the assumption of little differences in general waste amounts and composition in both studies, the amount of plastic waste from commercial enterprises without packaging can be roughly estimated to be 200,000 t per year (= 250,847 t- 47,000 t). Hauer (2008) estimated the annual amount of commercial waste to 1.3-1.5 million tons, Laner (2008) to 1.0 million tons (through extrapolation of data from Styria). At a rough estimate, the plastic content in waste from commercial enterprises without packaging would therefore be 20%.

2.1.1. Generation of plastic waste in Austrian municipal solid waste

In 2015, MSW amounted for 4.16 million tones (=482 kg/cap*a). Plastic relevant streams are residual waste (1,431,600 t in 2015), bulky waste (244,210 t in 2015), WEEEs (78,900 t in 2015), separate collected plastic packaging waste (154,701 t in 2015), and textiles (29.406 in 2015) (Table 6). Amounts of 2016 are shown in Appendix 3. Depending on waste collection systems, tourism and other factors, regional collected amounts differ between the Federal Provinces. The total amount of waste from households and similar establishments was stated 855.129 t in Lower Austria (520 kg/cap*a) and 885.464 t in Vienna (488 kg /cap*a) (Table 6).

Plastic (containing) waste	**Amount in Austria 2015 (t)**	**Amount in Austria in 2015[4] (kg/cap*a)**	**Amount in Vienna in 2015 (t)**	**Amount in Vienna in 2015[1] (kg/cap*a)**	**Amount in Lower Austria in 2015 (t)**	**Amount in Lower Austria in 2015[1] (kg/cap*a)**
Residual waste	1,431,600	166	523,545	289	230,869	141
Bulky waste	244,210	28	27,042	14.9	71,312	43.6
WEEEs	78,900	9.5	12,105	6.7	13,927	8.5
Separate collected plastic packaging waste	154,701	17.9	6,810	3.8	26,820	16.4
Waste textiles	29.406	3.4	4,023	2.17	5,240	3.2
Total waste generation [5]	**4,160,200**	**482**	**885,464**	**488**	**885,129**	**520**

Table 6: Selected MSW streams from households and similar establishments in 2015 (BMLFUW 2017)

The different specific amounts of residual waste can be attributed to many causes, including provisions under provincial law, existing collection systems, the number of second homes, the level of tourism or the proportion of waste from commercial enterprises which is disposed of jointly (UBA, 2017b). The lower specific amount of residual waste in Lower Austria compared to Vienna might also be caused by the fact, that in Vienna for household packaging, only hollow bodies are collected separately (plastic foils are mainly collected with the residual waste; only commercial enterprises have the possibility to collect foils separately) whereas in Lower Austria all fractions of LWP are collected together separately. The total specific amount of MSW is higher in Lower Austria. MSW also includes waste categories like bulky waste or biogenic waste, of which amounts are higher in Lower Austria than in Vienna. The amount of plastic waste in Austria is estimated at 66 kg/cap*a in 2015, this includes plastics in separately collected packaging, mixed waste and plastic components of WEEE and bulky waste (BMLFUW, 2017).

[4] Specific amounts partly self-estimated according to BMLFUW 2017

[5] Total MSW waste generation includes also non-plastic waste streams e.g. paper etc.

The content of plastic in MSW was estimated by Blum (2017). Waste electrical and electronic equipment (WEEE) is composed of a complex diversity of materials. According to study of Österreichische Forschungsinstitut für Chemie und Technik (cited in Frank, 2015) and other studies (cited in Blum, 2017), the share of plastics in WEEE is about 20%. In 2015, 244,210 t of bulky waste were collected. Hauer (2008, cited in Blum 2017) estimated a plastic share in bulky waste of 4-7%. This would be approximately 13,431 t (9,760 to 17,000 t) of plastics in bulky waste. The share of plastic packaging in residual waste is approx. 21.6% (FWMP 2017 cited in Blum 2017). Considering only separate collected plastic packaging and composite packaging waste, 154,700 t per year (20.8 kg/cap*a) were collected in 2015 (Table 7). Hence, approximately one third of plastic waste from households and similar establishments originates from separately collected packaging. This corresponds to a 3.7% share of municipal waste. The difference is caused by high amounts of plastics in mixed municipal waste (Blum, 2017).

The content of plastic in residual waste in Austria was estimated 15% in 2015 by UBA (2017, synthetic textiles included) and 21.6% by Blum (2017). Analysis of residual waste in 2010/2011 (Schneider and Lebersorger, 2011) revealed a share of 12% plastics in the residual waste of Lower Austria. The City of Vienna, MA 48 published a plastic content of 11.6 % in 2016. For Styria, 17.59% and 27.38 % (also including shoes and textiles) of plastic (containing) waste streams were calculated (BMLFUW, 2017).

Amount of plastic in following waste streams:	**Mass (t)**	**Mass (kg/cap*a)**	**Share in municipal waste (%)**
Municipal waste, separately collected[6]	154,700	17.9	3.7
Residual waste [1)]	309,226[7]	41.6	7.4
Bulky waste	13,431	1.8	0.3
WEEE	14,991	2.0	0.4
Total	**491,127**	**66.0**	**11.8**

Table 7: Plastic in Austrian municipal waste in 2015 (Blum, 2017)

2.1.2. Packaging waste generation in Austria

The packaging sector is the largest source of plastic waste in Austria – it generates about 50% of the total post-consumer plastic waste. According to the Packaging Ordinance 2014, packaging made of different materials (e.g. paper, glass, metals plastics, composite materials) has to be collected and treated separately. In 2015, throughout Austria 1,311,246 t of packaging waste were generated and collected separately or in mixed fractions like residual or commercial waste, thereof 294,888 t were plastics (BMLFUW, 2017). Considering 8,690,076 inhabitants in Austria, packaging waste generation amounts to 33.93 kg/cap*a.

[6] Waste plastics and composite materials – packaging according to BMLFUW, 2017a

[7] [1)]309,226 (=21.6%) according BMLFUW cited in Blum 2017 (→ total 491,127t); 214,741 (=15%) according UBA (2017) (→total 396,605 t)

According to Van Eygen et al. (2018), out of the approx. 300,000 (±3%) t of plastic packaging waste generated in Austria in 2013, the main shares were:

- large films (71,000t ±13%);
- small films (69,000t ±10%);
- small hollow bodies (49,000t ±11%);
- PET bottles (45,000t ±2%);
- large hollow bodies (18,000t 13%);
- large EPS (2,300 ±5%) and
- others (39,000 t±13%)

The polymer composition of the waste stream was dominated by: LDPE (46%±6%), PET (19%±4%) and PP (14%±6%). A Material Flow Analysis (MFA) of waste packaging material (subdivided by product and by polymer) is depicted in Appendix 2 (Van Eygen et al. 2018).

Plastic carrier bags

In Austria, 5,000 to 7,000 plastic carrier bags per year are considered to become waste. That is about 0.1% of the total waste amount. Almost all of them get either recycled or incinerated due to a densely developed collection system and a relatively high environmental awareness (BMLFUW, 2017). According to the Directive (EU) 2015/720, the number of existing plastic carrier bags has to be reduced by 50% until 2019. In December 2018, the Austrian government announced a planned set of measures for January 2020, including a ban on non-biodegradable light-weight plastic carrier bags.

2.1.2.1. Packaging waste generation in Vienna

In Vienna, approx. 5,000 PET-bottles are collected annually (MA 48, 2018a). According to MA 48 (2016), 5.5 t (= 0.003 kg/cap*a[8]) of plastic hollow-bodies (SN 57118) and 218.6 t PET-hollow bodies (SN 57130) (=0.119 kg/cap*a[1]) were collected in 2015. Mixed LWP amounted for 8,812.9 t (=4.79 kg/cap*a[1]). The specific amounts of separate collected packaging waste are lower than in Lower Austria. The total packaging waste generation in Vienna is difficult to estimate as plastic foils from households and similar establishments are mainly collected with residual waste. For commercial enterprises, the possibility of separate collection and treatment of plastic foils exists (large quantities with a higher degree of purity and usability). MA 48 (2016) analyzed the residual waste composition in 2015/2016 and stated a share of plastics in residual waste of 11.6%. No data about the collection efficiency could be found in literature. In 2015, 6,810 t of packaging plastic waste in MSW was generated in Vienna (BMLFUW, 2017), with 3.8 kg/cap*a considering 1,840,226 inhabitants. The development of collected quantities is depicted in Appendix 10.

[8] Specific amounts were self-calculated considering 1,840,226 inhabitants in 2015

2.1.2.2. Packaging waste generation in Lower Austria

In 2015, 26,820 t of MSW-plastic packaging waste were generated in Lower Austria, the specific collected amount was 16.04 kg/cap*a (own calculations). Residual waste analysis in 2014 showed that despite the separate collection of packaging, a share of 18.24 kg/cap*a of plastic- and composite material packaging was found in residual waste (NÖ Landesregierung, 2016).

The total amount of separately collected plastics in Lower Austria is 29.4 kg/cap*a (8.9 kg bottles and 20.5 kg LWP) (Table 8). Collection rate of plastic bottles in Lower Austria is 74%, collection rate of LWP 60 %. Collection efficiency of separate collected waste streams is shown Table 8 Recovery of valuable substances was calculated by separate collected amounts in 2014 and potential in residual waste (residual waste analysis performed in 2012) (NÖ Landesregierung 2016).

Category	Separate collected (kg /cap*a)	Potential in residual waste (kg/cap*a)	Estimated collection efficiency in %
Plastic bottles	8,9	3,1	74
LWP	20,5	13,4	60

Table 8: Coverage of separate collected waste in Lower Austria (NÖ AWP, 2016)

Residual waste composition in Lower Austria[9] was investigated in 2011 by the Institute of Waste Management. Results showed that 12% (17 kg/cap*a) of residual waste in Lower Austria were plastics, 6% (8.4 kg/cap*a) composite materials, 1% (1.1 kg/cap*a) WEEEs and 4% (5.3 kg/cap*a) textiles, 5% (6.5 kg/ap*a) other waste materials (Schneider and Lebersorger, 2011). Composition is described in more detail in Appendix 15. Pomberger et al. investigated status quo of plastic packaging waste collection from households in Lower Austria and the advantages and disadvantages of launching 'catch all plastic bins' for the year 2012 (Table 9, Pomberger et al., 2015). Collection rates are referred to LWP-collection amounts. It must be considered that the amount of miss-sorting of 2.14 kg/cap*a is not depicted in Table 9 as it has no relevance for calculation of collection rates. The fraction PS/PP cups was not considered in the calculations either. Results show an annual amount of 26 kg/cap of plastics in residual waste whereof 17.27 kg/cap*a were caused by pure plastics and 9.05 kg/cap*a by composite materials. The specific amount of plastic in LWP is lower than in residual waste and amounts 14.33 kg/cap*a (12.02 and 2.31 kg/cap*a) in 2012.

[9] Whole Lower Austria except the district Neunkirchen and municipalities without membership to waste management associations was investigated

Fraction	Mean generation of residual waste in Lower Austria in 2011(kg/cap*a)	Mean generation of LWP in Lower Austria in 2012(kg/cap*a)	Collection rates/Capturing rates) (%)
Plastics	17.27	12.02	
Beverage bottles	1.28	2.96	69.9 %
Plastic bottles	0.99	0.49	33. 4%
Plastic buckets and canisters	0.30	0.49	62.3 %
Plastic foils and sacks (packaging)	6.11	4.61	43.0 %
PS/ PP cups	0.00	1.48	-
Other plastic packaging (substitute fuel)	5,07	1.32	20.6 %
Non-packaging of similar material (plastic)	4.08	0.66	12.1 %
Plastic composite material	9.05	2.31	
Composite beverage cartons (substitute fuel)	2.53	1.15	31.3 %
Other composite packaging materials (substitute fuel)	4.08	0.49	10.8 %
Non-packaging of similar material (substitute fuels)	2.44	0.66	21.2 %
Total	**26.32**	**14.33**	

Table 9: Results of analysis of residual waste and LWP including collection rates of plastic like materials (Pomberger et al., 2015)

2.1.1. Generation of non-packaging similar plastic material

The generation of non-packaging similar plastic material (in German: Stoffgleiche Nichtverpackungen) ist not well documented in Austria, as there is no separate collection of this waste stream. Kranzinger et al. (2017) investigated the potential effects of an implementation of 'catch-all-plastic bins'. Results showed that in Austria plastics (lightweight packaging and similar non-packaging materials) are found with an average mass content of 13% in residual waste. With a quantity flow model an increase in the amount of plastics collected of 33.9 wt% was assumed to be realistic. This equals a calculated excess quantity of 19,638 t/ (=12.1 kg/cap*a).

2.1.2. Generation of other plastic relevant waste streams in Austria, Vienna and Lower Austria

Other relevant waste streams are end-of life vehicles, construction and demolition wastes, furniture, agriculture and medical waste, waste textiles and other waste.

End-of-life vehicles

End-of-life vehicles have a very heterogeneous, complex composition, comprising roughly 10,000 individual parts and around 40 different materials thereof 10-20 % plastics, rubber and textiles (BMLFUW, 2017). The plastic content of dismantled cars is estimated at 36% and composed of rubber and textile parts, fuel tanks, tires and large plastic parts (Kletzmayr and Glatz 2012, cited in Frank 2015). The average plastic content in vehicles after disassembly lies between 8 and 17 percent (Schmid 2010, cited in Frank 2015).

According to Statistics Austria, in 2015, around 4.75 million passenger cars were registered in Austria. Every year, approximately 250,000 passenger cars are taken off the road in Austria. Of these, only a portion of (48,000 end-of-life vehicles in 2015) is supplied for recovery in Austria while the majority of end-of-life vehicles are shipped (often illegally) abroad as "used vehicles" (BMLFUW, 2017a).

The volume of end-of life tyres amounted to approx. 55,950 tons in 2015 (BMLFUW, 2017a). Waste tires were also considered in the plastic budget estimate of Van Eygen (2017). They are composed of natural rubber (approx. 24%), synthetic rubber (approx. 21%), carbon black and fillers (approx. 26%), steel wires (approx. 26%), textile fabric (approx. 3%), oils and supplementary substances (approx. 10%). Van Eygen et al. (2017) estimated the total amount of plastic waste in the transport sector to approx. 54,000 t/a in 2010 (Table 5).

Construction and demolition waste

Construction and demolition waste amounted to 10 million tons in 2015 (increase of 46% since 2009) BMLFUW, 2017). The most relevant plastic fractions are:

- in bulky waste: carpets (67% plastic content), plastic windows;
- in separately collected plastic waste: plastic windows, plastic pipes;
- in waste from construction sites: 5% plastic content.

According to estimates of Frank (2015) and Van Eygen et al. (2017) total amount of plastic in construction and demolition waste is around 30,000 t/a, thereof 50% comes from construction sites, 40% from bulky waste and 10% from plastic windows and pipes.

Furniture

According to Frank (2015), in order to estimate the plastic content in the furniture, the furniture content in the bulky waste (244,200 t in 2015) has to be estimated. The Austrian Institute of Ecology (2001, cited in Frank 2015) states a share of furniture in bulky waste of 51%. Based on the average proportion of furniture in bulky waste, the proportion of mattresses and upholstered furniture is calculated. According to the Austrian Institute of Ecology (2002), the amount of upholstered furniture in bulky waste is 59%, the proportion of mattresses in bulky waste 19%, the average plastic content in upholstered furniture 15% and the average plastic content in mattresses 46%. The total mass flow of plastics in bulky waste was estimated by Frank (2015) and Van Eygen (2017) at a level of about 20,000 t in 2010.

Agriculture

Main streams of plastic waste in agriculture are:

- foils, films and sacks in residual waste from agriculture;
- separately collected films from agriculture.

In Frank (2015) the share of plastic films and sacks in residual waste from agriculture was estimated between 2% and 4,5% (in a highly agricultural province in Lower Austria) based on Obersteiner and Schneider (2005). An estimate of separately collected films of 2,5 kg/cap*a was taken from study in Switzerland. The total amount of plastic waste in Austrian agriculture was estimated at 33,000-50,000 t/a in Frank (2015) and Van Eygen (2017) (Table 5).

Medical Waste

In 2015, waste from the medical field amounted to 40.641 t (BMLFUW, 2017). Examples of plastic waste from the medicine sector are syringes, infusion bags and disposable gloves. An average plastic content in medical waste of 31% by mass was reported in Oberschneider and Scherhaufer (2008) cited in Frank (2015). The total amount of plastic waste in medicine was estimated at 14,000-18,000 t/a in Frank (2015) and Van Eygen (2017) (Table 5).

Waste textiles

Examples of waste textiles are clothing and furniture covers. The amount of waste textiles was 29,406 t in 2015, the estimated share of synthetics in textiles is 47% (Frank, 2015). The estimated amount of synthetic textile waste in Austria was 36,000t/a in 2010 (Van Eygen, 2017). In 2012 3.4 kg /cap*a was collected, the remaining potential in residual waste was 5.3 kg/cap*a. The estimated collection efficiency was 39% (NÖ AWP, 2016).

Other waste

Examples of other plastic waste are toys and sporting equipment. Van Eygen (2017) estimated the amount of plastic waste from other applications in Austria at 47,000 t/a (Table 5).

UBA (2017) defined other applications as plastic in residual waste and bulky waste from commercial enterprises, which are not collected via municipal waste management systems (in more detail described above in chapter 2.1).

2.2. Austrian Waste Collection System

In Austria, the collection of residual waste from households is obligatory (AWG, 2002) and mainly organized by formal collection via municipal waste collection schemes. Informal collection of packaging and residual waste is of minor importance in Austria. For the separate collection of household packaging waste, Producer Responsibility Organizations (PROs) need to be set up according to the Packaging Ordinance 2014 (see 2.2.2).

A large proportion of waste arising in Austria is caused by operational activities. As a result, the detailed examination of material flows at operational level is essential to promote sustainable development. This should be ensured with the mandatory creation and updating of a waste management concept (WMC) (BMLFUW, 2017a).

In accordance with Article 10 of the Waste Management Act 2002, a WMC must be created for plants whose operations generate waste and where more than 20 workers are employed. This obligation concerns every operator of such plants and also applies to all locally integrated establishments, including office buildings and schools, for example. Furthermore, when building and commissioning waste treatment plants, or if a number of major changes are planned for waste treatment plants (regardless of the number of employees), the application for approval must be accompanied by a waste management concept (BMLFUW, 2017a).

It is mandatory for all businesses in Austria with 100 or more employees to appoint a professionally qualified waste officer in writing. The order or dismissal is to be reported to the district administrative authority, or in cities with its own statute, to municipal authorities without delay (BMLFUW, 2017a).

2.2.1. Collection of Municipal solid waste in Austria

Mixed municipal waste from households and similar establishments is largely disposed of in the collection system through public domestic refuse collection or private enterprises. The latter are instructed to effect collection by municipalities or waste management associations. The waste from agriculture, service companies, small business enterprises and public bodies which is similar to that generated by households is predominantly collected together via domestic refuse collection (BMLFUW, 2017a).

Residual waste collection is organized by pick-up (collection) system or revolving emptying system. For residual waste from commercial enterprises which does not need to be collected by municipalities, collection systems, revolving emptying systems and returnable containers are available (BMLFUW, 2017a).

Bulky waste from households and similar establishments includes waste which cannot be collected via customary waste containers on account of their size or shape and which cannot be assigned to any recoverable collection. A collection system is typically organized via delivery to collection points for recyclables by citizens and a (loose) collection system (BMLFUW, 2017a).

Waste electrical and electronic equipment is collected in Austria through collection centers for recyclables or sometimes through municipal bulky waste collection, stationary and mobile municipal problematic substance collection centers or by specialist retailers and disposal companies. Regarding WEEE from private households, a free-of-charge take-back option exists according to the WEEE Ordinance. In 2015, approximately 80,246 tons of WEEE in total was collected by registered collection points (BMLFUW, 2017a).

2.2.1.1. Collection of municipal solid waste in Vienna

In Vienna, municipal waste collection is organized by one organization, namely the Municipal Department 48 (MA 48). Vienna's municipal territory offers approx. 430,000 waste containers, 19 waste collection centers and 112 sites for the collection of hazardous waste from households.

Residual waste, which includes high amounts of plastics (11.6% according MA 48 (2016)) is collected in bins with a capacity of 120 - 4,400 liters, which are mostly used by households. If their waste composition corresponds to that of household residual waste, commercial enterprises may also use these containers in some locations.

For the separate collection of recyclables, Vienna's collection system offers a combination of waste pick-ups (by MA 48) and waste deliveries (by citizens and businesses). Containers installed on properties (pick-up by MA 48) are complemented by containers publicly installed in parking lanes or on sidewalks (delivery by users at approx. 4,300 sites across the city) and containers at 19 waste collection centres. Additional

containers for plastic foils and kitchen scraps are available for commercial enterprises (MA 48, 2013a). Since 2018, recyclable hollow plastic bottles (e.g. PET-bottles) and composite beverage cartons are collected together separately. Plastic foils and other plastic packaging from households is collected in residual waste and subsequently sent to energy recovery. More information is available in chapter 2.2.2.1.

2.2.1.1. Collection of municipal solid waste in Lower Austria

The fulfillment of waste management in Lower Austria is the responsibility of multiple municipalities. The province is divided in 5 waste management regions with 558 municipalities (out of total 573) organized in 22 environmental associations and 3 city units similar to associations (

Appendix 7, Amt der NÖ Landesregierung, 2015).

The "Lower Austrian Waste Management Association" (NÖ AWV) builds the umbrella corporation of waste management in Lower Austria, in cooperation with the department of "Environmental Economy and Regional Planning Support of the State of Lower Austria" (RU3).

2.2.2. Collection of plastic packaging in Austria

Out of different plastic waste streams, in Austria only plastic packaging is collected separately.[10]

The EU Packaging and Packaging Waste Directive (94/62/EC) was converted into Austrian law through the Waste Management Act 2002 (amendment on packaging in 2013) and the Packaging Ordinance 1992 (now replaced by the Packaging Ordinance 2014).

According to the Packaging Ordinance 2014, all manufacturers, distributors and importers that place packaging or packaged goods on the Austrian market are required to take the packaging back free of charge and ensure its recycling or reuse. The Ordinance is applied also to producers and importers of one-way dishes.

For packaging from households and similar commercial establishments, it is required to join a packaging compliance scheme (Producer Responsibility Organization, PRO). For commercial packaging, for meeting the obligations one can either a) manage the collection and treatment of packaging waste by joining a PRO or b) through an own scheme provided that the recycling facilities are state-of-the-art, minimum recycling rates for each packaging material are fulfilled and annual data reports are submitted to the BMNT (ARA, 2018):

On the Austrian market, seven PROs are authorized for the collection, sorting and recovery of household packaging and eight for commercial packaging, however, *Austria Glas Recycling* (AGR) as part of the ARA group is only responsible for the collection and recovery of glass packaging and *GUT Galle Umwelttechnik GmbH* is only available for already existing customers upon expiry of the authorization (BMNT 2019; see

[10] The collection of all plastics together ('catch al plastic bin´) was investigated in Lower Austria by Kranzinger et al. (2017) and Pomberger et al., (2015). Results of ecological and economical assessment showed that 'catch al plastic bins´ would increase the amount of material recycling, which has positive impacts to the climate. Non-packaging plastic wastes (e.g. styropor, toys, household items) could be collected in a pilot test at recycling centers.

Appendix 11 and 12). *Altstoff Recycling Austria AG (ARA)* is part of the Green Dot System PRO EUROPE and was a monopoly in Austria from 1993 to 2009 for commercial and to 2015 for household packaging. The ARA-Collection system is described in more detail in Appendix 10. ARA still has the highest market shares with 60-70% (see Table 10) and collected 761,000 t of packaging waste from households, industry and commerce in 2015, thereof 207,000 t were lightweight packaging. 182,000 t of collected lightweight-packaging waste was recycled.

Collection and recycling system	**Plastic packaging (commerce)**	**Lightweight-packaging (household)**
Altstoff Recycling Austria (ARA) AG	75,56 %	72.02%
Bonus Holsystem für Verpackungen GmbH & Co. KG	11,35 %	5.06%
ELS Austria GmbH (now "good waste Austria GmbH")	0%	0%
European Recycling Platform (ERP) Austria GmbH, Landbell Group	0.77%	2.17%
INTERSEROH Austria GmbH	6.18%	11.62%
Reclay UFH GmbH	6.14%	9.13%

Table 10: PROs for household and commercial packaging in Austria and their market shares for plastic and light-weight packaging (including plastics) (BMNT, 2019).

In Austria, around 1.8 million bins for the collection of waste packaging made of paper, plastic, metal and glass are available. In addition, kerbside collection service for packaging (yellow bag/ yellow bin) for 1.6 million households is organised by PROs (ARA 2018). Collection systems vary between regions. The range is from lightweight-packaging (LWP) to bottles only (city of Vienna), depending on the region (BMLFUW, 2017, MA48, 2018, NÖ AWP, 2016). In the household sector, often so called lightweight-packaging (LWP) is collected. LWP includes plastic packaging, composite materials, in some provinces also packaging from wood, textiles, ceramics and biogenic packaging materials is separately collected.

2.2.2.1. Collection of plastic packaging in Vienna

In Vienna, the collection of plastic items was initiated as early as in 1989 by the Municipal Department MA48. Foils, yoghurt cups and hollow items were collected in separate containers for the first few years. The coming into force of the Packaging Ordinance on 1 October 1993 led to the collection of all types of plastic packaging covered by the ordinance in one mixed system as "plastics and composite materials". As of December 1995, only large plastic packaging foils and large-volume hollow plastic items for packaging were collected separately. From autumn 2004 to spring 2005, the system was switched over to a new collection scheme for hollow plastic items (plastic bottles for beverages, detergents, cosmetics, food such as ketchup etc.). By changing the collection scheme in 2005, the collected amount decreased (

Appendix 7, Appendix 8) but it was possible to reduce the portion of incorrectly discarded bottles from up to 40% to less than 10%.

The currently used containers dispose of lockable lids with openings for inserting the bottles (MA 48 2012b). In some districts, also kerbside collection service via yellow bags is available. Since 2018, composite cartons (formerly collected separately via the "Ökobox" system) are collected together with hollow plastic items. In the 2nd half of 2019, the introduction of containers for the collection of plastic bottles and composite cartons together with metals is planned. Other plastics packaging like foils etc. are only collected separately for commercial packaging (higher quality and quantity) and via residual waste for household packaging. Separately collected and non-collected plastics in Vienna are listed in Table 11.

In Vienna, containers for plastic bottles plastic bottles are installed at more than 1,900 public places all over the municipal territory and 16 collection centers. Large residential complexes collect partly directly on the real estate. Vienna offers more than 12,600 containers with yellow lids for the collection of plastic bottles. There is one bring point per 405 inhabitants (collection coverage = 100%). Since 2013, the MA 48 also offers a pick-up collection of plastic bottles by means of "yellow bags" in some municipal districts of Vienna (mainly in areas characterised by single-family homes) with a pick-up interval of six weeks without further costs for households (www.wien.gv.at). With the introduction of yellow bags, it was possible to double the collection rate in these test areas.

Figure 2: Collection of plastic bottles in Vienna (Source: www.wien.gv.at)

In total, about 5,000 tonnes of plastic bottles are collected every year in Vienna.

Collected plastics	Non-collected plastics
• **non-returnable beverage bottles (PET),** • **bottles for detergents, dishwashing liquids, household cleaners,** • **containers for cosmetics such as shower gels and shampoos,** • **plastic bottles for supplies such as cooking oil and ketchup,** • **other plastic bottles.** • **Since 2018: milk- and beverage composite carton packages are collected together with plastic bottles** • **Light-weight plastic packaging of commercial enterprises**	• returnable plastic bottles, • engine oil bottles, • lubricant and adhesive bottles and containers, wood, • plastic mugs, • small plastic bags, • bubble wrap, • foil, • white styrofoam, • meat trays, • rubber foam, • buckets, • canisters, • textiles

Table 11: Collected and non-collected plastics in Vienna

Despite of the plastic bottles collection in Vienna, businesses are still allowed to collect light-weight plastic packaging (in particular foils of large surface). Commercial enterprises are provided with containers with flat lids and without locks for collecting plastic foils.

Since 2008, street cleaners collect and separate plastic bottles and beverage cans from street sweepings and emptied waste bins. By 2012, a total of 1,300 tonnes of such waste were thus collected separately and duly recycled.

2.2.2.2. Collection of plastic packaging in Lower Austria

In Lower Austria, plastic packaging is collected in different collection systems (NÖ AWP, 2016):

- Lightweight-packaging (LWP) – bring and kerbside system (910)
- Plastic bottles including beverage composite carton – bring and collection system (915)
- Lightweight and metal packaging – collection system (930)
- Plastic bottles and metal packaging incl. beverage composite carton – collection system (935)
- Recycling bin – collection system

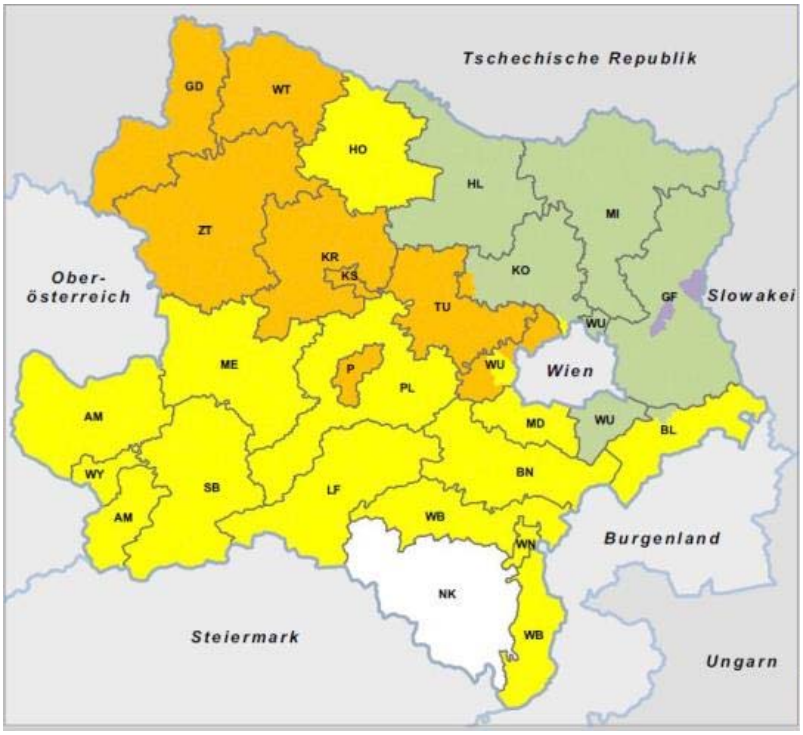


Figure 3: Waste management regions in lower Austria (yellow=system 910, orange=915, violet=930, green=935, white = recycling bin collection system) (NÖ AWP, 2016).

Furthermore, in 13 collection regions of Lower Austria plastic packaging is collected within the Modul 5[11] ARA System at local recycling centres. By means of these collection points 734 t of plastic packaging is collected per year.

[11] Modul 5 Collection: Household Packaging and sources with waste similar to the waste generated by a household can be delivered to take-over points of the communities within the Moduls 5 (local recycling centres).

2.2.3. Collection of non-packaging similar plastic waste

The potential of the collection of non-packaging of similar plastic material in Austria was investigated by Pomberger et al. (2015) and Kranzinger et al. (2017). However, at the moment non-packaging of similar plastic waste is not collected separately in Austria.

2.2.4. Collection of other relevant waste streams

End-of-life vehicles

In Austria, there are around 700 enterprises (motor vehicle dealers, workshops, waste disposal companies, recyclers, secondary raw materials dealers, shredder operators) which take on end-of-life vehicles free of charge. The collection points for end-of-life vehicles are published on the website of the Federal Ministry of Agriculture and Forestry, Environment and Water Management (BMLFUW, 2017a).

2.2.5. Role of "informal" waste collection in Austria

Disparities in earnings between Western and Eastern European countries are the reason for a well-established informal sector actively involved in collection and transboundary shipment activities from Austria to Hungary. The preferred objects are reusable items and wastes within the categories bulky waste, WEEE, and metals, intended to be sold on flea markets. Despite leading to a loss of recyclable resources for Austrian waste management, these informal activities may contribute to the extension of the lifetime of certain goods when they are reused in Hungary; nevertheless, they are discussed rather controversially. An estimated amount of approx. 100,000 t per year of reusable items informally collected in Austria is transshipped (Ramusch et al., 2015). Another important sector of informal waste collection is end-of-life vehicles: in 2015, only 19% (48,000) out of the 250,000 passenger cars are taken off the road in Austria was supplied for recovery in Austria while the majority of end-of-life vehicles were shipped (illegally) abroad as "used vehicles" (BMLFUW, 2017).

3. Waste generation and collection in Slovakia

3.1. Waste generation in Slovakia

According to data from the Report on the State of the Environment of Slovakia in 2017, which is annually issued by the Ministry of the Environment of the Slovak Republic, 14,284,891.98 tonnes of waste were created in Slovakia. In comparison, in 2016, 34% less waste was generated than in 2017. In Slovakia, the year-on-year increase in total waste production has been persisting for a long time. The largest waste producer according to the classification of economic activities is industrial production (especially other waste) with a total share of 32% in waste production.

Waste Category	Amount (t)
Dangerous waste	389,267.74
Other waste	11,758,837.17
Municipal waste	**2,136,787.07**
Total	**14,284,891.98**

Table 12: Waste generation balance SK in 2017

Related to 5,435,343 inhabitants, the annual average municipal waste production in 2017 was 393.13 kg. In Slovakia, the definition of municipal waste is given in Act no. 79/2015 on waste and amending and supplementing certain acts as follows:

- **Municipal waste**is household waste generated on the territory of the municipality during the activities of natural persons and wastes of similar characteristics and composition, the originator of which is a legal person or a natural person - entrepreneur, except for wastes arising from the immediate performance of activities forming the subject of business or activities of a legal person or natural person - entrepreneur; Waste from households serving individuals for their individual recreation, such as gardens, cottages, , or for parking or storing a vehicle used for household purposes, especially from garages, garage stands and parking stands, are also considered household wastes. Municipal wastes are also all wastes generated in the municipality during the cleaning of public roads and areas, which are the property of the municipality or in the administration of the municipality, and also in the maintenance of public greenery, including parks and cemeteries, which are the property of the municipality or in the administration of the municipality and other greenery on the plots of land people. Municipal wastes composed of:
    - Mixed municipal waste and
    - Separately collected municipal waste (plastics, glass, etc.)
- Hazardous waste is waste that has at least one hazardous property listed in an annex to a separate regulation.
- Other waste is waste that does not exhibit any of the properties of hazardous waste. It is a group that does not pose a great risk to the environment. This category includes building spoil, organic agricultural waste (straw) and others. This waste group is particularly problematic because of its large volume but not its chemical composition.

In Slovakia, plastics are found in almost all waste streams. If we wanted to divide plastic waste into different types of plastic waste, we would conclude that pure plastics is mainly found in the separated municipal waste component - Plastics. In particular, plastic packaging waste or non-construction polystyrene and the like is concentrated here. The rest would be classified as waste containing plastic, such as bulk waste, waste from electrical equipment and from vehicles. But such sorting of plastic waste is very general and there are no statistical data in Slovakia. The same is true for specific plastic products, waste and packaging.

The publicly available comprehensive information on the collected waste data is available only on enviroportals (www.enviroportal.sk), in the section - partial monitoring system, where data are grouped according to waste catalog numbers. Some waste, say diapers, syringes, etc., are not specified in the Waste Catalog as plastic waste, but only as other waste.

According to the Waste Catalog (see Appendix 19) valid in the (SR) Slovak Republic, we can say that plastic waste also comes from industrial production in the form of residual waste, such as:

- Waste Group 02 - Waste from agriculture, horticulture, forestry, hunting and fishing, aquaculture and from food production and processing, under catalog no. 020104 waste plastics except packaging (Table 13)
- Waste Group 04 - Wastes from the taper, fur and textile industries, under catalog no. 040209 composite material waste (impregnated textile, elastomer, plastomer[12]) (Table 13
- Waste Group 07 - Waste from organic chemical processes, catalog no. 070213 waste plastic (Table 13)
- Waste Group 12 - Wastes from shaping, physical and mechanical treatment of metal and plastic surfaces, catalog no. 120105 plastic shavings and chips (Table 13)
- Waste Group 17 - Building wastes and demolition wastes including excavated soil from contaminated sites, sub-group 1702 wood, glass and plastics, under catalog no. 170203 plastics; 170204 glass, plastic and wood containing dangerous substances or contaminated with dangerous substances; subgroup 1706 with catalog no. 170603 Other insulating materials consisting of or containing dangerous substances, and 170604 Insulation materials other than those specified in 170601 and 170603 (Table 13)

[12] A plastomer is a polymer material which combines qualities of elastomers and plastics, such as rubber-like properties with the processing ability of plastic. As such, the word plastomer is a portmanteau of the terms plastic and elastomer. Significant plastomers are ethylene-alpha olefin copolymers.

Plastic containing waste groups (WG) from production (residual waste)	Amount (t)
WG 02: agriculture, horticulture, forestry, hunting and fishing, aquaculture and from food production and processing, under catalogue no. 020104 waste plastics except packaging	146.28
WG 04 - Wastes from the taper, fur and textile industries, under catalog no. 040209 composite material waste (impregnated textile, elastomer, plastomer	3,327.52
WG 07 - Waste from organic chemical processes, catalog no. 070213 waste plastic	47439.8
WG 12 - Wastes from shaping, physical and mechanical treatment of metal and plastic surfaces, catalog no. 120105 plastic shavings and chips	434.22
WG 17 - Building wastes and demolition wastes including excavated soil from contaminated sites, 170203 170204 170603 170604	 1,640.91 2,225.43 71.32 2,402.06
Total	**57,687.54**

Table 13: Generation of (plastic containing) industrial waste by catalogue number of SR in 2017

Region	Material recovery (t)	Thermal recovery (t)	Other recovery (t)	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Trnava region							10.23	10.23
Generation of waste 020104 in SR	2.77		0.11	79.7			63.7	146.28

Table 14: Waste group 020104 (waste plastics except packaging)

The authors have included the construction waste group 07 in industrial production waste, as the waste catalogue does not clearly specify which of the waste has been produced during production, construction or demolition. Therefore, it should be noted that this group of sets can also be included in bulky waste in municipal waste as well as in the construction industry.

3.1.1. Generation of plastics in Municipal waste in Slovakia

According to Table 1, we can say that in Slovakia, **2,136,787 tons of municipal waste** were created in 2017 (**393 kg/cap*a**). Here, too, we see a year-on-year increase in waste production. In 2016, the production of municipal waste per capita was 33 kg lower and amounted 360 kg/cap*a. The largest amount of kg waste per capita in 2017 was produced in Bratislava region (**502 kg/cap*a**), closely followed by Trnava region (**500 kg/cap*a**).

From Act No. 79/2015 on Waste Zz, it is the duty of municipalities to provide and implement a separate collection of "classic KO components". This collection includes: paper and cardboard, glass, plastics, metals and biodegradable municipal waste (BDMW).

Some waste streams are also included in municipal waste. For the purpose of this report, the following are interesting for us: electrical waste, batteries. The whole Slovak waste catalog is depicted in Appendix 19.

Based on the ČMS (partial monitoring system) we are able to identify, at least in part, plastic waste coming from municipal waste. Catalog No. 200139 summarizes other plastics (without packaging) which are registered as a separate waste component, even if they are collected together in yellow containers (Table 15).

Municipal waste 200139	Bratislava region (t)	Trnava region (t)	Slovakia (t)
In 2017	7,138.50	4,697.33	44,385.95
In 2016	6,361.35	4,157.81	36,123.34
In 2015	5,891.03	4,298.55	34,658.29
In 2014	5,346.18	4,546.09	31,568.28

Table 15: Production of other plastics, without packaging in municipal waste 200139 in 2017

Many plastic waste types are generated in municipal waste groups such as

- Bulky waste under catalog number 200307
- Minor construction waste under catalog number 200308

In Slovakia, these groups of municipal waste do not specify the percentage/proportion of plastics included in the waste. For example, considering furniture waste, it is very likely that a large proportion of such waste is plastic. However, this waste clearly belongs to the bulky waste section, and we will not get to the plastic waste data.

Plastic containing waste group	Bratislava region (t)	Trnava region (t)	Slovakia (t)
Bulky waste (200307)	30,843.57	25,539.21	197,939.48
Small building waste (20308)	14,360.88	22,455.84	79,163.07

Table 16: Plastic containing bulky waste (200307) and small building waste (200308) generation in Slovakia in 2017

The same principle applies to individual municipal waste streams such as batteries and electrical waste. In this case, the processing companies also show a number of plastics in the material balance of the processing, but these data are not included in the municipal waste group, but in the waste group 1912 not specified. This waste already belongs to waste from industry. In addition, plastics from both electrical waste and batteries are summarized in one category.

(Plastic containing) waste group	Amount in Bratislava region (t)	Amount in Trnava region (t)	Amount in Slovakia (t)
Batteries and accumulators (200133) hazardous waste	**526.95**	**151.12**	**2,819.31**
Batteries and accumulators (200134)	**17.38**	**17.27**	**49.78**
200133 + 200134	**544.33**	**168.39**	**2,869.09**
Hazardous parts from electrical waste (200135)	**300.34**	**287.02**	**3,104.81**
Other waste (200136)	**840.84**	**687.85**	**6,449.22**
200135+200136	**1,141.18**	**974.87**	**9,554.03**

Table 17: Generation of waste batteries and WEEE in Slovakia in the year 2017

In Table 17, waste batteries and WEEEs in 2017 in Slovakia is described. They are assigned to following waste catalog numbers:

- 200133 - batteries and accumulators classified as hazardous waste
- 200134 - batteries and accumulators that are left
- 200135 - hazardous parts from electrical waste
- 200136 - Other waste

Subsequently, in Table 18 the amount of generated plastics and rubber from the processing of waste from concrete, electrical waste and others is listed.

Plastic and rubber waste from waste processing	Amount in Bratislava region (t)	Amount in Trnava region (t)	Amount in Slovakia (t)
Plastic and rubber (191204)	2,454.82	8,888.25	27,743.39

Table 18 Generation of plastic and rubber waste after processing another waste streams in Slovakia in 2017

3.1.2. Packaging waste generation in Slovakia

Packaging and packaging waste is nowadays an integral part of consumer production. Different packaging is made of different materials. Some are made entirely of paper and cardboard and some are made of

plastics. Composite packaging is also made of various materials. Paper represents the highest share of packaging materials by weight. But it has to be considered that the density (specific weight) of plastic is much lower than that of paper.

Table 19 shows packaging waste generation in Slovakia in 2017. **Plastic packaging waste** amounted **119,409.31 t in 2017**. Related to 5,447,662 inhabitants in 2017 this is about **22 kg/cap*a**. Its recovery (material and thermal) rate was 58.03 %.

Packaging material	**Amount (t)**	**Recovery rate**
Glass	85.675.81	62.25 %
Plastics	**119,409.31**	**58.03 %**
Papier	214,445.39	78.85 %
Metals	28,814.85	83.01 %
Wood	59,631.34	57.81 %
Other	9,867.17	100.78 %
Total	517,843.87	69.53 %

Table 19: Packaging waste generation in Slovakia in 2017 according to State of the Environment Report of the Slovak Republic

Manufacturers facilitate labeling by means of graphic marks (Table 19) which are accompanied by written and numerical data. Based on this information, people should simply identify waste and packaging and classify it properly to waste containers.

Material of plastics packaging	**Numerical designation**	**Abbreviation**
polyethylene terephthalate	1	PET
High density polyethylene	2	HDPE
Polyvinylchloride	3	PVC
Low density polyethylene	4	LDPE
Polypropylene	5	PP
Polystyrene	6	PS

Table 20: Designation of plastic waste packaging in Slovakia

Furthermore, we encounter plastic packaging in combination with other materials that can be separated and called composites. They are marked with the letter C and the abbreviation of the material that prevails on the package (Table 21).

Composite „C"packaging material	**Numerical designation**
Plastic / aluminum	90

Plastic / tin plate	91
Plastic / various metals	92

Table 21: Designation of composite packaging "C" materials in Slovakia

3.1.3. Generation of other plastic relevant waste streams in Slovakia

Number and weight of processed old vehicles is listed in Table 22.

(Plastic containing) waste stream	Amount (t)	Number
End-of-life vehicles processed	33,270.80	35,462

Table 22: Processing of end-of -life vehicles in Slovakia in 2017

Among other streams of waste, it is worth mentioning the flow of old vehicles and vehicles. Here, too, we can determine the amount of plastics and plastic waste produced on the basis of a partial monitoring system and waste catalog in Slovakia. Waste generated according the catalog number in 2017 is shown in Table 23.

- - 160119 - plastics from old vehicle and various means of transport
- - 160103 - worn tires

(Plastic containing) waste stream	Amount in Bratislava region (t)	Amount in Trnava region (t)	Amount in Slovakia (t)
Old vehicle plastics and various means of transport (160119)	878.18	179.9	2,071.3
End of life tires (160103)	743.94	5,826.9	17,355.22

Table 23: Generation of plastic waste and end-of-life tyres out of end-of-life vehicles in Slovakia in 2017

3.2. Waste collection system in Slovakia

In most Slovak towns/cities and municipalities, the so-called local integrated system of separate waste collection is in operation (MIS). Non-packaging products made from an equal/similar material as packages are also collected together with packaging commodities.

The majority of the inhabitants have the possibility of separating their waste and more than 2/3 of the inhabitants also regularly use the system of separate waste collection. Most inhabitants have access to collection bins or other systems for separate collection. In general, separate collection includes paper, plastics and mixed glass, separate collection of composite materials/ tetra packs has been supported in municipalities, particularly together with the plastic waste (EC, 2015).

The municipalities are responsible for the management of municipal waste generated in the municipality and with minor construction waste, unless otherwise provided by the Waste Act.

The cost of the mixed municipal waste collection container is borne by the original waste producer. The municipality shall stipulate in the generally binding regulation the amount of these costs and their inclusion in the local fee for municipal and small construction waste or stipulate another way of the payment.

The cost of providing collection containers for the separate collection of municipal waste components, for which extended producer responsibility is applied, is borne by the manufacturer of the reserved product, the relevant producer responsibility organization, or a third party. The costs of these collection containers cannot be included by the municipality in the local municipal waste and construction waste fee.

The costs of collecting containers for separate collection of municipal waste components (paper, metals, plastic, cardboard packaging, mixed municipal waste, glass), for which extended producer responsibility is not applied, are borne by the municipality and may be included in the local municipal waste and construction waste fee.

Local taxes and local fees for municipal waste pursuant to section 77 of Act no 582/2004 are described in legal framework report and also in Appendix 20.

3.2.1. Collection of Municipal waste in Bratislava Region and Trnava Region

OLO a.s. has an important position in the area of municipal waste management in the territory of the largest Slovak city of Bratislava and an irreplaceable position in the entire waste management of the capital city. They provide services in the field of collection, removal and disposal of municipal and small construction waste.

The company provides its services to waste producers, who are natural persons - citizens having permanent or temporary residence in Bratislava and legal entities performing their activities in Bratislava.

In addition to its core business of collecting, transporting and incinerating municipal waste, the company also carries out ancillary services such as sorting of waste collected in a separate collection system, waste collection through large-capacity containers, incineration of third-party waste (excluding hazardous waste) through large-capacity containers, incineration third-party waste (excluding hazardous waste), electricity generation and sales and the sale of secondary raw materials.

At the same time, OLO operates its own waste collection center which is set up for the free legal storage of municipal waste. It is intended for natural persons and entrepreneurs who are involved in the system of municipal waste collection in Bratislava.

Other major companies that provide their services for waste disposal or collection in the Bratislava region are Marius Pedersen, a.s. and FCC CEE, a.s .

The FCC Group in Slovakia is one of the leading companies in the area of comprehensive waste management services in the Slovak Republic. The company provides services for more than 490,000 inhabitants in approximately 325 municipalities and serves over 1400 industrial and commercial customers.

Marius Pedersen actively carries out the collection, transport, sorting, recovery and disposal of municipal waste in close cooperation with over 400 cities and municipalities, providing services to nearly 1,000,000 inhabitants.

3.2.2. Collection of plastic packaging in Slovakia

Producers of packaging and non-packaging products who market their products are responsible for where their waste ends up, and therefore also for the financing of separate waste collection. They do so collectively through producer responsibility organizations (PROs). Among the largest OZVs = organizáciou zodpovednosti výrobcov = PROs in Slovakia, is ENVI - PAK or NATUR-PACK.

Thus, producers cover the costs of collection, transport, re-use preparation, recycling, purchase of colored containers, as well as wages, energy, or sorting line costs. This brings budget and budget savings to municipalities and cities - the more waste a municipality or a city sorts out, the lower costs it will have with the disposal of residual mixed waste.

They provide waste management (collection, recovery and recycling) for all types of packaging and non-packaging products in accordance with the principle of extended producer responsibility.

OZV conclude contracts with selected partners for services provided within their competence. In the case of collection, recovery and recycling, these are the three main companies, as in the case of municipal waste collection. They are companies:

- OLO, S. A.:
- Marius Pedersen, a.s.
- FC CEE, a.s.

Plastic packaging waste is collected in yellow containers or yellow bags in Slovakia.

For every village is clearly stated in VZN what belongs to plastic bins. The rules for sorting of plastics are almost identical in every village, only a few exceptions vary. In some municipalities, depending on the waste collection and processing company, tetrapaks are also thrown into plastics, in others polystyrene is not thrown into plastic containers. Collection of other relevant waste streams:

The collection of other waste streams is ensured in Slovakia through the OZV organisation (similar as with packaging and non-packaging products). For example, the collection of electro waste is carried out as following:

- Either the inhabitants of the municipality will bring the electrical waste to the waste collection center in the municipality wherethe waste will be grouped. When a full collection point is called, the company with which the waste collection contract has been concluded comes to remove and process the waste.

- Another possibility is that a company that has a contracted community collects waste – it is called "podomový zber odpadu" (house-to-house waste collection) and often exists in rural areas where municipality does not have a collection court but waste is collected from each household directly.

Plastic packing material is collected separately together with other plastic materials in the waste category "plastics".

3.2.3. Collection of plastic-similar non-packaging waste

In Slovakia, non-packaging similar to plastics is collected separately together with plastic packaging materials in the waste stream "plastics" (see above).

3.2.4. Collection of plastics

In Bratislava plastic is collected in yellow containers where following plastics are collected separately together (Barbora and Barbora, nn):

- Plastic bottles from beverages
- Plastic cups
- Foils, plastic bags and micro-pocket bags
- Plastic packaging from food and drugs
- Plastic packaging of laundry detergents and cosmetics
- Tetrapack = beverage carton = multilayer composite material
- Packaging of thin-walled aluminum
- Packaging polystyrene
- Thermal covers for food
- Plastic adhesive tape
- Credit cards, loyalty plastic cards
- Plastic caps from "coffee-to-go" cups
- All metals
- Products and packaging marked with codes: PET, HDPE, PCV, LDPE, PP, PS

Not collected in this waste stream are:

- Greasy plastic bottles (→ mixed waste)
- Plastics contaminated with chemicals and oils
- Plastics contaminated by food remains, biowaste
- Drugs and medication in plastic wrapping coated with aluminum foil
- Toothpaste tubes
- Toothbrushes
- "coffee-to-go cups (it is a composite and belongs to mixed waste
- Paper-/plastic-aluminum bags from spices
- Compostable/ biodegradable plastics, bioplastics (made from biomass rather than oil), PLA, cellophane (transparent cellulose foil)
- Rubber (→ mixed waste)
- Cables (→waste collection center)
- Plastic foam (→ waste collection center)
- Floor coverings (→ waste collection center)
- TV screens (→ waste collection center)
- Bubble-gums (→ mixed waste)

4. Recycling, treatment and disposal of plastic waste and plastic containing waste streams in Austria

In 2015, 71% of plastics in waste were treated in thermal treatment plants, 28% were recycled and only 1% was landfilled as share of various non-pure-plastic waste streams (Table 24, UBA 2017).

Treatment	Amount of treated waste (t)	%
Landfill	13,998	1%
energetic recovery	649,096	71%
recycling (material utilization)	252,190	28%
Sum	**915,284**	**100%**

Table 24: Overview about the treatment of plastic waste and plastic containing waste streams (UBA, 2017)

Mixed waste streams containing plastics are mainly treated thermally, whereas the greater part of pure plastic waste streams is recycled. 64 % of thermal treatment is carried out in incineration plants for municipal waste (Siedlungsabfälle), the rest is treated in other incineration plants (e.g. of the cement or cellulose industry). For the recycling of 252,190 t of plastic waste in 2015, 38 plants with a capacity of 319,000 t are available to produce recyclates, (semi-finished) products, polystyrene and building materials. Landfilled plastics are mainly residues from mechanical biological treatment (MBT) plants (UBA, 2017). In 2015, 221,994 t of the plastic waste treated in Austria were pure plastics (UBA, 2017).

Depending on the mass and nature of plastic waste (type, degree of pollution and purity) different utilization opportunities exist (material and energetic recovery). Material recovery can be performed as mechanical or feedstock recycling (BMLFUW, 2017).

The treatment of plastic (containing) waste streams from different sectors was investigated by Frank (2015): A summary of the assessment of treatment ways of plastic-containing waste streams in Austria for the year 2010 is presented in Table 25.

Sector	Input (t)	Input (%)	Material recovery (t)	Thermal recovery (t)	Landfilling (t)
Other	67,500	12,0	2,000	65,500	
Packaging	279,600	51,0	96,200	155,400	28,000
Medicine	17,200	3,0	4,600	12,600	
Households	47,700	9,0	3,200	44,500	
Construction	31,200	6,0	4,700	26,500	
Furniture	23,200	4,0	0,000	23,200	
WEEE	19,400	3,0	7,800	11,600	
Agriculture	48,900	9,0	12,900	36,000	
Transport	17,800	3,0	4,400	13,400	
Total	**552,500**	**100%**	**135,800**	**388,700**	**28,000**
%			**24,6**	**70,4**	**5,1**

Table 25: Treatment ways of plastic (containing) waste streams in Austria (Frank, 2015)

Study of Van Eygen (2017) and European plastics industry statistics on the recovery rates of waste plastics in Europe report similar ranges, e.g. European plastics industry reports for Austria in 2010 for post-consumer waste: 27% for mechanical and chemical recycling, 70% for thermal utilization, while the remaining 3% is landfilled (PlasticsEurope, 2011 cited in Van Eygen, 2017).

A Comparison of the delivery of waste plastics to different waste treatment options in studies from the years 1994, 2004 and 2010 indicate a trend of moving away from landfilling towards increased mechanical and chemical recycling and thermal utilization. The increased mechanical recycling rates are the success of an Austrian policy change: from 2004 onwards, the Austrian Landfill Ordinance defines a ban on the landfilling of waste with an organic carbon content higher than 5%, which therefore led to a rapid decline of the amount of waste plastics being deposited (Van Eygen, 2017).

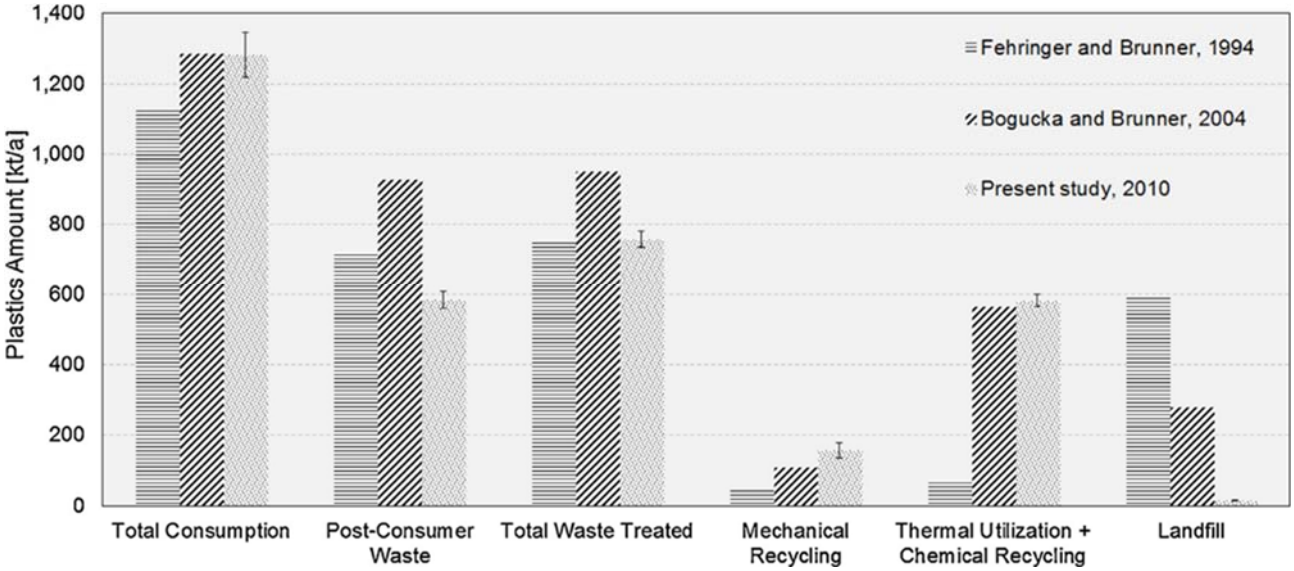


Figure 6: Comparison of the results from different studies on plastic consumption, waste production and waste treatment in Austria (Van Eygen, 2017; Fehringer and Brunner, 1997, Bogucka and Brunner, 2007 cited in Van Eygen, 2017).

4.1. Waste recycling and treatment in Austria

With regard to waste management, Austria is among the top performers in the EU (EC, 2017) and meets already all EU recycling targets, including packaging waste recycling. Austria has one of the highest levels of municipal waste (MSW) recycling in Europe - 56 % in 2014 (25% material recycling, 31% composting/AD), even though for 2010–2014 total recycling rates were slightly below the ones recorded in 2007–2009. To meet recycling targets for 2030 (65%) additional efforts will be needed. Therefore, Austria should now focus on prevention and diverting waste from incineration to recycling.

4.1.1. Recycling and treatment of MSW

In 2015, around half of the approximately 4,160,000 tons of MSW from households and similar establishments was supplied for material recovery. More than 40% underwent thermal treatment, while less than 10% underwent mechanical-biological treatment (BMLFUW, 2017a)

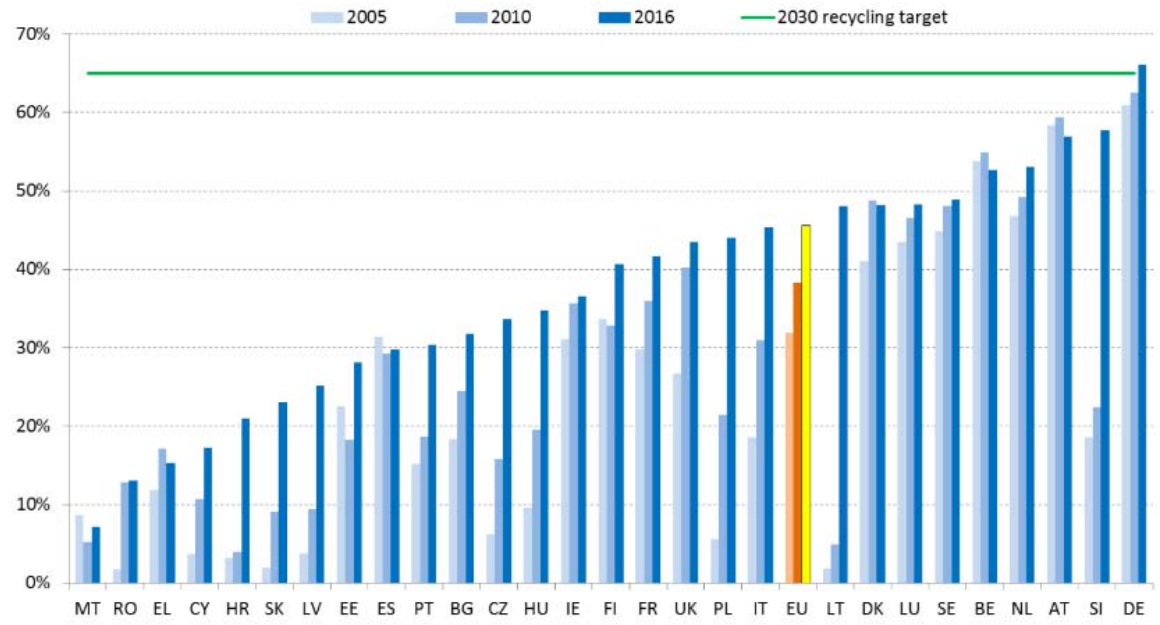


Figure 4: Recycling rate of municipal waste in the EU. 2016 data for Ireland, Greece, Austria, Portugal, Romania, Finland and United Kingdom not available and the following are used: Greece, Austria, Romania, Finland, United Kingdom (2015), Portugal (2014) and Ireland (2012). 2005 data for Croatia refer to 2007. 2010 data for Denmark refers to 2009 (EC 2018).

Recycling and treatment of bulky waste

The majority of bulky waste is sorted and - after shredding - treated thermally and biologically (BMLFUW, 2017).

Recycling and treatment of WEEE

The aim of treating WEEE is the reclamation of recyclable recoverables and the separation of components containing pollutants. To this end, WEEE undergoes specific processing in separate plants. The complex design of the equipment, which is constructed using a variety of joining techniques, is often very laborious to disassemble into its individual components. Manual activities are therefore largely limited to the removal of components and assemblies for reuse or to remove any harmful substances. Materials are largely separated by means of automated crushing and sorting techniques.

In Austria, there are currently around 40 plants available for the initial treatment of waste electrical and electronic equipment. Large electrical equipment is treated in shredders. Harmful substances and/or component parts featuring a high pollutant content are separated out beforehand prior to crushing pursuant to the Waste Treatment Obligations Ordinance, Federal Law Gazette II No 363/2006, as amended. The separation into ferrous and non-ferrous metal and other residues meets current state-of-the-art requirements. For small electrical appliances and VDUs, there are treatment methods available based on prior manual disassembly and mechanical processing which ensure extensive recovery of the materials contained therein, such as metal, glass and plastics. Harmful substances (e.g. CFCs, VOCs and mercury switches) are also removed from refrigerators, freezers and air-conditioning appliances in special treatment plants prior to recovery of the metal, plastic and glass. Lamps are separated mechanically in encapsulated establishments with exhaust air collection and purification and separated out into different types of material (BMLFUW, 2017a).

The share of plastics in WEEEs was estimated to be 15.3% in 1980 and 20% in the year 2000 (Novak, 2001). Müller and Guttenbrunn (2018) state an average share of plastics in E-waste of 20-25%. Three types are most commonly used, namely HIPS (27%), other polymers/thermos. etc. (26%) and ABS 24% (Figure 4). The plastic content in WEEE per category, published by EERA (2018), is listed in Table 26.

Plastics in WEEE	**Content**
SDA (small domestic appliances)	30%
LDA (large domestic appliances)	15%
ICT (information and communication technology)	20%
Tools	10%
Temperature Control Equipment	25%
Screens	20%

Table 26: Plastic content in WEEE per category (EERA, 2018).

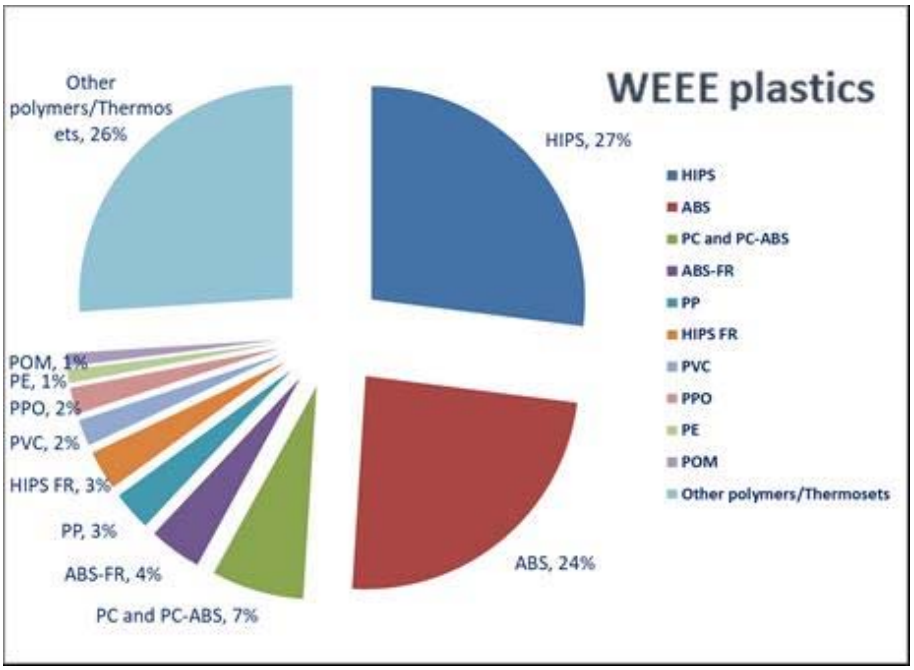


Figure 4: Plastic waste types in WEEE (Müller and Guttenbrunn, 2018).

4.1.1.1. Waste recycling and treatment of MSW in Vienna

The direct landfilling of waste with organic carbon content higher than 5 % is banned (Landfill Ordinance, BGBl. II Nr. 291/2016). MSW as well as bulky and commercial waste are treated in a grate waste to Energy (WtE) plant for energy production. The City of Vienna operates its own waste treatment plants

and is responsible for the entire chain of waste management from collection to treatment and, finally, disposal. Table 27 provides an overview of treatment facilities in Vienna.

Facility	Treatment method	Capacity [t/a]
Lobau composting plant	composting	150,000
Biogas plant in Simmering	anaerobic digestion	22,000
WtE plants: Flötzersteig, Spittelau, Pfaffenau, WSO 4	thermal	780.000
Pfaffenau waste logistics centre	Pre-treatment for the WSO 4 and interim bale storage of residual waste	130,000
z-PROSA, central collection site for hazardous materials, next to Rintertent	Temporary storage, after-sorting, and packaging for transport of used cooking oil, lead accumulators etc.; in some cases, removal of pollutants beforehand: fluorescent lamps, mercury containing waste, batteries, chemicals,...	Approx. 1,000
"Rinter Tent", until July 2019[13]; KUSSO (plastics sorting plant), until the end of 2016	Mechanical sorting of separately collected recyclables (plastics, paper, glass, metal)	

Table 27: MSW treatment in Vienna (MA 48, 2013b & 2018)

Combustion of residual waste

Some plastics end up in residual waste – the average plastic content in the residual waste is estimated to be 15 to 21.6 % (UBA, 2017; Blum, 2017). Since 2009, residual waste (including plastics like foils, etc.) is combusted together with other waste materials (e.g. bulky waste) in three incineration plants (Flötzersteig, Spittelau, Pfaffenau) which produce electricity, district heat and cooling. Combustion residues are treated (removal of metals), consolidated and disposed at the landfill Rautenweg.

[13] The Rintertent will be renewed to fulfill requirements of modern waste management. In summer 2019, the demolition of the old tent should start. In 2022, a new building for the treatment of yearly 250,000 t will be available. The slag hall for transforming ash/slag to ash/slag concrete for landfilling at 'Rautenweg' is located right next to the Rinter Tent and will not be renewed, therefore it is still in operation.

4.1.1.2. Waste recycling and treatment in Lower Austria

MSW together with bulky and commercial waste are treated either a) in a grate Waste to Energy (WtE) plant for energy production or b) through mechanical pretreatment in mechanical biological treatment (MBT) plants or splitting plants. Table 28 provides an overview of treatment facilities for residual and bulky waste in Lower Austria (NÖ Landesregierung, 2016).

Facility	Treatment method	Capacity (t/a)
WtE Dürnrohr	thermal	525,000
A.S.A. Zistersdorf	thermal	162,500
MBT St. Pölten	mechanical-biological	62,000
Grüne Tonne GmbH Breitenau	sorting	25,000
MBA"Rottner" Fischamend	mechanical-biological	27,000
Total		**801,500**

Table 28: Residual and bulky waste treatment in Lower Austria (NÖ Landesregierung, 2016)

4.1.2. Recycling and treatment of plastic packaging

In general, mechanical recycling of plastics refers to the processing of plastic waste into secondary raw material or products without significantly changing the chemical structure of the material. Plastics and plastics-containing waste that cannot be sustainably mechanically recycled to the required standard from an economic and environmental perspective provides a valuable resource for other recovery solutions such as feedstock recycling and energy recovery to maximize the recovery of its embedded energy and resources (Plastics Europe, 2019):

In Austria, plastic packaging that has been collected is sorted according to different kinds of plastics and the impurities removed. Subsequently, the sorted plastic packaging is crushed, washed, dried, melted and processed into granular material. The granular material is then used in plastics processing companies as a raw material during the production phase. Since the different kinds of plastics melt at different temperatures, precise sorting of the plastic packaging is necessary in order to produce a high-quality plastic granulate. Unsorted packaging plastics may either be crushed or agglomerated into coarse granules in order to produce, for example, simply shaped products such as slabs or channels or, following crushing, are used as secondary fuels for energy production in industry. The high-grade methods of material recovery include, for example, bottle-to-bottle recycling, where PET bottles which are collected separately are used in the manufacture of new PET beverage bottles following color sorting and a special cleaning procedure (BMLFUW; 2017a)

The plastic packaging recycling rate in Austria in 2015 was 33.6%, the total recovery rate was 100%. The recycling and/or recovery rates relate to the packaging volume. Here, the net packaging masses (without misses, impurities, etc.) are considered that are materially or materially/energetically recovered. On top of the thermal recovery of packaging that are collected separately, energetic recovery also takes account of the incineration of packaging (that were not collected separately) in the residual waste in incineration plants featuring energy recuperation (BMLFUW, 2017a).

According to Plastics Europe (2017), the recycling rate of plastic packaging in Austria is below EU-average (rank 21 out of 30) with the top three countries in plastics recycling being Czechia, Germany and the Netherlands (Figure 5). The reason for that is first of all a different calculation method including different points of measurement — before vs. after sorting or before vs. after recycling.

The amendment 2018/851 to the Waste Framework Directive (2008/98/EC) includes a harmonization on the calculation of the recycling targets: they should be based on the weight of municipal waste which enters recycling. As a general rule, the actual measurement of the weight of municipal waste counted as recycled should be at the point where municipal waste enters the recycling operation. Nevertheless, in order to limit administrative burdens, Member States should, under strict conditions and by way of derogation from the general rule, be allowed to establish the weight of municipal waste recycled on the basis of measuring the output of any sorting operation. Losses of materials which occur before the waste enters the recycling operation, for instance due to sorting or other preliminary operations, should not be included in the waste amounts reported as recycled.

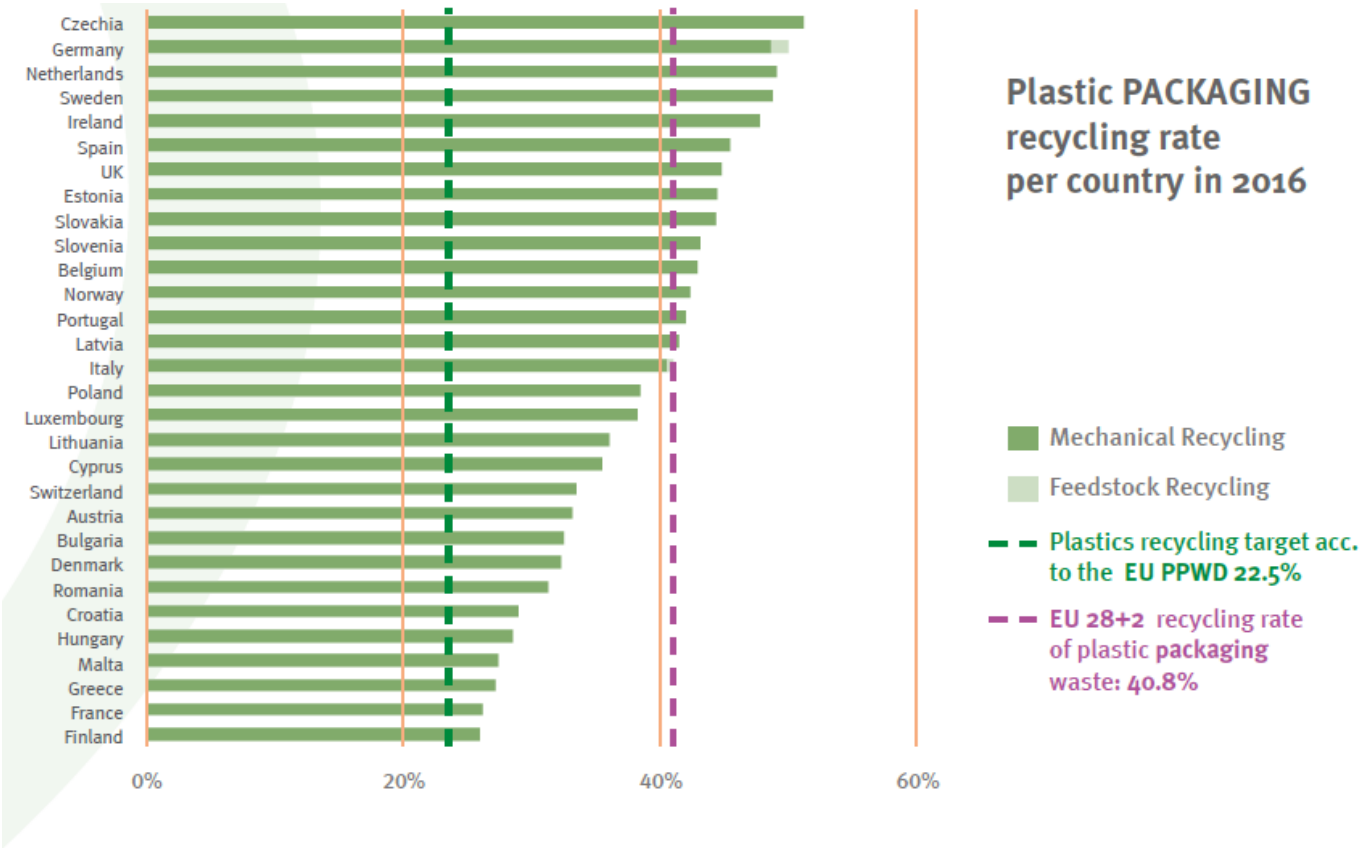


Figure 5: Recycling rate of plastic packaging in Europe (Plastics Europe, 2017).

Furthermore, recycling and recovery rates are influenced by the national waste management system: higher recycling rates are e.g. achieved in countries with a landfill ban. Also, the collection system and the quality of the collected plastics may influence their treatment.

In order to achieve the new EU targets of 55% plastics recycling by 2030, further measurements for an overall increase in plastics packaging recovery need to be set: e.g. bottle deposit as in other countries such as Germany or new collection and sorting strategies for regions with low recovery levels (in particular Vienna). A study of Kranzinger et al. (2017) detected plastics (lightweight packaging and similar non-packaging materials) at an average mass content of 13% in residual waste in Lower Austria. Despite this huge potential, only 3% of the total amount of residual waste (1,687,000 t /a) is recycled. This implies that most of the recyclable materials contained in the residual waste are destined for thermal recovery and are lost for recycling. An implementation of 'catch-all-plastics bins' may also provide an adequate solution to increase recycling rates.

4.1.2.1. Recycling and treatment of plastic packaging waste in Vienna

Collected hollow-bodies are sorted and prepared for further treatment. Until the end of 2016, the separation of plastic was performed in the Viennese sorting plant "KUSSO" located in the Rintertent where plastics from the collection of bottles, plastics from businesses and from yellow bags were sorted (MA48, 2018). The Rintertent will be renewed in the next years, in the meantime, the plastics sorting based on the best available technology is outsourced to another federal state (Styria) (Bezirksblatt Donaustadt, 2018).

4.1.2.2. Recycling and treatment of plastic waste in Lower Austria

Due to its heterogeneity, direct recycling of the collected lightweight-fraction is not possible. Only sorted material without impurities can be transferred to recyclates: Plastic packaging that is sorted (PET, HDPE, PS or PP) and pressed into bales is provided for recyclers. Other polymerisates are used for the production of containers, foils, etc. About 50% of plastic packaging material is consists of mixed fractions which are used for production of noise protection barriers, road markers, roof tiles or something similar. The rest of it substitutes fuels.

There are 4 MBT (mechanical-biological treatment) plants in Lower Austria: Fischamend (27,000 t capacity), St. Pölten (88,000 t capacity), Steinthal (10,000 t capacity) and Wiener Neustadt (24,000 t capacity) (BMLFUW, 2017).

The energy content of waste is used in the combustion process of mixed residual and bulky waste from Lower Austrian waste associations. The waste incineration plants (grate firing) for Lower Austria are situated in Zwentendorf/Dürnrohr (capacity of 525,000 t/y) and Zistersdorf (capacity of 130,000 t/y) (BMLFUW, 2017).

4.1.3. Recycling and treatment of non-packaging similar plastic material

There is no data available for the recycling and treatment of non-packaging similar plastic material for Austria, but generally, as no license fees are paid to PROs for the collection, sorting and recycling of non-packaging plastics material, it is not recycled but combusted in incineration plants together with mixed residual and bulky waste.

4.1.4. Recycling and treatment of other relevant waste streams

Recycling/treatment of End-of-Life Vehicles

In Austria, about 700 enterprises (motor vehicle dealers, repairers, disposal companies, secondary raw material traders, shredder companies) take on end-of-life vehicles free of charge. Collection points are published on the homepage of the BMNT (Federal Ministry of Sustainability and Tourism). Treatment is performed in approved enterprises in accordance with the state of the art. Approximately 48,000 end-of-

life vehicles with a total weight of approx. 43934 t of 47,926 t were shredded in Austria in 2015 with a reuse and recycling rate of about 87%. Because of trans-border shipment of end-of-life vehicles, the weight of end-of-life vehicles treated in Austria declined by 48 % compared with 2009 (BMLFUW, 2017, BMLFUW 2017a).

The recycling routes for plastics in end-of-life vehicles can be mapped in two different processes. First, the waste plastics of old vehicles are separated by disassembly. The remainder after disassembly is fed to a shredding process, in which plastics are separated again. The plastic content of dismantled cars is estimated at 36% and composed of rubber and textile parts, fuel tanks, tires and large plastic parts (Kletzmayr and Glatz 2012, cited in Frank 2015). The average plastic content in vehicles after disassembly lies between 8 and 17 percent (Schmid 2010, cited in Frank 2015).

About 3,000 t of tires were retreaded. After mechanical treatment, approx. 25,400 t were recycled and 33,300 t incinerated (BMLFUW, 2017a).

4.1.5. Plastics and their environmental effects: Recycling of plastics containing persitent organic pollutants

The proportion of plastics in various waste streams is rapidly increasing and presents an opportunity for material and energy recovery. It is therefore important that recycled plastics have as few hazardous or prohibited substances as possible to minimize risks and make them usable for the widest range of applications. The OECD therefore aims to identify political measures to bring chemical and waste management strategies more closely into line to ensure safer products and strengthen the markets for recycled plastics. While some markets for specific plastic recyclates (PET and HDPE) are well established, the plastics industry tends to react very sensitively to price changes for new plastics and oil. In cooperation with the Chemical Committee, an OECD report is to be drawn up outlining the interfaces between chemical and waste management strategies in OECD countries and examining in more detail the economic and ecological problems and the effects from the perspective of the circular economy (BMLFUW, 2017a).

The purity of the plastic types is an essential criterion for high-quality recycling. The heterogeneity and the different, sometimes harmful additives complicate or prevent recycling. For example, the addition of the flame retardant HBCD (hexabromocyclododecane) to EPS (expanded polystyrene; Styropor) in the construction sector is by law excluding it from recycling: The EU POPs (Persistent Organic Pollutants) Regulation states a general destruction or conversion requirement for POPs with a limit of 1000 mg / kg for HBCD. Only if this limit is exceeded, this waste can be recycled as a normal waste. With regard to EPS waste from construction (e.g. insulation boards), this means that material recycling is only possible if it is free of HBCD (for example, blending of new insulation boards) (BMLFUW, 2017).

Glass fibre- and especially carbon fibre-reinforced plastic (CFRP) are becoming more and more widely used due to their high specific strengths. For the time period 2012 to 2020, a quadrupling of the global demand for CFRP is forecasted. Today's high level of material integration in lightweight applications requires intensive material composites and complex superstructures, making waste recycling much more difficult. With CFRP recycling, the difficulties lie in the exposure and processing of the fibres, in the reheating of the plastics contained and in the preservation of the fibre length. The safety of their thermal treatment is still unclear (formation of respirable particles). Currently there are no processes that allow glass fibres recycling. The recycling of fiberglass is also less attractive, since the production of glass fibres from primary material is very cheap (BMLFUW, 2017).

4.2. Waste disposal in Austria

Austria has one of the lowest landfilling rates in the EU-28 (4%), because the Austrian Landfill Ordinance (BGBl. II Nr. 291/2016) sets out a landfill ban on waste since 2004 (BGBl. II Nr. 291/2004) with a total organic carbon (TOC) content of over 5%. Thus, all municipal solid waste (MSW) is effectively banned from being landfilled without pre-treatment. Mechanically-biologically pre-treated (MBT) waste cannot fulfil the 5% TOC limit, but landfilling of MBT-waste is legal if the calorific value (Ho) does not exceed 6,600 kJ/kg dry mass. This regulation ensures that high calorific waste materials (including plastics) are separated and used for thermal recycling.

But despite all provisions, it is not possible to entirely remove plastics before landfilling. In 2015, 13,998 t of plastic waste (plastic containing solid wastes and plastic in cured colours and lacquers) was landfilled in 50 landfills. 88 % of these landfilled wastes were residues from mechanical biological treatment (SN 91103) with low amounts of plastic. The detailed composition of Austrian landfilled plastic waste is listed in Appendix 18 (UBA, 2017).

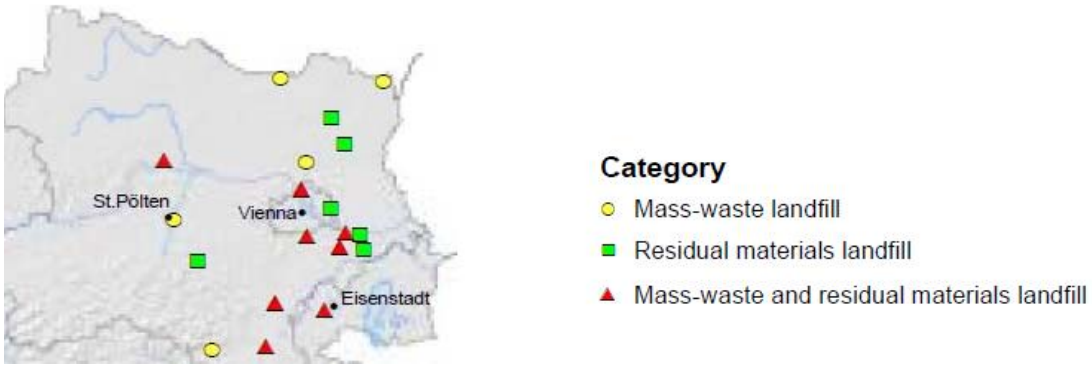


Figure 6: Landfills in Vienna and Lower Austria (Diagram according to the BMLFUW, 2017a)

4.2.1. Disposal of waste in Vienna

Vienna has one big landfill for the disposal of thermally treated municipal waste, namely the landfill "Rautenweg" and one mass-waste and residual materials landfill called "Langes-Feld" (see Figure 6).

4.2.2. Disposal of waste in Lower Austria

The disposal of untreated residual waste was usual till 2003 (before the legally binding 'landfill ban'). Since 2004, waste is pretreated prior to landfilling, either thermally or mechanically-biologically (MBT). Several landfills of different types are located in Lower Austria (see Figure 6).

5. Recycling, treatment and disposal of plastic waste and plastic containing waste streams in Slovakia

Recyclable plastics are processed according to customer needs, other mixed plastics are crushed and materialized in construction. Recycled plastics can no longer be used for products that come into direct contact with food for hygienic reasons.

HDPE (PE-HD) - High density polyethylene, used for the manufacture of hollow articles, mainly for the production of detergent packaging but also for bags. PET bottle closures are also made of high-density polyethylene.

PET (Polyethylene terephthalate) - they are most represented in beverages, vegetable oils, but also in detergents (cleaning agents) and, for example, in medicines or vitamins.

PVC - Polyvinyl chloride is one of the most problematic types of plastic, which contains substances that seriously endanger the environment and human health. The use of PVC for recycling is very limited, and therefore it is mostly landfilled or incinerated. Particularly in incinerators, PVC is a source of hazardous chlorine-containing chemical compounds, of which dioxins are the most dangerous.

Worldwide, the pressure to ban PVC is growing. The biggest negatives are associated with chlorine, which is used most in PVC production.

The main disadvantage of PVC is that sodium chloride (NaCl) is used to produce chlorine gas from the chemical industry. Chlorine in nature occurs in such small quantities that living organisms cannot cope with it. It contributes to the formation of highly toxic dioxins that damage the immune and hormonal systems.

At present, PVC pots are produced for domestic greasy ointment, detergent containers such as starch (Fig. 8), shampoos (Fig. 9), fast food crucibles, but also for foods such as yoghurt beverages.

LDPE (PE-LD) - Low density polyethylene is mainly used for film production. Typical PE-LD products are waste bags, agricultural films, magazine covers, bags and sacks.

PP - Polypropylene is widely used in industry because it has good strength, hardness and stability. Polypropylene produces pump parts, tanks, fittings and the like. In households we encounter food packaging such as vegetable butter, cleaners, shampoos, but also finished sauces. Polypropylene is also used to pack sweets such as napolitane, chocolate.

PS - Polystyrene is widely used for its thermal insulation and protective properties, used as thermal insulation and packaging material. Polystyrene is a transparent, hard, yet very brittle plastic. It is harmless to health (at normal temperatures) and therefore found use as a food packaging material. We meet him to buy new products that are covered with polystyrene packaging for protection. We will find it when buying a TV, refrigerator, washing machine, computer monitor.

The recycling of plastics is possible after a very thorough sorting, since the properties of the granulate obtained from the waste plastic differ from those of the new raw material. The number of recycling lines and the amount of plastic packaging suitable for recycling is therefore limited:

- PE is reused for garbage bags and waste bins

• PVC for the manufacture of bars, tubes, plastic furniture,

• PET bottles can be cleaned, milled into small pieces, melted and made into fabrics and furniture.

5.1. Waste recycling and treatment in Slovakia

The material recovery is the dominant recovery activity with 31% of the total amount of waste generated. The high share of landfilling waste, up to 31% of the total amount of waste generated, remains a problem. In 2017, 111 waste refuse collectors and 19 incinerators and waste co-incineration plants were operated, of which 2 were municipal waste.

Waste management	**Amount (t)**
Landfilling	3,820,877.10
Burning without energy use	47,109.09
Other disposal	402 844,39
Burning with energy recovery	740,506.37
Recycling	3,777,779.75
Other waste recovery	357,317.08
Other waste management	3,032,584.70

Table 29: Waste management without municipal waste in 2017 in Slovakia

In the following tables we can see the handling of plastics from industrial production and industrial processing according to the partial monitoring system in 2017 in Slovakia. Waste catalog definitions are listed in Chapter Two.

Region	**Material recovery (t)**	**Thermal recovery (t)**	**Other recovery (t)**	**Disposal by Landfilling (t)**	**Thermal disposal without recovery (t)**	**Other Disposal (t)**	**Other waste managment (t)**	**Togeter (t)**
Trnava region							**10.23**	**10.23**
Generation of waste 020104 in SR	2.77		0.11	79.7			63.7	**146.28**

Table 30: Waste management in 2017 by catalogue number of plastic waste 020104 (waste plastics expect packaging) (Trnava region)

Region/waste managment of 040209	Material recovery (t)	Thermal recovery (t)	Other recovery (t)	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Bratislava region	180.86			17.22			237.5	**435.58**
Trnava region	3.52				0.3		0.9	**4.72**
Production of waste in SR/2017	355.09	1.8	1.96	807.87	0.3		2,160.51	**3,327.52**

Table 31: Waste management in 2017 by catalogue number of plastic waste 040209 (composite material waste)

Region/waste managment of 070213	Material recovery (t)	Thermal recovery (t)	Other recovery (t)	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Bratislava region	3,241.95	16.54	70.36	503.91		247.72	1,866.56	**5,947.03**
Trnava region	981.14		128.61	440.28		0.95	1,920.11	**3,471.09**
Production of waste in SR/2017	27,129.56	265.64	1,045.59	4,411.92	45.66	344.28	14,197.15	**47,439.8**

Table 32: Waste management in 2017 by catalogue number of plastic waste 070213 (waste from organic chemical processes waste plastic)

Region/waste managment of 120105	Material recovery (t)	Thermal recovery (t)	Other recovery (t)	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Bratislava region		1.8	1.15	59.9			0.18	**63.03**
Trnava region	2.84						0.01	**2.85**
Production of waste in SR/2017	253.85	1.8	1.73	98.78		2.35	75.71	**434.22**

Table 33: Waste management in 2017 by catalogue number of plastic waste 120105 (wastes from shaping, physical and mechanical treatment of metal and plastic surfaces)

Region/waste managment of 170203

	Material recovery (t)	Thermal recovery (t)	Other recovery [t]	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Bratislava region	27.66	12.48	0.85	902.6		0.38	43.84	**987.81**
Trnava region	0.16		0.1	0.02			5.39	**5.67**
Production of waste in SR/2017	147.31	20.7	32.53	951.1		0.98	488.28	**1,640.91**
Region/waste managment of 170204 glass, plastic and wood containing dangerous substances or contaminated with dangerous substances/2017								
Bratislava region	219.59		5	16.83			1474.59	**1716.01**
Trnava region				3.72			27.73	**31.45**
Production of waste in SR/2017	262.09	94.32	5	205.61	7.02	8.61	1,642.79	**2,225.43**
Region/waste managment of 170603 other insulating materials consisting of or containing dangerous substances /2017								
Bratislava region	0.2			23.48			6.06	**29.74**
Trnava region				0.36			3.66	**4.02**
Production of waste in SR/2017	0.2			48.32		9.18	13.62	**71.32**
Region/waste managment of 170604 insulation materials other than those specified in 170601 and 170603 /2017								
Bratislava region	20.34	0.46	34.57	221.17		3.99	213.29	**493.82**
Trnava region				76.17			66.18	**142.35**
Production of waste in SR/2017	21.62	152.74	34.63	1,099.7	16.32	8.06	1,069	**2,402.06**

Table 34: Waste management in 2017 by catalogue number of plastic waste 170203 (plastics), 17204 (glass, plastic and wood containing dangerous substances or contaminated with dangerous substances, 170603 (other insulating materials consisting of or containing dangerous substances), 17604 (insulation materials other than those specified in 170601 and 170603

5.1.1. Recycling and treatment of Municipal waste

In 2017, in Slovakia, according to MSM, plastics from mixed municipal waste without packaging was mainly used for material recovery.

Region/waste managment of 200139	Material recovery (t)	Thermal recovery (t)	Other recovery (t)	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Bratislava region	7,138.5							**7,138.5**
Trnava region	4,697.33							**4,697.33**
Production of waste in SR/2017	44,383.83			2.12				**44,385.95**

Table 35 Waste management of municipal waste plastics without packaging

Separate collection is considered to be inadequate and, in view of the requirements of the Waste Framework Directive with regard to the objective of achieving a recycling level of 50%, the collection efficiency needs to be increased, while the collection of biodegradable waste, cooking oil and fat is also needed, wood, waste batteries and accumulators, textiles and clothing.

From the long-term monitoring of sorted waste collection, it is possible to observe a slightly increasing trend in the number of sorted waste components, however, in terms of Slovakia's commitments in the area of preparation for re-use and recycling of waste, it will be necessary to intensify the collection.

Recycling and treatment of bulky waste

According to Table 36, we see that landfilling is prevalent in the management of bulky waste in Slovakia.

Region/waste managment of 200307	Material recovery (t)	Thermal recovery (t)	Other recovery (t)	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Bratislava region		8,478.84		22,364.73				**30,843.57**
Trnava region				25,539.21				**25,539.21**
Production of waste in SR/2017		22,838.78		175,100.7				**197,939.48**

Table 36: Waste management of bulky waste and plastics within

Recycling and treatment of WEEE

Targets for the recovery of electrical waste, both material and recycling, have been met since 2005 for all categories of waste.

In 2017, the producers secured the collection of electrical waste in the total amount of 29,829,589 kg, which is 52.25% (5.42 kg / inhabitant), thus achieving a minimum collection rate of 45% of the average weight of electrical equipment marketed in the SR in the previous three years within the meaning of EP and Council \ t 2012/19 / EU on Waste Electrical and Electronic Equipment (WEEE) and the objective of collecting 49% of the average weight of electrical and electronic equipment placed on the market in the Slovak Republic in the previous three years according to Annex no. 3 of the Waste Act.

Region	Material recovery (t)	Thermal recovery (t)	Other recovery (t)	Disposal by Landfilling (t)	Thermal disposal without recovery (t)	Other Disposal (t)	Other waste managment (t)	Together (t)
Bratislava region	123.07	0.8	1.57	49.31	1.2		2,278.87	**2,454.82**
Trnava region	682.65	26.78	7,029.55	643.84		276	229.44	**8,888.25**
Production of waste in SR/2017	6,232.46	531.98	8,439.69	3,463.21	1.32	865.02	8,209.72	**27,743.39**

Table 37 Waste management of plastic and rubber of WEEE

5.1.1.1. Recycling and treatment of Plastic packaging waste in Bratislava region Trnava region

Table 38 shows the share of packaging waste recovery in Slovakia in 2016.

Material	Amount (t)	Recovery
Glass	85,675.81	62.25 %
Plastic	**119,409.31**	**58.03 %**
Paper	214,445.39	78.85 %
Metals	28,814.85	83.01 %
Wood	59,631.34	57.81 %
Others	9,867.17	100.78 %
Together	517,843.87	69.53 %

Table 38: Recovery rate of packaging waste in Slovakia in 2016

Almost sixty percent of the plastics were recovered (thermal treatment and material recovery). By 2016, the total amount of packaging waste has been increasing. The recycling and recovery rate is increasing for individual packaging waste, the targets set for 2016 are being met.

As one of the largest companies operating on the Slovak market in waste management, it provides comprehensive services in the field of waste management. Its focus is on customers from the municipal and business spheres, industrial enterprises and retail chains.

After harvesting, the secondary raw materials are sorted on sorting lines and processed in pressing equipment, mainly in continuous channel presses and shipped to recycling facilities such as paper mills, glassworks and plastic processors. Here, waste is used as feedstock for its own recycling and production process or is used for energy production. The most advanced waste sorting equipment includes a technological line for automatic optical sorting of plastic waste using a ballistic separator. The optical drive can distinguish between commodities based on the type of plastic and color. The project of introducing a new plastic sorting technology promotes increased quality and quantity of sorted plastic collection. Plastic waste is processed in a volume of about 2500 tons per year. By launching a new line, it is possible to process this volume of materials in one change. On the new line 1.5 tons of input material can be processed in one hour. Every day, 10 - 11 tons will undergo one change in the line. By using the new technology, we expect a reduction in sorting waste, which ranged from 40% to 50% in the past. Another method of plastics processing is - processing of plastic by crushing. It concerns the processing of waste technical plastics from the production of automotive, electrical and consumer industries. Waste in the form of sprays, non-conforming products, races or so-called. plastic cakes are processed in our 2 crushing centres. The output of our processes is a high-quality grit that is reused in the manufacturing process of our business partners around the world. As part of our business activities, we also trade in plastic crumbs and granulates from the production of other entities. Subsequently, the waste is sent to stationary presses. The sorted waste is pressed into bales to make it easier to handle. Subsequently, the packages are shipped to the final processors. Waste disposal in Slovakia

In the long term, a negative high proportion of waste landfill in total waste management (31% for total waste and 61% for municipal waste) persists.

5.1.2. Disposal of waste in Bratislava region

In the Bratislava region and especially in the capital Bratislava, there is no problem with landfilling, thanks to the waste incinerator OLO, a.s.

According to Priatelia Zeme cited EC, 012, 12,000 illegal landfills still existed in 2012.Barbora Sedova stated in 2015 that according to unofficial estimates, there are approximately 6,000 illegal dumps in Slovakia.

6. Selected measures and public awareness initiatives in Austria

6.1. Austrian measures and public awareness initiatives

Measures in waste management are only successful if supported by the population. Therefore, people should get regularly informed about waste prevention, re-use, separation and collection of waste. Measures include the promotion of waste collection, comprehensive solutions for packaging waste, multi-use packaging, material and resource management, green events etc., some examples are listed below:

- The *Initiative to avoid plastic bags ("Pfiat di Sackerl")* was founded in July 2016 and is based on the amendment of the EU-Packaging Directive, after which member states have to reduce plastic carrier bags to a maximum of 90 bags/cap.*a by 2019. The BMNT committed itself to reduce plastic carrier bags to a maximum of 25 plastic bags /cap*year in voluntary agreement together with 14 well-known Austrian commercial enterprises (together 30% market share) and NGOs such as Greenpeace and Global 2000. According to this agreement handed over single use carrier must be charged. Exceptions thereof are so called knot bags for fruits and vegetables. But in order to also reduce the amount of knot bags, they are no longer available in the cash area. Additionally, information for customers and the use of multi-use bags should be improved. Environmental projects should be promoted. In order to assess the progress, the BMNT publishes data of signing enterprises in annual reports. First surveys stated that the enterprises could reduce the number of single-use carrier bags (including fruit bags) by about 20% (112 million bags) in 2016 compared to 2014. For all enterprises only approx. 30 light and heavy plastic carrier bags were sold per capita and year in Austria in 2016 (Handelsverband, 2018.
- *Waste prevention in enterprises.* The aim is to help companies identify and realize their waste prevention potential through easier accessible information, the financing of external advice and the start-up financing of material efficiency investments as well as the support of environmental management systems.
- The *Zero Pellets Loss Initiative* was launched by the BMNT together with Association of the Austrian Chemical Industry in 2015. With technological improvements, 90% of the pellet loss could be reduced by 2016 (UBA, 2016).
- *Toss it in the bin* (Reinwerfen statt wegwerfen). This anti-littering campaign was launched by ARA (Austria's leading PRO) in 2012 in connection with the "Sustainability Agenda for Beverage Packaging" (www.reinwerfen.at).

6.2. Measures and public awareness initiatives in Vienna

The communication strategy of the MA 48 focuses on information and educational measures for citizens. Waste consultants support this strategy. MA 22, the municipal department for environment protection, supports studies in the field of waste management. Since the early 1990s, the Vienna government has financed or co-financed several hundred studies and pilot projects on waste prevention and promoted the re-use of products, multi-use packagings or green events, some examples are provided below.

- *48er Tandler* (prior inititative from 1989 to 2015: 48er-Basar). Since 2015, waste reduction and reuse are promoted by this initiative of the Municipal Department 48 in Vienna. Every year, 130,000 items from collection boxes ('Tandler-Box') at waste disposal sites are refurbished. Further items include Viennese lost-and-found items and no longer required items from the municipality of Vienna. With the revenues from sold objects at the second hand market located in the 5th district and donations in kind, social projects are supported (MA 48 - City of Vienna, 2019).
- *Clean-up actions.* Since 2006, joint spring-cleaning actions have been organized and kindergartens, schools, clubs and individuals have participated: in recent years, an average of 17,000 people has actively participated. Since the beginning of the campaign, some 160,000 volunteers have collected around 300 tons of waste with a volume of around 3,000 cubic meters.
- *WasteWatcher.* The Vienna Clean Act of 1 February 2008 provided for an explicit ban on contamination in public places and created the legal basis for the WasteWatcher (50 full-time employees and 400 educated employees of the MA48) that provide public oversight. They are authorized to impose penalties and report infringements to the competent authority of the Department of Water Legislation (MA 58). Since 2008, 70,000 official acts were conducted; the illegal deposition of cooling units and bulky waste could be reduced by 60% respectively. Furthermore, 123 million tons of cigarette butts are annually collected. The use of provided plastic bags for dog excrements (campaign "nimm ein Sackerl für mein Gackerl") is also monitored: more than 100,000 of these bags are used on a daily base and are subsequently incinerated together with municipal waste (MA 48 – City of Vienna, 2019a).
- *Green events.* Using multi-use cups at the Viennese Donauinselfest (more than 3 million visitors per year) for example helped to reduse the amount of waste by 9,000 kg in 2014.
- *The MA48 Viennese Mobile Dishes Service* ("Wiener Geschirrmobil"), a rentable camper trailer providing glasses, porcellain dishes, cutlery and dish washers for events with 200 to 2000 visitors, permitting the regular cleaning and avoiding one-use dishes and cutlery (MA 48 – City of Vienna, 2019b).

6.3. Measures and public awareness initiatives in Lower Austria

Waste consultants are responsible for communication measures on separate collection in Lower Austria. The current WMP of Lower Austria (planning period 2016-2020) defines objectives and describes measures for the Lower Austrian waste management. Main targets are e.g. increased efficiencies of coverage and the economy of recycling centers. An important measure is the optimization of separate collection of recyclables until 2020. For residual waste, it is planned to optimize the separation of recyclables and to minimize the contamination of residual waste (sorting analysis planned). Plastic waste collection should be improved with the aim to collect material for high-quality recycling. The reduction of various collection systems for plastic packaging is also intended. Therefore, Lower Austria takes measures for outlining plastic flows (quantities and qualities as well as material composition of plastic waste) in order to enable an ideal plastic waste treatment. A Pilot project on material collection centers (collection of non-packaging of similar material) is discussed (NÖ AWP 2018).

In the past numerous measures and studies have been implemented in Lower Austria:

- The FFG project *REC2Tec-Part* of the Monanuniversität Leoben supported by the Upper (KC, Kunststoffcluster) and Lower Austrian plastics cluster (plusEco) is dealing with an up-cycling instead of down-cycling of secondary plastics by using special additives in order to increase the quality of material and new plastics sorting and design for recycling concepts (MA 48 – City of Vienna, 2019a).
- The potential of recyclable materials in residual waste was analyzed in residual waste material flows in Lower Austria 2010/11 by Schneider and Lebersorger (2011).
- Plastic waste streams in Lower Austria (quantities and amounts) have been presented within a pilot study. The results of the study commissioned by the Federal State of Lower Austria aim to transfer excess quantities of plastic packaging and non-packaging recyclables from the residual waste system to the separately collected waste system by introducing a so-called *´catch-all-plastics bins´* (Kranzinger, 2017).
- Different plastic collection schemes were evaluated: The coverage of collection schemes was 61% for plastic- and composite packaging (collection system LWP). For plastic bottles it was 72% if plastic bottles only were collected and 88% if plastic bottles were collected together with metal packaging.

Measures for target group orientated information to avoid/ separately collect waste will be set until 2020. Already existing measures that are relevant for plastic waste reduction are:

- *Lower Austrian Spring Clean-Up* ("We keep Lower Austria clean"): Since 2006, 29,000 volunteers participated in 640 clean-ups, collecting 221 t of waste (NÖ Umweltverbände, 2019).[14]
- "*Don't produce waste*" ("Mach keinen Mist") is an Austria-wide initiative on anti-littering for car driving schools together with Mc Donald's Austria. People should be sensitized for a proper handling of waste during driving instructions. Littering is now part of the driving education and is explained by a film produced in cooperation with Austrian Chamber of Commerce (WKO) and driving schools (WKO - Austrian Chamber of Commerce, 2019)
- Participation in the Federal-Provinces networks „*Green Events Austria*" and "*Clean festivals*"
- *Reduction of plastic bags*: several actions are set to raise awareness for multiple use
- Public relations to raise waste separation and collection

7. Selected measures and public awareness initiatives in Slovakia

7.1. Slovakian measures and public awareness initiatives

WWF is one of the world's largest independent nature conservation organizations. It has 5 million supporters and representations in more than 150 countries worldwide. WWF is committed to contributing to halting the damage to Earth's natural environment. It is dedicated to protecting Earth's biodiversity, protecting endangered species of plants and animals, forests, waters, seas and oceans.

WWF International today released a global study on Solving Plastic Pollution Through Accountability. He talks about how plastics production grows, how plastics lands, and how plastic waste is harmful to all living things, including humans. The study notes that in 2016 alone, 396 million tons of new plastics were produced worldwide, that is 53 kilograms per inhabitant of the planet. The production of newly manufactured plastics is growing by 4% per year since 2000, mainly because they are cheap.

The most newly manufactured plastics in the world need the packaging industry - up to 40%, followed by the automotive and construction industries. And the trend is rising. Most of them - in 2016 up to 40% of new plastics were designed for single use only and had a life cycle of less than a year. In particular, they were bags, food containers, bottles. In fact, only 9% of plastic waste is recycled worldwide. Plastics have already been found in all seas, including the deepest place - the Mariana Ditch. Not only do they pollute the oceans, most of the waste pollutes the rivers and soils, and the remains of plastic have been found in more than 240 animal species.

Therefore, WWF launched a Global Petition for End of Plastics in Nature, which was signed by 250,000 people in the first three weeks. Support her maybe at WWF International. The petition is launched by WWF before the UN Environment Meeting of the United Nations Environment Assembly (UNEA), which will take place on 11-15. 3. in Nairobi. "WWF calls on governments to adopt an international agreement to stop sea and ocean pollution by plastic waste, to develop political and financial instruments to promote the use of recycled plastics and other environmental alternatives; Companies are calling for measures to reduce the production of plastics and plastics waste and to find alternative packaging for products. And the public to use the "consumer power" to ask producers for an alternative to plastics and reduce their own plastic waste production, "explains Miroslava Plassmann, director of WWF Slovakia.

8. Comparison of waste management systems in Austria and Slovakia

To answer the question in what extent demographic and economic characteristics as well as waste management systems influences plastic pollution of the environment we compared the different systems of Austria and Slovakia. Within a quite small study region the average population density is nearly the same and amounts 110.9 in Slovakia and 105.8 in Austria whereas, on a small-scale level, there are differences. The populations density is 1,156 in Bratislava while 4,553 persons per square meter live in Vienna. The economic and waste management conditions vary strongly between both countries. Austria with a higher GDP than Slovakia in general produces higher amounts of waste. Average annual generation of municipal waste per capita is 488 kg in Austria and 393 kg in Slovakia. Also amounts of plastic packaging materials, which is most important plastic waste stream, exceeds with 34 kg/cap*a in Austria the Slovak generation of 22 kg/cap*a.

This fact does not need to lead to a higher pollution potential in Austria because in terms of waste collection, treatment and recycling Austria performs better than Slovakia. Whereas only 4% of Austrian MSW are dumped to landfills, two thirds (66.5%) of municipal waste still ends up in Slovak landfills. And this amount is even higher, if illegal landfills are considered. Landfill taxes for MSW are much higher in Austria and amount 87 € whereas only 4.98 € to 9.96 € have to be paid in Slovakia. Actual recycling rates of MSW are low in Slovakia (10.3 %) and amount 56% in Austria. Only 3 % of household waste produced is recycled (Recyclingportal, 2019).

Separate collection in Slovakia is still considered as inadequate to reach recycling level of 50%, but in the long-term monitoring slightly increasing trends are observed and Slovakia is now supporting separate waste collection. In 2016 a new law came into force that expands product responsibility, supports separate waste collection and helps avoiding landfilling and illegal waste dumping. The Ministry of the Environment hopes for more effective fight against illegal dumping sites, of which there are between 2,500 and 7,000 nationwide, depending on how they are counted. In Austria illegal dumping is only observed in individual cases (Spectator, 2019). Informal waste sector is assumed to be relevant in Slovakia, where also illegal waste burning, has to be considered. According to personal stories, waste is still burned occasionally by Slovaks to heat their homes (no official data). EC, 2012 also stated that general environmental awareness of the public is still on low level and awareness raising measures are needed. It stated that according to two NGOs households still burn or dump their waste, even not being fully aware of the environmental harm caused by these actions.

In terms of collection system and material recovery Slovakia performs well for plastic. While in Austria only plastic packaging waste is collected separately, Slovakia collects all plastic, including non-packaging, separately. Due to diversity of collection, treatment and disposal in the investigated regions direct comparison of indicators is not always possible. Even in Austria there are different systems for collection of plastic waste. Whereas in Vienna only bottles and tetra pack are collected together separately via yellow containers/sacks (companies also have the possibility to collect foils), Lower Austria offers possibility to also collect plastic packaging waste separately (e.g. foils) together with bottles. In Slovakia non-plastic packaging is collected separately also. A new law should be valid in Slovakia from the year 2022 that all plastic bottles (and aluminum cans) will be deposited. This measure should increase the recycling rate of plastics.

Recovery and recycling rates for plastic packaging in Austria are 100% and 33.6%, respectively, Slovakia reaches 58% recovery and 52.7% recycling (Eurostat, 2019). But despite of that fact, 9% of collected plastic waste ends up in landfills in Slovakia, whereas Austria could minimize this share to 1%.

In both countries, generated plastic waste amounts in the study regions were difficult to gain, as data exists on national and federal region but rarely for separate provinces. Due to different waste collection systems and therefore different definitions of waste categories, a comparison of all plastic relevant waste streams is not possible. An overview about main waste management indicators is given in Table 39.

	Austria	Slovakia
Area (km^2)	83,878	49,036
Inhabitants	Austria: 8,690,076 Vienna: 1,840,573	Slovakia: 5,435,343 Bratislava City: 425 500
Density (Persons/km^2)	Austria: 105.8 Vienna: 4,553	Slovakia: 110.9 Bratislava City: 1,156.15
GDP / cap.	40,000	15,600
Total MSW generation (t)	Austria: 4,160,200 Vienna: 855,464 Lower Austria: 855,129	Slovakia: 2,136,787 in 2017 Bratislava City: 140,594 Trnava Region: 243,865 Bratislava Region: data n.a.
MSW (kg/cap.*year)	Austria: 488 in 2015 (BMLFUW, 2017) Vienna: 482 in 2015 (BMLFUW, 2017) Lower Austria: 520 in 2015 (BMLFUW, 2017)	Slovakia: 324 kg in 2015 (EC, 2014a), 393 in 2017 Bratislava city: 338 Bratislava region: data n.a Trnava region: 430 Bratislava: 502 in 2017 Trnava: 500 in 2017
MSW recycling	56 % in 2014: 25% material recycling, 31% composting /AD	10.3 % in 2014: (5.1 % material recycling, 5.2% composting)
Landfilling	4%	61%
	Austria	**Slovakia**
Landfill taxes for MSW	87€/ t Rates since 2006 (CEWEP, 2017)	4.98 to 9.96 € /t according to number of separate collected fractions Rates since 2016

		(CEWEP, 2017)
Total PLASTIC in Waste	Austria: **916,360 t** in 2015 (UBA, 2017) Thereof 191,929 t can be assigned to pure plastic waste streams, 705,767 t plastic arises in plastic containing waste streams.	<u>Slovakia:</u> data n.a.
PLASTIC in Municipal Waste **=Post-consumer plastic waste**	491,127 t in 2015 (Blum, 2017) (Calculated according estimated shares of plastics in MSW, residual waste, bulky waste and WEEE) 66 kg/cap*a (Blum, 2017) 67 (own calculations based on Van Eygen, 2017) *491,127 – 300,000 = 191,127 plastic in MWS without packaging = 22 kg/cap*a*	<u>Slovakia:</u> *Available data: plastic in MSW without packaging: 44,483 t* *Roughly estimated: 250,000 t* *(→ 24 kg plastic +22 kg plastic packaging = 46 kg/cap*a → 250,025 t)* *(→ 44,483 t plastic in MSW without packaging (=24 kg/cap*a))*
Plastic packaging generation	<u>Austria:</u> 294,888 t in 2015 (BMNT, 2017) 300,000 t in 2013 (=35 kg/cap*a) ((van Eygen, 2018)	<u>Slovakia:</u> 119,409.31 t in 2017 (own calculation 119,409.31/5,435,343*1000= 22 kg/cap*a)
Material recovery (% of collected plastic)	34% (Plastics Europe, 2017) 33.6% (BMLFUW,2017a)	58 %
Landfilling (% of collected plastic)	1% of total plastic waste was landfilled in 2015 as share (UBA, 2017) 1% minor amounts coming from residues from mechanical pre-treatment (as plastics) and WtE (as ashes) were landfilled (van Eygen et al. 2018)	9%
	Austria	**Slovakia**
Separate collection recycling targets	Plastic waste targets (Packaging Ordinance 2014): (<u>packaging only!</u>): • separate collection 60 % • recycling 50 %	Plastic waste targets (SK WM Plan (2016-2020): • 55% material recovery • 15% energy recovery • 5% landfilling
Funding / Instruments	• Packaging: EPR Scheme (since 2015) • Deposit € 0.29 for refillable plastic beverage containers at national level	• EPR scheme under implementation • Funding till 2016: Recycling Fund, ENVI-PAK

Collection system	Only packaging Vienna: bottles only (HDPE+PE) Lower A.: PET-bottles & low-weight packaging (LWP)	All plastic (incl. non-packaging) Bratislava city: mainly bring points, (minor) civic amenity sites
Collection coverage	Vienna: 100% 1 bring point / 405 inhabitant	Bratislava city: 99% 1 bring point / 430 inhabitant
Plastic separately collected (kg /cap*a)	Lower Austria: 29,4 kg/cap (8.9 - PET bottles, 20.5 – LWP) (NÖ AWP, 2016) Vienna: 3.8 separate collected plastic packaging (bottles) Additionally collected: LWP 4.79 plastic foils 0.017	Trnava: 31.8 kg/cap Bratislava city: 9,4 kg/cap
Plastic collection rate	Vienna: 22% of total plastic (HDPE+PET) Lower Austria: 74% of PET bottles, 60 % of LWP (NÖ AWP, 2016)	Bratislava city: 41%
Recycling rate (%) **EU target 2020: 55%**	Vienna: ~20% (estimation) Lower Austria: 69%	Bratislava city: 10 % Trnava region: 40%
	Austria	**Slovakia**
Recycling rate for plastic packaging In 2015 EU reached 22.5 %, EU target for 2030 is 75%	Overall recycling rate for plastic packaging: 26%±7% whereas 40%±3% was treated in Waste to Energy plants and the remaining 33% ±6% in the cement industry (van Eygen et al. 2018)	40-45%

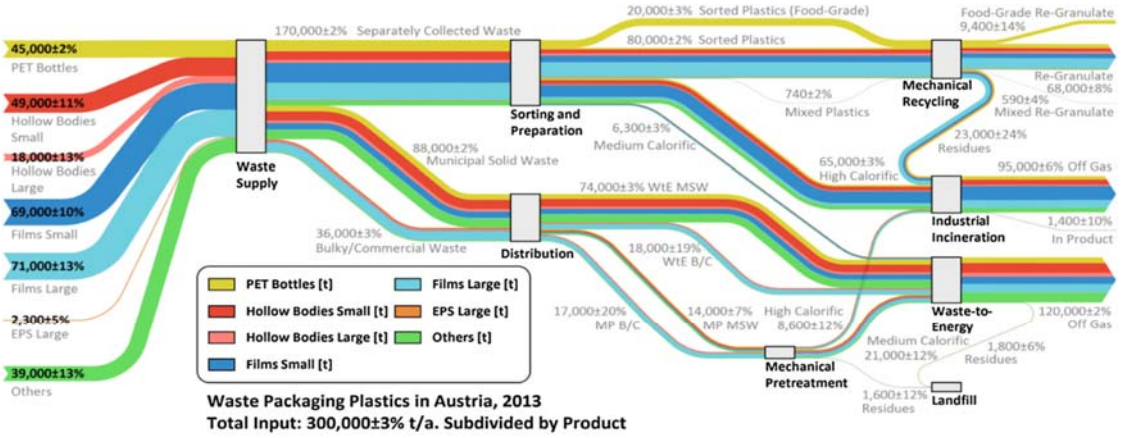
Table 39: Comparison of Austrian and Slovakian waste management system

9. APPENDIX

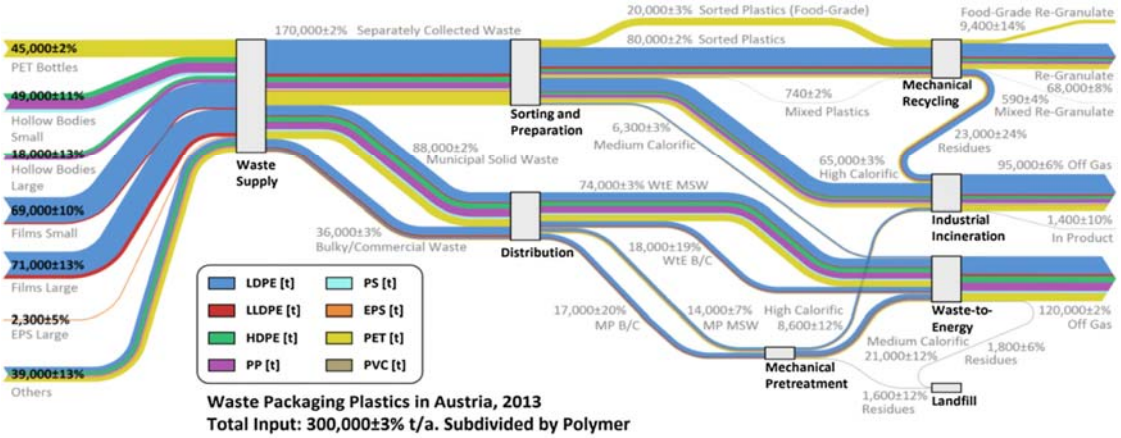
Appendix 1: Amounts of primary plastic waste in Austria in 2015 (source UBA, 2017, based on the electronic data management system EDM)

Waste stream	**Amount of primary waste in t**
Pure plastic waste	191,929
Residual and bulky waste, LWP	705,767
Colours and lacquers	12,915
Colours and lacquers cured	5,112
Plastic sludge	587
Plasticizer	51
Sum	**916,361**

Appendix 2: Results of the material flow analysis for the total waste stream subdivided by (a) product category and (b) polymer. The values are given by the mean (2 significant digits) and the relative standard deviation (Van Eygen et al. 2018).



(a)



(b)

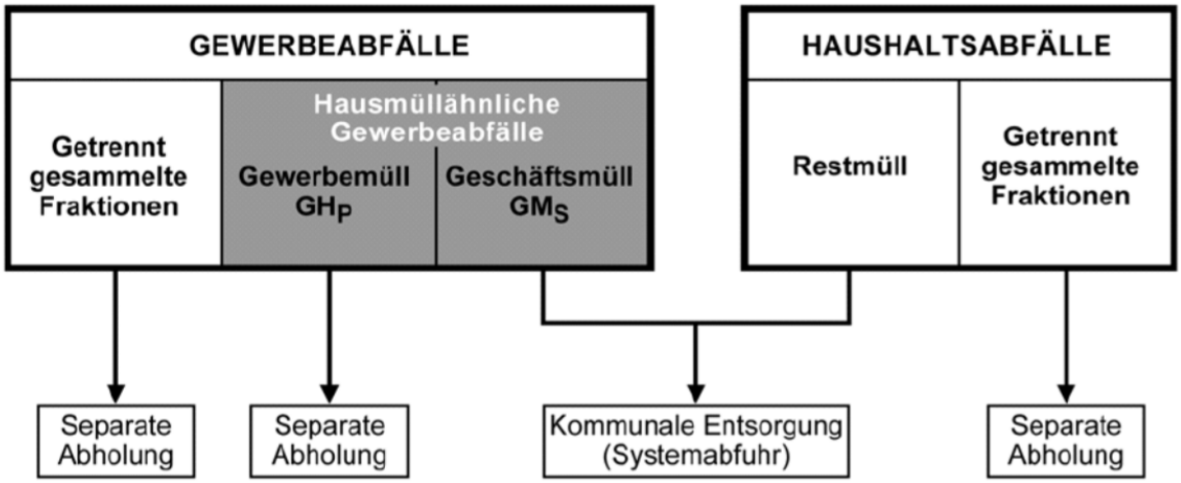
Appendix 3: Amount of selected waste streams from households and similar establishments in entire Austria, Vienna and Lower Austria in 2016

Waste material	Amount in Austria in 2016 (t)	Amount in Austria in2016[1] (kg/cap*a)	Vienna (2016) Mass (t)	Vienna (2016) (kg/cap*a):	Lower Austria (2016):	Lower Austria (2016) (kg/cap*a):
Residual waste	1,436,700	164	528,000	285	230,000	139
Bulky waste	246,600	28	27,000	14.6	71,000	42.9
WEEEs	83,100	9.5	11,091	6	20294	12.3
Used plastics, composite materials – packaging	156,700	17.9	7, 088	3.8	27,796	16.8
Other recyclables incl. packaging	29,200	3.3	2,966	1.6	5,909	3.6
Waste textiles	33,900	3.9				
Total waste generation	4.268.474	488	901,878	487	895,322	541

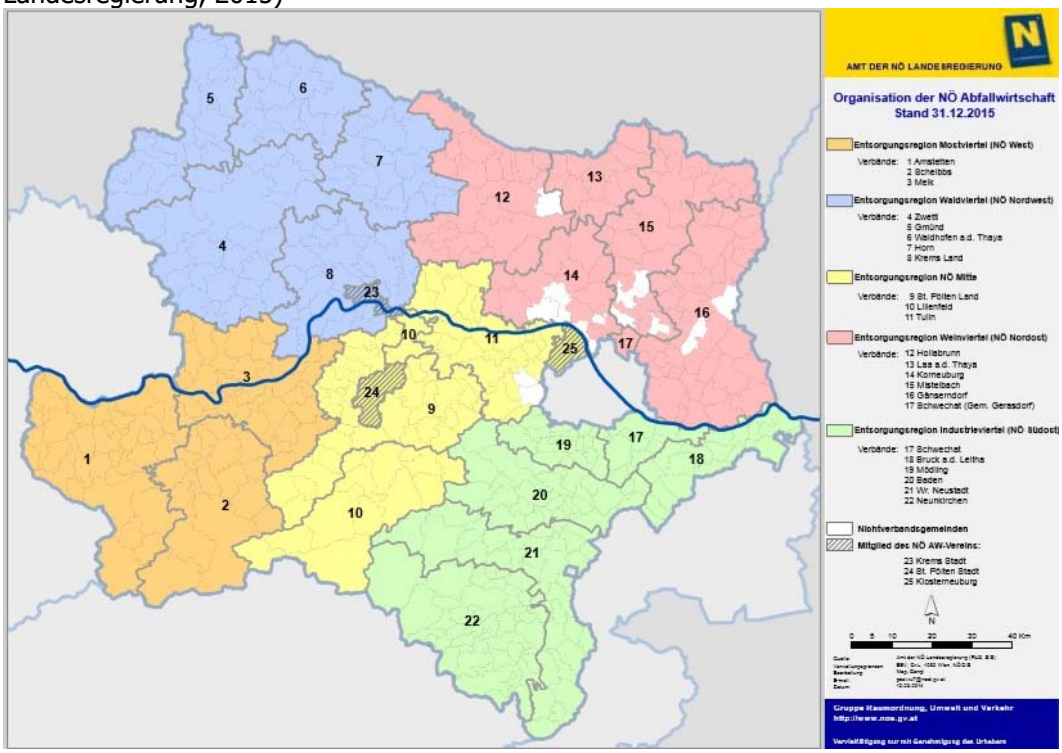
Appendix 4: Waste collection system in Austria (selected waste streams) (BMLFUW, 2017)

Municipal waste	
Mixed municipal waste (residual waste)	Kerbside collection
Bulky waste	Delivery to civic amenity sites by citizens; kerbside (loose waste)
Lightweight-packaging	Kerbside (bags); bring system (containers at collection points)
WEEEs	Bring system (civic amenity sites), take-back in trade
Commercial waste	
Mixed MSW from commerce, not municipally collected	Kerbside collection
Construction waste	Kerbside collection

Appendix 5: Scheme of waste from industry and commerce categorized according to their collection type and their reference to household waste (Pomberger and Eisenberger, 2010)

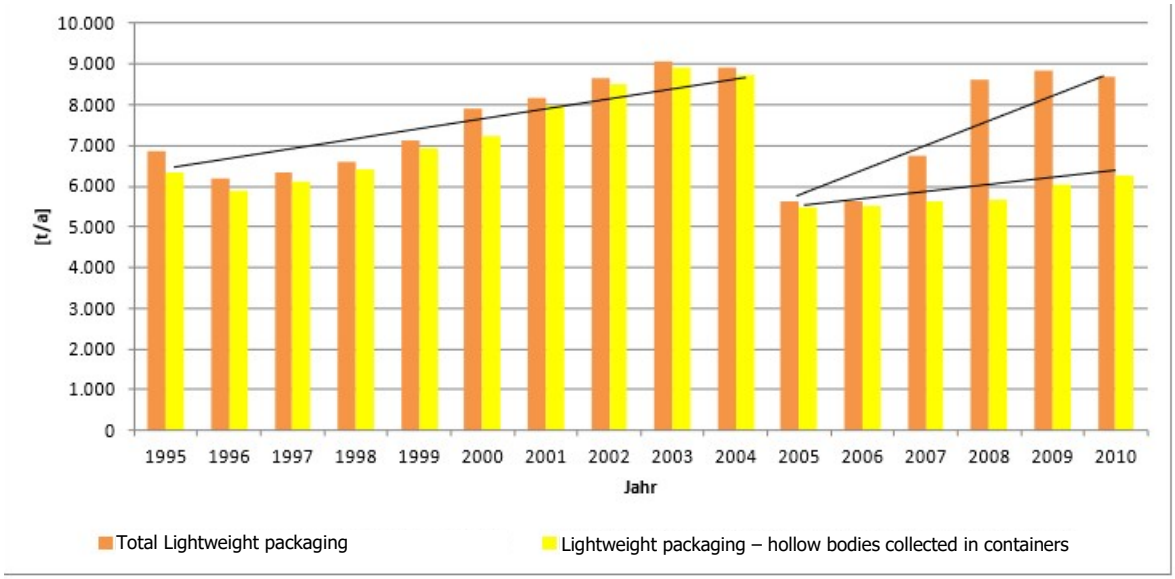


Appendix 6: Organizational structures of waste management in Lower Austria in 2015 (NÖ Landesregierung, 2015)

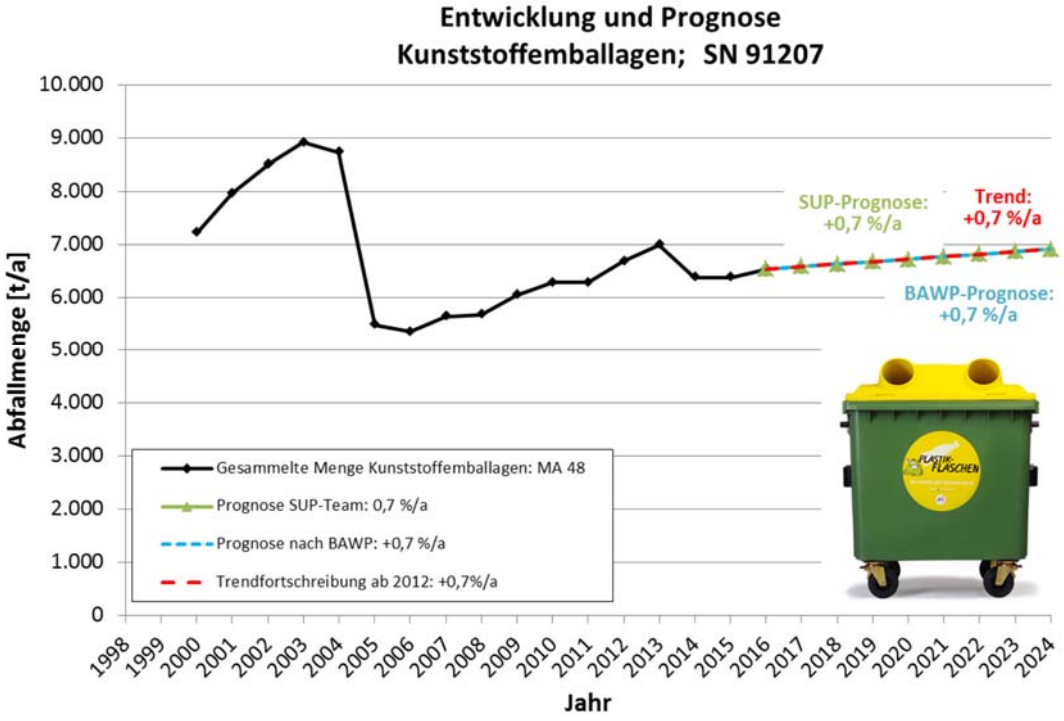


Appendix 7: Amounts of collected lightweight packaging – MA 48 (2010: 8,999 tons)

Collected amounts of LWP and hollow bodies for the years 1995-2010 are shown. In 2014, 5.7 kg bottles per capita were collected. The collection rate (bottles, HDPE+PET) of the total plastic amount was 22%.

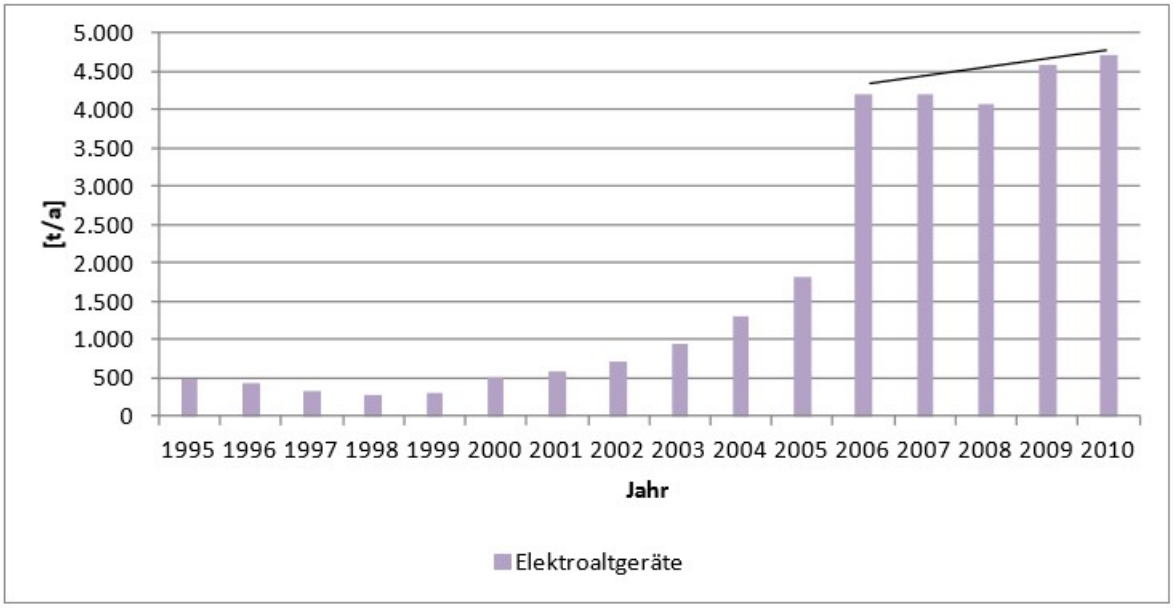


Appendix 8: Plastic packaging trend



For 2018, an amount of 7,200 t of plastic hollow bodies is expected (Wiener Abfallwirtschaftsplan, 2012).

Appendix 9: Collection of WEEE (electrical and electronic waste) – MA 48 (2010: 4,710 tons)



Appendix 10: The ARA-Collection system in Austria

According to Scharff 2005 (cited in Reh et al. 2014), the collection system is divided in 7 modules (module 1 – households, module 2 – small enterprises, module 3 – industry and commercial enterprises: kerbside collection, module 4 – shopping streets waste management, module 5 – recycling centers, module 6 – additional purchase of residual waste (= packaging material collected with residual waste), module 7 – Industry and commerce: delivery to waste treatment/ recycling. Module 3, 4 and 7 comprise commercial and industrial disposal.

LWP and metals from households and similar institutions are collected heterogeneously in Austria: 1) separate collection of LWP and metals 2) collection of recyclable plastic packaging and metals, other LWP are collected with residual waste 3) collection of plastic bottles and metal packaging, other LWP are collected with residual waste 4) Collection of LWP and metal packaging 5) collection of plastic bottles and metal packaging, collection of other LWP with residual waste.

Clients of ARA for commercial and industrial waste can choose between 3 types of packaging waste disposal:

- Individual solutions for commercial and industry (with free choice of waste management companies)
- Solutions for small enterprises (amounts are similar to households and are disposed free of charge, additional 1,200 recycling centers for the takeover of single-origin ARA licensed packaging materials
- Direct solutions with kerbside collection for big amounts of packaging waste in combination with internal collection and management measures (ARA, 2016)

Appendix 11: Approved collection and recycling systems (PROs) for household packaging (§ 29 BZW. § 78 ABS. 20 AWG 2002), current state: November 2018

System operator	Address	Contact	Categories
ARA Altstoff Recycling Austria AG	Mariahilfer Straße 123 1062 Wien	Tel. 01/599 97-0 Fax 01/595 35 35 araag@ara.at www.ara.at	Paper, Metals, Light-weight packaging
AGR Austria Glas Recycling GmbH, belonging to the ARA group	Mariahilfer Straße 123 7. Stock 1062 Wien	Tel.: 01/214 49 00 Fax 01/214 49 08 agr@agr.at www.agr.at	Glass
Bonus Holsystem Gesellschaft m.b.H. & Co KG	Georg Pirmoser Straße 2 6330 Kufstein	Tel. 05372/610 82 05372/610 83 team@bonus.at www.bonus.at	All
good waste austria GmbH (formerly ELS Austria GmbH)	Kupelwiesergasse 12/6 1130 Wien	Tel.: 0680 24 700 18 service@els-austria.at www.els-austria.at	All
Interseroh Austria GmbH	Ungargasse 33 1030 Wien	Tel. 01/714 20 05-0 Fax 01/714 20 05-40 austria@interseroh.com www.interseroh-austria.com	All
European Recycling Platform (ERP) Austria GmbH	Rennweg 9 1030 Wien	Tel. 01/235 01 40 Fax 01/235 01 40-99 austria@erp-recycling.org www.erp-recycling.at	All
Reclay UFH GmbH	Siebenbrunnengasse 17/2/1, 1050 Wien	Tel. 01 994 99 69-0 oesterreich@reclay-group.com www.reclay-ufh.at	All

Appendix 12: Approved collection and recycling systems for commercial packaging (§ 29 BZW. § 29 ABS. 7 AWG 2002). Current state: November 2018

System operator	Address	Contact	Categories
ARA Altstoff Recycling Austria AG	Mariahilfer Straße 123 1062 Wien	Tel. 01/599 97-0 Fax 01/595 35 35 araag@ara.at www.ara.at	Paper, metals, plastics, EPS, other composites, ceramics, wood, textiles, biogenic packaging materials
AGR Austria Glas Recycling GmbH, belonging to the ARA group	Mariahilfer Straße 123 7. Stock 1062 Wien	Tel. 01/214 49 00 Fax 01/214 49 08 agr@agr.at www.agr.at	Glass *(always categorized as 'household packaging' by the Packaging Differentiation Ordinance 2015)*
Bonus Holsystem Gesellschaft m.b.H. & Co KG	Georg Pirmoser Straße 2 6330 Kufstein	Tel. 05372/610 82 Fax 05372/610 83 team@bonus.at www.bonus.at	Paper, metals, plastics, EPS, other composites, ceramics, wood, textiles, biogenic packaging materials
European Recycling Platform (ERP) Austria GmbH	Rennweg 9 1030 Wien	Tel. 01/235 01 40 Fax 01/235 01 40-99 austria@erp-recycling.org www.erp-recycling.at	Paper, metals, plastics, EPS, other composites, ceramics, wood, textiles, biogenic packaging materials
good waste austria GmbH (formerly ELS Austria GmbH)	Kupelwiesergasse 12/6 1130 Wien	Tel.: 0680 24 700 18 service@els-austria.at www.els-austria.at	Paper, metals, plastics, EPS, other composites, ceramics, wood, textiles, biogenic packaging materials
Interseroh Austria GmbH	Ungargasse 33 1030 Wien	Tel. 01/714 20 05-0 Fax 01/714 20 05-40 austria@interseroh.com www.interseroh-austria.com	Paper, metals, plastics, EPS, other composites, ceramics, wood, textiles, biogenic packaging materials
Reclay UFH GmbH	Siebenbrunnengasse 17/2/1, 1050 Wien	Tel. 01 994 99 69-0 oesterreich@reclay-group.com www.reclay-ufh.at	Paper, glass, metals, plastics, EPS, other composites, ceramics, wood, textiles, biogenic packaging materials

			(glass is always categorized as 'household packaging' by the Packaging Differentiation Ordinance 2015)
Gut Galle Umwelttechnik GmbH	Webgasse 29/2, 1060 Wien	Tel. 01 890 88 25 office@gut.at www.gut.at	*No new licensing is possible; existing contracts are continuing until the end of authorization.*

Appendix 13: Lightweight packaging collection from households: partner for PROs in Lower Austria 2018

Colletion region	**Collection partner 2018**
301 - Krems an der Donau (Stadt)	Brantner Walter GmbH Brennaustraße 10 3500 Krems
302 - Sankt Pölten (Stadt)	Stadt St. Pölten - Abfallwirtschaft Weiterner Straße 40 3100 St.Pölten
303 - Waidhofen an der Ybbs (Stadt)	FCC Mostviertel Abfall Service GmbH Clemens-Holzmeister-Straße 2 3300 Amstetten
306 - Baden FCC Austria	FCC Austria Abfall Service AG Hans-Hruschka-Gasse 9 2325 Himberg
307 - Bruck an der Leitha	Pöck GmbH Ludwig Boltzmannstr. 1 7100 Neusiedl am See
308 - Gänserndorf	Komm. Rat Hans Reinbold GmbH Hauptplatz 6 2291 Lassee
309 - Gmünd	Brantner-Dürr GmbH & Co KG Kleinschönau 102 3533 Kleinschönau
310 - Hollabrunn	Brantner Walter GmbH Brennaustraße 10 3500 Krems
311 - Horn	SaubermacherDienstleistungsAG Hans Roth Strasse 1 8073 Feldkirchen bei Graz
313 - Krems (Land)	Brantner Walter GmbH Brennaustraße 10 3500 Krems
314 - Lilienfeld	Kerschner Umweltservice und Logistik GmbH Hörsdorf 30 3240 Mank
316 - Mistelbach	Berthold Entsorgungsges.m.b.H. Stronsdorf 191 2153 Stronsdorf
317 - Mödling	Grundner GmbH Feldgasse 302 2534 Alland
320 - Scheibbs	Abfallwirtschaft Ötscherland Gewerbepark Haag 2 3250 Wieselburg
322 - Waidhofen an der Thaya	SaubermacherDienstleistungsAG Hans Roth Strasse 1 8073 Feldkirchen bei Graz
324 - Schwechat	FCC Austria Abfall Service AG Hans-Hruschka-Gasse 9 2325 Himberg
325 - Zwettl	Brantner-Dürr GmbH & Co KG Kleinschönau 102 3533 Kleinschönau

Appendix 14: Lightweight packaging collection from households: partner for PROs in Vienna

Sammelregion	**Sammelpartner**
Vienna	MA 48, City of Vienna

Appendix 15: Composition of residual waste in Lower Austria (Schneider and Lebersorger, 2011)

Restmüllzusammensetzung auf Landesebene nach Hauptfraktionen (Schneider and Lebersorger, 2011)

LANDESEBENE	**Mittelwerte und Konfidenzintervalle**		
Hauptfraktion	**Masse-%**	**Volumen-%**	**kg/E/a**
1-Papier u. Kartonagen	7,0% ± 0,6%	12,1% ± 0,7%	9,5 ± 0,8
2-Glas	3,7% ± 0,5%	0,7% ± 0,3%	5,0 ± 0,7
3-Kunststoffe	12,4% ± 0,7%	46,0% ± 1,1%	16,9 ± 0,9
4-Materialverbunde	6,2% ± 0,4%	10,5% ± 0,5%	8,4 ± 0,6
5-Metalle	2,8% ± 0,2%	2,7% ± 0,2%	3,8 ± 0,3
6-Biogene Abfälle	17,8% ± 1,0%	5,7% ± 0,5%	24,3 ± 1,3
7-Hygienewaren	12,3% ± 1,1%	9,2% ± 0,7%	16,8 ± 1,5
8-Textilien	3,9% ± 0,5%	3,5% ± 0,5%	5,3 ± 0,7
9-Holz	0,9% ± 0,2%	0,5% ± 0,1%	1,3 ± 0,3
10-EAG	0,8% ± 0,2%	0,2% ± 0,1%	1,1 ± 0,3
11-Problemstoffe	0,7% ± 0,2%	0,2% ± 0,0%	1,0 ± 0,2
12-Sonstige Abfälle	4,8% ± 0,5%	2,8% ± 0,4%	6,5 ± 0,7
13-Inertstoffe	3,5% ± 0,6%	0,7% ± 0,1%	4,8 ± 0,8
14-Siebfraktion <40mm	23,2% ± 1,2%	5,2% ± 0,5%	31,6 ± 1,7
Summe	100,0%	100,0%	136,0

Appendix 16: Estimated plastic content in waste streams according to ÖNORM, SN-numbers listed in ascending order, plastic content in decimal notation (source: UBA, 2017, Appendix II)

Abfallart	Gefahr	Bezeichnung	Kategorie	Kunststoff-anteil
18702		Papier und Pappe, beschichtet	KS-haltig	0,01
18718		Altpapier, Papier und Pappe, unbeschichtet	KS-haltig	0,01
35201	gn	elektrische und elektronische Geräte und Geräteteile, mit umweltrelevanten Mengen an gefährlichen Abfällen oder Inhaltsstoffen	KS-haltig	0,20
35202		elektrische und elektronische Geräte und Geräteteile, ohne umweltrelevante Mengen an gefährlichen Abfällen oder Inhaltsstoffen	KS-haltig	0,20
35203	gn	Fahrzeuge, Arbeitsmaschinen und -teile, mit umweltrelevanten Mengen an gefährlichen Anteilen oder Inhaltsstoffen (z. B Starterbatterie, Bremsflüssigkeit, Motoröl)	KS-haltig	0,15
35204		Fahrzeuge, Arbeitsmaschinen und -teile, ohne umweltrelevante Mengen an gefährlichen Anteilen oder Inhaltsstoffen	KS-haltig	0,15
3				
35205	g	Kühl- und Klimageräte mit FCKW-, FKW- und KW-haltigen Kältemitteln (z.B Propan, Butan)	KS-haltig	0,25
35206	g	Kühl- und Klimageräte mit anderen Kältemitteln (z.B. Ammoniak bei Absorberkühlgeräte n)	KS-haltig	0,25
35207	g	Leiterplatten, bestückt	KS-haltig	0,30
35208		Leiterplatten, entstückt oder unbestückt	KS-haltig	0,30
35211	g Flüssig kristallan-zeigen (LCD)		KS-haltig	0,15
35212	g	Bildschirmgeräte, einschließlich Bildröhrengeräte	KS-haltig	0,26
35220	gn	Elektro- und Elektronik-Altgeräte - Großgeräte mit einer Kantenlänge größer oder gleich 50 cm mit gefahrenrelevanten Eigenschaften	KS-haltig	0,21
35211		Elektro- und Elektronik-Altgeräte - Großgeräte mit einer Kantenlänge größer oder gleich 50 cm	KS-haltig	0,21
35230	g	Elektro- und Elektronik-Altgeräte - Kleingeräte mit einer Kantenlänge kleiner oder gleich 50 cm mit gefahrenrelevanten Eigenschaften	KS-haltig	0,35
35231		Elektro- und Elektronik-Altgeräte – Kleingeräte mit einer Kantenlänge kleiner 50 cm	KS-haltig	0,35

35314			Kabel	KS-haltig	0,66
35322		gn	Bleiakkumulatoren	KS-haltig	0,09
35339		gn	Gasentladungslampten (z.B. Leuchtstofflampen, Leuchtstoffröhren)	KS-haltig	0,03
35342		g	Kabel mit gefährlichen Isolierstoffen (Teer, Öl u. dgl.)	KS-haltig	0,66
55502		g	Altlacke, altfarben, sofern lösemittel- und/oder schwermetallhaltig, sowie nicht voll ausgehärtete Reste in Gebinden	F&L	0,50
55502	88		Altlacke, altfarben, sofern lösemittel- und/oder schwermetallhaltig, sowie nicht voll ausgehärtete Reste in Gebinden	F&L	0,50
55502	91		Altlacke, altfarben, sofern lösemittel- und/oder schwermetallhaltig, sowie nicht voll ausgehärtete Reste in Gebinden	F&L	0,50
55503		g	Lack- und Farbschlamm	F&L	0,20
55503	88		Lack- und Farbschlamm	F&L	0,20
55503	91	g	Lack- und Farbschlamm	F&L	0,20
55507		g	Farbstoffrückstände, sofern lösemitte- und/oder schwermetallhaltig, sowie nicht voll ausgehärtete Reste in Gebinden	F&L	0,50
55508		g	Anstrichmittel, sofern lösemittelhaltig/ und/oder Schwermetallhaltig und/oder biozidhaltib sowie nicht voll ausgehärtete Rest in Gebinden	F&L	0,50
55508	88		Anstrichmittel, sofern lösemittelhaltig und/oder schwermetallhaltig und/oder biozidhaltig sowie nicht voll ausgehärtete Reste in Gebinden	F&L	0,50
55509			Druckfarbenreste, Kopiertoner	F&L	0,10
55509	91		Druckfarbenreste, Kopiertoner	F&L	0,50
55510			sonstige farb-, lack- und anstrichhaltige Abfälle	F&L	0,50
55510	91		sonstige farb-, lack- und anstrichhaltige Abfälle	F&L	0,50
55513			Altlacke, Altfarben, ausgehärtet (auch ausgehärtete Reste in Gebinden)	F&L ausgehärtet	1,00
55513	91		Altlacke, Altfarben, ausgehärtet (auch ausgehärtete Reste in Gebinden)	F&L ausgehärtet	1,00
55521			Pulverlacke, schwermetallfrei	F&L	1,00
55522		g	Pulverlacke, schwermetlallhaltig	F&L	1,00

55523		g	Druckfarbenreste, Kopiertoner mit gefahrenrelevanten Eigenschaften	F&L	0,50
55903		g	Harzrückstände, nicht ausgehärtet	F&L	0,50
55904		g	Harzöl	F&L	0,50
55905		g	Leim- und Klebemittelabfälle, nicht ausgehärtet	F&L	0,50
55905	91	g	Leim- und Klebemittelabfälle, nicht ausgehärtet	F&L	1,00
55905	91	g	Leim- und Klebemittelabfälle, nicht ausgehärtet	F&L ausgehärtet	1,00
55906			Leim- und Klebemittelabfälle ausgehärtet	F&L ausgehärtet	1,00
55907		g	Kitt- und Spachtelabfälle, nicht ausgehärtet	F&K	0,50
55908			Kitt- und Spachtelabfälle, ausgehärtet	F&L ausgehärtet	1,00
55909			Harzrückstände, ausgehärtet F	&L ausgehärtet	1,00
57101			Phenol- und Melaninharz	KS-Abfall	1,00
57102			Polyester	KS-Abfall	1,00
57104			Imprägnierharz	KS-Abfall	1,00
57107			ausgehärtete Formmassen (Duroplast)	KS-Abfall	1,00
57108			Polystyrol, Polystyrolschaum	KS-Abfall	1,00
57108	77	g	Polystyrol, Polystyrolschaum	KS-Abfall	1,00
57110			Polyurethan, Polyurethanschaum	KS-Abfall	1,00
57111			Polyamid	KS-Abfall	1,00
57112			Hartschaum (ausgenommen solcher auf PVC-Basis)	KS-Abfall	1,00
57116			PVC-Abfälle und Schäume auf PVC-Basis	KS-Abfall	1,00
57117			Kunstglas-, Polyacrylat- und Polycarbonatabfälle	KS-Abfall	1,00
57118			Kunststoffemballagen und -behältnisse	KS-Abfall	1,00
57119			Kunststofffolien	KS-Abfall	1,00
57119	77	g	Kunststofffolien	KS-Abfall	1,00
57120			Polyvinylacetat	KS-Abfall	1,00
57121			Polyvinylalkoholabfälle	KS-Abfall	1,00
57122			Polyvinylacetal	KS-Abfall	1,00
57123			Epoxidharz	KS-Abfall	1,00
57123	77	g	Epoxidharz	KS-Abfall	1,00
57124			Ionenaustauscherharze	KS-Abfall	1,00

57125		g	Ionenaustauscherharze mit anwendungsspezifischen, schädlichen Beimengungen	KS-Abfall	1,00
57126			fluorhaltige Kunststoffabfälle	KS-Abfall	1,00
57127		g	Kunststoffemballagen und -behältnisse mit gefährlichen Restinhalten (auch Tonercartridges mit gefährlichen Inhaltsstoffen)	KS-Abfall	1,00
57128			Polyolefinabfälle	KS-Abfall	1,00
57128	77	g	Polyolefinabfälle	KS-Abfall	1,00
57129			sonstige ausgehärtete Kunststoffabfälle, Videokassetten, Magnetbänder, Tonbänder, Farbbänder (Carbonbänder), Tonercartridges ohne gefährliche Inhaltsstoffe	KS-Abfall	1,00
57130			Polyethylenterephthalat (PET)	KS-Abfall	1,00
57130	77	g	Polyethylenterephthalat (PET)	KS-Abfall	1,00
57131			aufbereitete Kunststoffabfälle, qualitätsgesichert	KS-Abfall	1,00
57132			abbaubare Kunststoffe und Kunststoffverpackungen	KS-Abfall	1,00
57201		g	Weichmacher mit halogenierten organischen Bestandteilen	KS-Abfall	1,00
57202		g	Fabrikationsrückstände aus der Kunststoffherstellung und -verarbeitung	KS-Abfall	1,00
57202	88		Fabrikationsrückstände aus der Kunststoffherstellung und -verarbeitung	KS-Abfall	1,00
57203		g	Weichmacher ohne halogenierte organische Bestandteile	Weichmacher	1,00
57301			Kunststoffschlamm, lösemittelfrei	KS-Schlamm	0,20
57303			Kunststoffdispersionen (auf Wasserbasis)	KS-Schlamm	0,10
57303	77	g	Kunststoffdispersionen (auf Wasserbasis)	KS-Schlamm	0,10
57304			Kunststoffemulsionen	KS-Schlamm	0,10
57305		g	Kunststoffschlamm, lösemittelhaltig, mit halogenierten organischen Bestandteilen KS-Schlamm 0,20	KS-Schlamm	0,20
57306		g	Kunststoffschlamm, lösemittelhaltig, ohne halogenierte organische Bestandteile	KS-Schlamm	0,20
57501			Gummi	KS-Abfall	1,00
57502			Altreifen und Altreifenschnitzel	KS-haltig	0,70
57502	77	g	Altreifen und Altreifenschnitzel	KS-haltig	0,70
57504			Gummi-Metall	KS-haltig	0,70
57505			Latexschaumabfälle	KS-Abfall	1,00
57506			Gummimehl, Gummistaub	KS-Abfall	1,00
57507			Gummigranulat	KS-Abfall	1,00

57702			Latex-Schlamm, verfestigt oder stabilisiert	KS-Abfall	1,00
57703			Latex-Emulsionen	KS-Schlamm	0,10
57705			Gummischlamm, lösemittelfrei	KS-Schlamm	0,10
57706		g	Gummischlamm, lösemittelhaltig	KS-Schlamm	0,20
57801			Shredderleichtfraktion, metallarm	KS-haltig	0,50
57803			Shredderleichtfraktion, metallreich	KS-haltig	0,50
57804			Shredderschwerfraktion	KS-haltig	0,50
57805		g	gefährlich verunreinigte Fraktionen und Filterstäube aus Schredderanlagen	KS-haltig	0,50
58101			Polyamidfasern	KS-Abfall	1,00
58102			Polyesterfasern		
58107			Stoff- und Gewebereste, Altkleider	KS-haltig	0,50
59201		g	Reste von festen Bauchemikalien (z. B Betonzusatzmittel, Dichtungsmassen, 2-Komponenten-Schäume)	KS-Abfall	1,00
91101			Siedlungsabfälle und ähnliche Gewerbeabfälle	KS-haltig	0,15
91101	77	g	Siedlungsabfälle und ähnliche Gewerbeabfälle	KS-haltig	0,15
91103			Rückstände aus der mechanischen Abfallaufbereitung	KS-haltig	0,20
91103	77	g	Rückstände aus der mechanischen Abfallaufbereitung	KS-haltig	0,20
91105			Hausmüll und hausmüllähnliche Gewerbeabfälle, mechanisch-biologisch vorbehandelt	KS-haltig	0,20
91107			heizwertreiche Fraktion aus aufbereiteten Siedlungs- und Gewerbeabfällen und aufbereiteten Baustellenabfällen, nicht qualitätsgesichert	KS-haltig	0,30
91108			Ersatzbrennstoffe, qualitätsgesichert	KS-haltig	0,40
91108	77	g	Ersatzbrennstoffe, qualitätsgesichert	KS-haltig	0,40
91201			Verpackungsmaterial und Kartonagen	KS-haltig	0,01
91206			Baustellenabfälle (kein Bauschutt)	KS-haltig	0,03
91206	77	g	Baustellenabfälle (kein Bauschutt)	KS-haltig	0,03
91207			Leichtfraktion aus der Verpackungssammlung	KS-haltig	0,70
91207	77	g	Leichtfraktion aus der Verpackungssammlung	KS-haltig	0,70
91302			aerob stabilisierte Abfälle aus der MBA	KS-haltig	0,02
91401			Sperrmüll	KS-haltig	0,31
91402			heizwertreiche Fraktion aus aufbereitetem Sperrmüll, nicht qualitätsgesichert	KS-haltig	0,70

91501			Straßenkehricht	KS-haltig	0,02
91501	77	g	Straßenkehricht	KS-haltig	0,02
91601			Viktualienmarkt-Abfälle		
91702			Friedhofsabfälle, die nicht den Anforderungen der Kompostverordnung i.d.g.F. entsprechen	KS-haltig	0,20
92101			Mischungen von Abfällen der Abfallgruppe 921, zur Kompostierung	KS-haltig	0,01
92401			Mischungen von Abfällen der Abfallgruppen 924 und 921, die tierische Anteile enthalten, zur Kompostierung	KS-haltig	0,01
94701			Rechengut	KS-haltig	0,02
94702			Rückstände aus der Kanalreinigung	KS-haltig	0,05
94901			Rückstände aus der Gewässerreinigung (Bachabkehr-, Abmäh- und Abfischgut)	KS-haltig	0,08
94902			Rechengut aus Rechenanlagen von Kraftwerken	KS-haltig	0,02
97101	gn		Abfälle, die innerhalb und außerhalb des medizinischen Bereiches eine Gefahr darstellen können, z. B. mit gefährlichen Erregern behafteter Abfall gemäß ÖNORM S2104	KS-haltig	0,66
97102			desinfizierte Abfälle, außer gefährliche Abfälle	KS-haltig	0,66
97102	77	g	desinfizierte Abfälle, außer gefährliche Abfälle	KS-haltig	0,66
97104			Abfälle, die nur innerhalb des medizinischen Bereiches eine Infektions- oder Verletzungsgefahr darstellen können, gemäß ÖNORM S 2104	KS-haltig	0,66
97104	77	g	Abfälle, die nur innerhalb des medizinischen Bereiches eine Infektions- oder Verletzungsgefahr darstellen können, gemäß ÖNORM S 2104	KS-haltig	0,66
97105			Kanülen und sonstige verletzungsgefährdende spitze oder scharfe Gegenstände, wie Lanzetten, Skalpelle u. dgl., gemäß ÖNORM S 2104	KS-haltig	0,66
97105	77	g	Kanülen und sonstige verletzungsgefährdende spitze oder scharfe Gegenstände, wie Lanzetten, Skalpelle u. dgl., gemäß ÖNORM S 2104	KS-haltig	0,66

Appendix 17: Waste generated in 2015 in t (BMLFUW, 2017a)

Group designations pursuant to ÖNORM S 2100 (2005)		**Municipal waste from households and similar establishments**	**Excavated materials**	**Construction waste**	**Secondary waste**	**Other waste**	**Total**
11	Food, beverage and tobacco waste					31000	31000
12	Waste plant and animal fat products					81000	81000
13	waste from animal husbandry and slaughtering					0	0
14	Hides and leather waste					0	0
17	Wood waste	244000				886000	1130000
18	Pulp, paper and cardboard waste	660000				1014000	1674000
19	Other waste from the processing and refinement of animal and plant products					0	0
31	Waste of mineral origin (excluding metal waste)	218000	32764000	7798000	859000	2287000	43926000
35	Metal waste	196000			4000	2443000	2643000
39	Other waste of mineral origin as well as waste from refining processes					2000	2000
51	Oxides, hydroxides, salt waste					108000	108000
52	Waset from acids, lyes, concentrates					75000	75000
53	Waste from plant treatment agents and pesticides as well as pharmaceutical products and disinfectants					12000	12000
54	Waste from mineral oil and coua refining products		10000	1860000		251000	2121000
55	waste from organic solvents, paints, lacquers, glues, bonding agents and resins	*19000*				54000	73000
57	**plastic and rubber waste**	***27000***			**150000**	**211000**	**388000**

58	Textile waste (natural and chemical fibre products)	29000				13000	42000
59	Other waste from chemical conversion and synthesis products					11000	11000
91	**Solid municipal waste including similar commercial waste**	1831000		339000	1228000	960000	4358000
92	Waste for biological recovery	936000			354000	780000	2070000
94	Waste from water treatment, waste water treatment and water use				13000	856000	869000
95	Liquid waste from waste treatment plants				55000	52000	107000
97	waste from medical institutions					41000	41000
	Total (rounded off)	4160000	32774000	9997000	2663000	10168000	59762000

Appendix 18: Landfilled waste streams according to SN numbers and containing plastic shares in 2015 (UBA, 2017)

type of waste (SN-number	name	treated amount of plastic containing waste streams(t)	plastic share(t)
91103	residues from mechanical biological treatment	61,572	12,314
91105	MBT waste from households and similar commercial waste	43,574	871
91501	street sweepings	22,610	339
91302	aerobe stabilized waste from MBT-plants	18,086	362
94702	residues from sewer cleaning	2,089	104
91206	construction waste (no demolition waste)	27	1
35202	WEEEs, without relevant amounts of dangerous wastes or substances	9	2
55513	cured old lacquers and old paints (also cured residues in containers)	4	4
Total		**147,971**	**13,997**

Appendix 19: Municipal waste by catalogue number in SR

20	**MUNICIPAL WASTES (HOUSEHOLD WASTES AND SIMILAR WASTE FROM TRADE, INDUSTRY AND INSTITUTIONS) INCLUDING THEIR COMPONENTS FROM COLLECTED COLLECTION**	Type of waste : N= dangeroes waste O=ordinary
20 01	COMPONENTS OF MUNICIPAL WASTES FROM SEPARATE COLLECTION EXCEPT 15 01	
20 01 01	paper and cardboard	O
20 01 02	glass	O
20 01 03	multilayer cardboard-based composite materials	O
20 01 08	biodegradable kitchen and restaurant waste	O
20 01 10	clothing	O
20 01 11	textílie	O
20 01 13	rozpúšťadlá	N
20 01 14	kyseliny	N
20 01 15	zásady	N
20 01 17	fotochemické látky	N
20 01 19	pesticídy	N
20 01 21	žiarivky a iný odpad obsahujúci ortuť	N
20 01 23	vyradené zariadenia obsahujúce chlórfluórované uhľovodíky	N
20 01 25	jedlé oleje a tuky	O
20 01 26	oleje a tuky iné ako uvedené v 20 01 25	N
20 01 27	farby, tlačiarenské farby, lepidlá a živice obsahujúce nebezpečné látky	N
20 01 28	farby, tlačiarenské farby, lepidlá a živice iné ako uvedené v 20 01 27	O
20 01 29	detergenty obsahujúce nebezpečné látky	N
20 01 30	detergenty iné ako uvedené v 20 01 29	O
20 01 31	cytotoxické a cytostatické liečivá	N
20 01 32	liečivá iné ako uvedené v 20 01 31	O
20 01 33	batérie a akumulátory uvedené v 16 06 01, 16 06 02, alebo 16 06 03 a netriedené batérie a akumulátory obsahujúce tieto batérie	N
20 01 34	batérie a akumulátory iné ako uvedené v 20 01 33	O
20 01 35	vyradené elektrické a elektronické zariadenia iné ako uvedené v 20 01 21 a 20 01 23, obsahujúce nebezpečné časti *)	N
20 01 36	vyradené elektrické a elektronické zariadenia iné ako uvedené v 20 01 21, 20 01 23 a 20 01 35	O
20 01 37	drevo obsahujúce nebezpečné látky	N
20 01 38	drevo iné ako uvedené v 20 01 37	O
20 01 39	plasty	O
20 01 40	kovy	O
20 01 40 01	meď, bronz, mosadz	O
20 01 40 02	hliník	O
20 01 40 03	olovo	O
20 01 40 04	zinok	O
20 01 40 05	železo a oceľ	O
20 01 40 06	cín	O
20 01 40 07	zmiešané kovy	O
20 01 41	odpady z vymetania komínov	O

20 01 99	odpady inak nešpecifikované	
20 02	ODPADY ZO ZÁHRAD A Z PARKOV VRÁTANE ODPADU Z CINTORÍNOV	
20 02 01	biologicky rozložiteľný odpad	O
20 02 02	zemina a kamenivo	O
20 02 03	iné biologicky nerozložiteľné odpady	O
20 03	INÉ KOMUNÁLNE ODPADY	
20 03 01	zmesový komunálny odpad	O
20 03 02	odpad z trhovísk	O
20 03 03	odpad z čistenia ulíc	O
20 03 04	kal zo septikov	O
20 03 06	odpad z čistenia kanalizácie	O
20 03 07	objemný odpad	O
20 03 08	drobný stavebný odpad	O
20 03 99	komunálne odpady inak nešpecifikované	

Appendix 20: Section 77 of Act no. 582/2004 Coll. on Local Taxes and Local Fees for Municipal Waste

Pursuant to Section 77 of Act no. 582/2004 Coll. on Local Taxes and Local Fees for Municipal Waste and Small Construction Wastes as amended, the fee is paid for the activities of mixed municipal waste management, biodegradable municipal waste management activities, sorted collection of municipal waste components not covered by extended producer responsibility caused by inconsistent sorting of separately collected municipal waste components, which are covered by extended producer responsibility and costs exceeding the usual costs according to § 59 par. 8 of the Waste Act.

The municipal waste yield for municipal waste and small construction waste is used exclusively by the municipality for the collection, transport, recovery and disposal of municipal waste and small construction waste. Podľa § 81 ods. 7 zákona o odpadoch je obec povinná:

(a) to ensure the collection and transport of mixed municipal waste generated in its territory for the purpose of recovery or disposal in accordance with this Act, including the provision of collection containers corresponding to the mixed municipal waste collection system in the municipality;

(b) ensure the introduction and implementation of separate collection

1. biodegradable catering waste, other than that of which the natural person is the entrepreneur and the legal person who operates the mass caterer (hereafter "the kitchen operator");
2. edible oils and household fats,
3. biodegradable garden and park waste, including cemetery waste;

(c) ensure the introduction and implementation of separate collection of municipal waste for paper, plastics, metals, glass and multilayer board-based composite materials, at least to the extent required by the provisions laid down for separate collection of municipal waste;

(d) allow the manufacturer of the EEE and the manufacturer of portable batteries and accumulators, the relevant third party or the relevant producer responsibility organization at their expense

1. to establish and operate in its territory a system of separate collection of electrical waste from households and used batteries and accumulators, \ t
2. use existing municipal waste collection facilities to the extent necessary

(e) to enable producer responsibility for packaging to be collected, at its expense, by the collection of sorted municipal waste components to which extended producer responsibility applies, under a contract with it;

f) to provide, at the request of the producer responsibility organization, the data referred to in Article 28 (1); 5 (a) d) the second point of the Waste Act,

(g) ensure, where appropriate, at least twice a year, the collection and transport of bulky wastes and separately collected municipal waste from households containing harmful substances for recovery or disposal; this does not apply to a municipality with less than 5 000 inhabitants and a collection yard is established in its territory

(h) publish on its website a detailed general description of the entire municipal waste management system, including a separate collection in the municipality.

The municipality is obliged to enable the person collecting, transporting, recovering and disposing of the biodegradable kitchen and restaurant waste for the kitchen operator at its cost and in accordance with the generally binding regulation of the municipality:

(a) to establish and operate in its territory a system for the separate collection of biodegradable kitchen and restaurant waste;

(b) use existing municipal waste collection facilities to the extent necessary for this purpose.

The obligation to establish and ensure the implementation of separate municipal waste collection for biodegradable catering waste does not apply to a municipality which:

a) ensure the energy recovery of these wastes in the waste recovery facility R1 by the activity listed in Annex no. 1 to the Waste Act,

(b) demonstrates that at least 50% of the population composts their own waste;

(c) demonstrates that this does not allow for technical problems of collection, in particular in the historical centers of cities and in sparsely populated areas; that exception applies only to that part of the municipality,

(d) demonstrates that this is economically unacceptable, since the cost of handling this biodegradable kitchen waste cannot be covered even when determining a local fee of 50% of the statutory ceiling of the local fee rate.

Requirements for separate collection of municipal waste are specified in § 14 of the Decree of the Ministry of the Environment of the Slovak Republic no. Implementing certain provisions of the Waste Act.

If a municipality introduces in its territory or part thereof a quantitative collection of mixed municipal waste for all producers of municipal waste or for certain categories of municipal waste producers, it shall be obliged to enable the producers of municipal waste to which this collection relates:

individual determination of the interval of removal of municipal waste from the place designated by the municipality pursuant to § 81 par. 9 písm. (d) of the Waste Act, whereas for non-biodegradable municipal waste this interval may be longer than 14 days or

selecting the size of the collection container from at least three options to be established by the municipality in a generally binding regulation; if they are municipal waste producers, who are co-owners of the property, or if it is an apartment building, the choice of collection container size is possible only after agreement of all the originators, unless they agree, the municipality decides.

The municipality, on whose territory there is no quantity collection of mixed municipal waste, is obliged, upon request, to introduce a quantity collection with such a legal entity or natural person - entrepreneur who proves that:

the amount of municipal waste produced by it is precisely measurable,

municipal wastes and small building wastes are appropriately secured against loss, theft or other unwanted leakage until they are removed.

Pursuant to § 81 para. 20 of the Waste Act, the municipality is obliged to introduce a quantity collection of small construction waste.

The municipality may, in the territory of the municipality, collect, including mobile collection, and transport municipal waste, with the exception of biodegradable kitchen and restaurant waste from the operator of the kitchen, the municipality itself or the contracting authority for carrying out this activity with the municipality; this does not apply to distributors collecting and collecting through the collection point of used portable batteries and accumulators. If it is the collection of packaging waste and waste from non-packaging products, only those who have a contract concluded with the municipality pursuant to Article 59 Para. 4 of the Waste Act with the organization of producer responsibility, with which the municipality has entered into a contract pursuant to § 59 par. 2 of the Waste Act.

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