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Management of plastic packaging: the case of Austria

Abstract: *Plastics, especially from packaging, have gained increasing attention in waste management. In this context, the EU has proposed higher recycling targets to encourage the recycling of (plastic) packaging. To accurately calculate the recycling rates, detailed information on the flows of plastic packaging is needed. Therefore, the aim of this study is to quantitatively and qualitatively investigate the waste management system for plastic packaging in Austria in 2013 using material flow analysis, taking into account the used product categories and the polymer composition. The results show that 300,000 t/a (35 kg/cap·a) of waste plastic packaging were produced, mainly composed of large and small films and small hollow bodies, including PET bottles. Correspondingly, the polymer composition of the waste stream was dominated by LDPE (46%), PET (19%) and PP (14%). 58% was collected separately, and 26% of the total waste stream was recovered as re-granulates, whereas the rest was thermally recovered in waste-to-energy plants (40%) and the cement industry (33%). The targets set by the EU and Austria were reached comfortably, although to reach the proposed future targets major technological steps regarding collection and sorting will be needed. However, the current calculation point of the targets, i.e. on the input side of the recycling plant, is not deemed to be fully in line with the overall objective of the circular economy, namely to keep materials in the economy and prevent losses. It is therefore recommended that the targets be calculated with respect to the actual output of the recycling process, provided that the quality of the output products is maintained, to accurately assess the performance of the waste management system.*

1 Introduction

Plastics have an ever increasing importance in waste management due to concerns about environmental problems and the availability of non-renewable resources. This has stimulated policy initiatives focusing on the waste management of especially plastic packaging, as this is the main application of plastics and makes up the largest share in the post-consumer plastic waste stream (Van Eygen et al. 2017a; World Economic Forum et al. 2016). One of these initiatives is the recycling target imposed by the EU, which currently requires 22.5% of waste plastic packaging to be recycled (EPC 2004), and is proposed to be increased to 55% by 2025 (EC 2015). For the calculation of these recycling rates and to draw the right conclusions on the overall environmental performance and potentially improve the system, detailed knowledge of the material flows within the economy is needed. In the case of plastic packaging, it is necessary to characterize the

waste stream with respect to product categories, on which many collection systems and sorting processes are based, as well as with respect to polymers, which need to be separated for the recycling process. Therefore, the aim of this study is to quantitatively and qualitatively investigate the waste management system for plastic packaging in Austria in 2013 with respect to polymer content and product categories. Based on these results, indicators on the performance of the system are calculated and compared with current and future policy targets.

2 Methods

Material flow analysis (MFA), using the software STAN 2.5, was used to quantify the flows of packaging plastics on the polymer and product category level. Eight polymers were taken into account: low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE), high-density polyethylene (HDPE), polypropylene (PP), polystyrene (PS), expanded polystyrene (EPS), polyethylene terephthalate (PET), and polyvinyl chloride (PVC). These polymers account for 99% of all plastics used in packaging in Europe, according to PlasticsEurope (2015). Furthermore, the waste stream was subdivided into seven product categories, including PET bottles, small (<5 L) and large (≥5 L) hollow bodies, small (<1.5 m²) and large (≥1.5 m²) films, large EPS (≥0.1 kg), and other products.

The main data sources used for this analysis were a study by Hauer et al. (2015), who carried out market research on packaging consumption and waste, as well as ARA (2016), who provided more detailed information on the separately collected waste. To assess the quality of the input data and subsequently the robustness of the results, the uncertainty of the input data was characterized using the approach described by Laner et al. (2016).

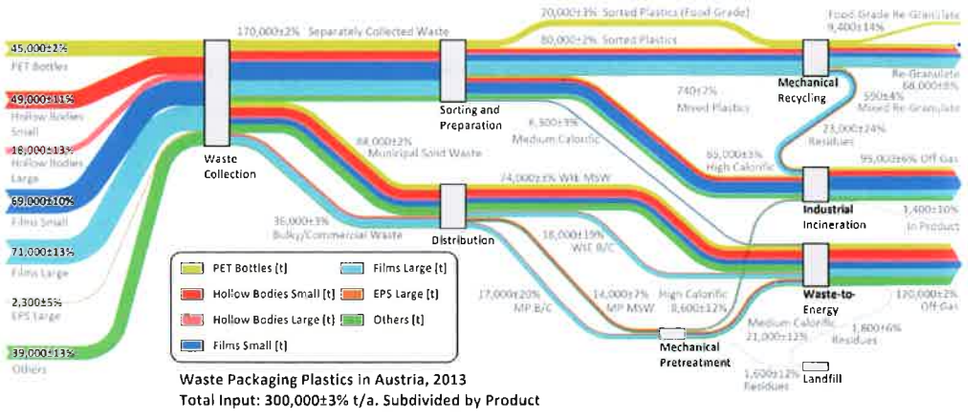

Figure 1: Results of the material flow analysis subdivided by product category.

3 Results and discussion

The main results of the MFA on a product category basis are presented in Figure 1. For a more detailed elaboration on the results, especially with regards to the various polymers, the reader is referred to Van Eygen et al. (2017b). The total mass of waste plastic packaging in Austria amounted to 300,000 t/a (tonnes per year, 103 kg) in 2013. The largest product categories were large films (28%), followed by small films (19%), small hollow bodies (18%), PET bottles (16%), others (13%), large hollow bodies (6%), and large EPS (1%). Furthermore, the total waste stream was composed mainly of LDPE (46%), followed by PET (19%), PP (14%), HDPE (11%), LLDPE (5%), PS (3%), EPS (2%), and PVC (<1%).

Three indicators are subsequently used for describing the extent to which materials are recirculated within the economy: the Collection Rate (the amount separately collected divided by the total waste amount), the Sorting Rate (the amount sorted and sent to the mechanical recycling processes divided by the total waste amount, as defined by the EU for the targets), and the Recycling Rate (the amount of re-granulate produced at the mechanical recycling plant divided by the total waste amount). These three rates are presented in Figure 2 for each of the product categories. For the total waste stream, a Collection Rate of 58% was reached, whereas 30% was discarded into the MSW and 12% into BCW. Overall, 26% was recovered as regranulate, 40% was treated in waste-to-energy plants and the remaining 33% in the cement industry. Concerning the product categories, especially EPS large (38%), PET bottles (45%) and films large (39%) showed high Recycling Rates.

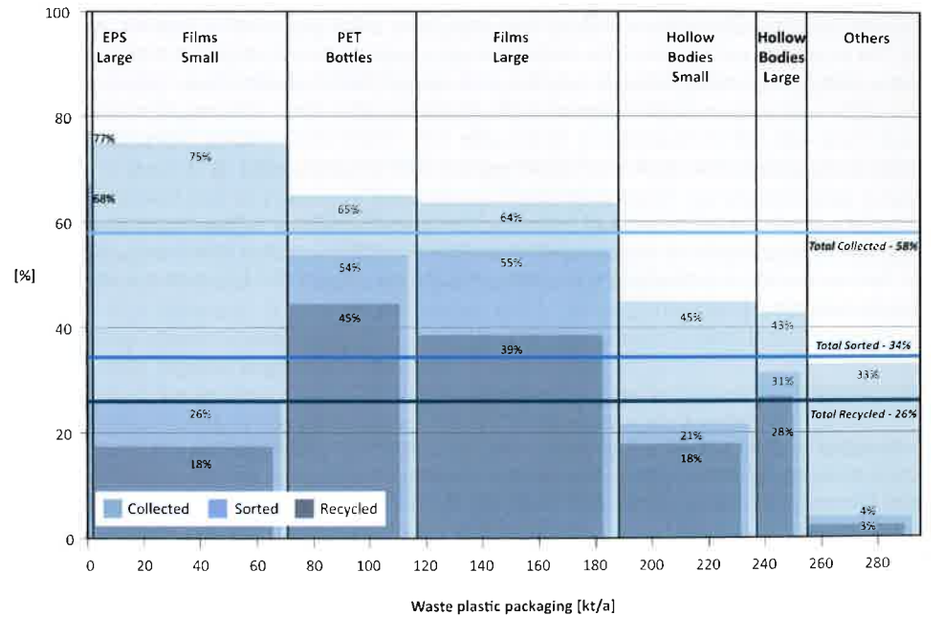

Figure 2: Comparison of the Collection, Sorting and Recycling Rates for each of the product categories and the total waste stream.

The EU recycling target of 22.5%, which is also the level required by the Austrian implementation (BMLFUW 2014), is reached comfortably with 34%. However, reaching the proposed future target of 55% by 2025 will require major increases for the collection and sorting efficiencies, especially since the reported Sorting Rates have stagnated over the past decade with values around 31-34% (Eurostat 2017).

Another important issue is the calculation point of the recycling targets, because the closer it is placed towards the end of the recycling chain (i.e. after the recycling plant), the more the actual amount of produced re-granulate is accounted for. Currently the calculation point is placed before the recycling plant. Thus, increasing targets could lead to a decreasing purity of the material in the input, because there is an incentive to maximize the quantitative outputs of the sorting plants. Therefore, fewer impurities (non-plastics as well as unwanted polymers) would be sorted out, causing higher material losses at the recycling plant as well as jeopardize the quality of the final re-granulate. Conversely, moving the calculation point towards the output of the recycling plant could nonetheless have adverse effects on the quality of the re-granulate as well, by encouraging the shift of high-quality recycling with relatively high losses to processes with lower-grade applications which can handle higher amounts of impurities. Consequently, it is crucial to consider the quality of the recycling products, besides the merely mass-based perspective of the recycling rates where including impurities into the product is encouraged.

This tendency of including impurities manifests itself at the sorting process, where mixed-plastics streams can be generated by design, which are subsequently recycled into mixed-polymer re-granulate (used e.g. as a substitute for wood). The recycling target can thus be reached in a more straightforward way, although the environmental benefits of these re-granulates have been called into question (see e.g. Astrup et al. 2009). The latter trend can be seen in the Netherlands for example, where much higher targets are set than in Austria (45% in 2015, rising each year to 51% in 2021, see MIM 2014) and therefore higher Sorting Rates of up to 50% in 2014 are reported (Eurostat 2017). This has led the share of mixed-polymer re-granulate to reach more than half of the produced re-granulate from household packaging waste (Nusselder and Odegard 2016), compared to about 1% of all packaging waste in Austria.

To accurately assess the performance of the waste management system, it is thus recommended that the quantitative recycling targets are accompanied by qualitative specifications (e.g. substitution). However, this would then necessitate re-evaluating the proposed recycling targets, and could increase the administrative burden for reporting.

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References

ARA. 2016. Personal communication with D. Schuch: Altstoff Recycling Austria AG.

Astrup, T., T. Fruergaard, and T. H. Christensen. 2009. Recycling of plastic: accounting of greenhouse gases and global warming contributions. *Waste Management & Research* 27(8): 763-772. DOI: 10.1177/0734242X09345868

BMLFUW. 2014. Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Vermeidung und Verwertung von Verpackungsabfällen und bestimmten Warenresten (Verpackungsverordnung 2014). *Bundesgesetzblatt für die Republik Österreich* BGBl. II Nr. 184/2014.

EC. 2015. *Proposal for a Directive of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste.* COM(2015) 596. European Commission. Brussels, Belgium.

EPC. 2004. Directive 2004/12/EC of the European Parliament and of the Council of 11 February 2004 amending Directive 94/62/EC on packaging and packaging waste. *Official Journal of the European Union* L47: 26-31.

Eurostat. 2017. Packaging waste. http://ec.europa.eu/eurostat/web/waste/key-waste-streams/packaging. Accessed 14.06. 2017.

Hauer, TB, A. C. Nielsen, and ÖIV. 2015. *Verpackungsaufkommen in Österreich 2013: Endbericht [Arising of Packaging in Austria 2013: Final Report].* Confidential Report. Altstoff Recycling Austria. Korneuburg, Austria.

Laner, D., J. Feketitsch, H. Rechberger, and J. Fellner. 2016. A novel approach to characterize data uncertainty in material flow analysis and its application to plastics flows in Austria. *Journal of Industrial Ecology* 20(5): 1050-1063. DOI: 10.1111/jiec.12326

MIM. 2014. Besluit van 27 oktober 2014, houdende regels voor verpakking en verpakkingsafval (Besluit beheer verpakkingen 2014). Ministerie van Infrastructuur en Milieu. *Staatsblad van het Koninkrijk der Nederlanden* 409.

Nusselder, S. and I. Y. R. Odegard. 2016. *Wat redt een Plastic Hero? De milieuvoordelen van kunststof recycling vertaald voor de consument [What does a Plastic Hero save? The environmental benefits of plastics recycling translated for the consumer].* CE Delft. Delft, the Netherlands.

PlasticsEurope. 2015. *Plastics - The facts 2014/2015. An analysis of European plastics production, demand and waste data.* Association of Plastics Manufacturers. Brussels, Belgium.

Van Eygen, E., J. Feketitsch, D. Laner, H. Rechberger, and J. Fellner. 2017a. Comprehensive analysis and quantification of national plastic flows: The case of Austria. *Resources, Conservation and Recycling* 117: 183-194. DOI: 10.1016/j.resconrec.2016.10.017

Van Eygen, E., D. Laner, and J. Fellner. 2017b. Circular economy of plastic packaging: current practice and perspectives in Austria. *Waste management.* DOI: 10.1016/j.wasman.2017.11.040

World Economic Forum, Ellen MacArthur Foundation, and McKinsey & Company. 2016. *The New Plastics Economy – Rethinking the future of plastics.* http://www.ellenmacarthurfoundation.org/publications.

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