



Report | International Comparison

August 2017



The collection of plastic packaging waste in several European countries: key figures, policies and lessons for the Netherlands.

1 Introduction

The International Comparison work package, part of the Netherlands Institute for Sustainable Packaging's plastic chain project, is intended to determine where five other European nations stand with regards to closing their plastic packaging materials chain, both in terms of raw materials and in an economic sense. The main objective of this work package is to derive starting points for interventions from the analyses that can be used in the Netherlands to further close the plastics chain. The countries have been selected to ensure that the three types of collection and recycling systems that are currently common in the EU are all featured: a comprehensive collection structure, a selective collection structure and a collection structure that relies on manual sorting by "hand pickers." The focus of this analysis is on domestic plastic packaging waste, unless explicitly stated otherwise.

2 System characteristics and results

Based on the various country reports, the key system characteristics of the collection systems for households have been summarised below. For each country, we will then provide a summary of the information we gathered pertaining to the closing of the plastic chain, with a focus on domestic plastic packaging waste. Next, starting points for policies that might be implemented in the Netherlands and conclusions are presented. We conclude with the approach and method. In the attachments the complete country reports can be found.

System characteristics

The table at the top of page 3 lists the various system characteristics for the collection of plastic packaging waste from households in the countries we examined. The characteristics of the Dutch system have been included for comparison.

Out of all their plastic packaging waste, Belgium and France only collect the stream of plastic bottles and flasks (selective collection). Both countries have been employing a uniform national system since the early nineties (blue PMD bags in Belgium, yellow TRI bins in France). In 2015, Belgium set a recycling target (sorter output) of 30% of its domestic plastic packaging waste. In that same year, France did not have a specific target for plastic packaging waste. Instead, it had a single recycling target of 75% of all domestic packaging waste.

In Germany, Greece, the Czech Republic and the Netherlands, all types of domestic plastic packaging waste are collected (comprehensive collection). In the Czech Republic, plastic non-packaging waste is collected with the plastic packaging waste. In Germany, a yellow-bag system has been used since 1991 for the collection of domestic plastic packaging waste. In Greece (blue bins) and the Czech Republic (yellow bins), national systems have been in place since the early 2000s. In the Netherlands, comprehensive collection was implemented in 2008. The Netherlands employs several collection systems. In 2015, Germany set a recycling target of 36% for its licensed domestic plastic packaging waste. The 2015 recycling targets set by Greece (22.5%), the Czech Republic (40%) and the Netherlands (45%) concern recycle targets for the combined total of all plastic packaging waste from both households and businesses. In the case of the Czech Republic, the aforementioned target of 40% concerns a collection target rather than a recycling target.

Finally, the examined countries hardly apply mechanical biological waste treatment.



Country	Collection-Strategie	Collection-System	Materials in system	Since	Sorting; Mechanical or manual	Chain oversight	Recycle target 2015 (output sorter versus onto the market)	Deposit-refund system
Belgium	Selective	Blue PMD bag	PBF*, metal packaging and beverage cartons	1994	Mechanical	PRO*	30% Domestic	No
France	Selective	Yellow TRI bin	PBF*, paper- & metal packaging and beverage cartons	1992	Mechanical	Municipalities	Overall objective of 75% domestic	No
Germany	Broad	Yellow bag	All plastic & metal packaging and beverage cartons	1991	Mechanical	PRO*	36%* Domestic	Yes
Netherlands	Broad	Various	Differs per municipality	2008	Mechanical	Municipalities	45% Domestic & Businesses	Yes (limited)
Czech Republic	Breed + KNV	Yellow bin	All plastic packaging and PNP*	2002	Mainly manual	Municipalities	40%* Domestic & Businesses	No
Greece	Breed	Blue bin	All plastic & metal packaging, paper, glas packaging and beverage cartons	2004	Mainly manual	Municipalities / PRO*	22.5% Domestic & Businesses	No

*Clarification of abbreviations; PBF=Plastic bottles and flasks; PNP=Plastic non-packaging; PRO=Producer responsibility organisations.

Furthermore: in practice, the Czech Republic's 40% target is a collection target (up to the sorter's front gate) rather than, as for the other countries, a target that is measured after sorting, at the recycler's front gate. The 36% recycling target for Germany pertains to the amount licensed.

Results

The table below shows the extent to which the various countries manage to close their plastic chain, both in terms of raw materials and in an economic sense. The results achieved in the Netherlands have been included for comparison.

With regards to the closing of the plastic chain in terms of raw materials, the table below shows the extent to which the aforementioned collection systems for plastic packaging waste from households manage to close the plastic chain. Furthermore, the achieved recycling percentage of all plastic packaging waste (from both households and businesses) is listed.

The cost recovery rate indicates the degree to which the chain is closed in an economic sense. To calculate the cost recovery rate, the domestic collection systems' revenue is divided by the costs of the system.

The revenue pertains to the plastic packaging waste made available for recycling. In Germany's case, this information is not publicly available, so the revenue after recycling is listed instead. The costs of the various collection systems pertain to the costs of collecting and sorting the domestic plastic packaging waste.

In order to determine the cost recovery rate of plastic alone, the costs have been allocated by mass for each collection system for domestic plastic packaging waste. The various packaging materials in the collection system must each carry part of the costs of the non-packaging materials (residue, contaminants and non-packaging materials). Each material's weight percentage is used for this calculation.

Country	Raw materials		Economic					
	Realisation system MPW	Realisation MPW and BPW together	Collection costs system MPW (tonne)	Sorting costs system MPW (tonne)	Collection & sorting costs system MPW (tonne)	Revenue/ ton recycled MPW system (output sorter)	Cost recovery rate municipal system	Cost recovery rate MPW (allocated in proportion to weight)
Belgium (*2)	29% (2015)	41.3% (2015)	€235	€157	€392	€391	59%	78%
France (*1)	22.5% (2014)	25.2% (2014)	NA	NA	€867	€256	19%	25%
Germany (*2)	28.4% *** (2015)	48.8% (2015)	€140	€80	€220	€590 (after recycling)	49% (after recycling)	34% (after recycling)
Netherlands	38% (estimate 2015) **	51% (2015)	Chain rennumeration (2015) amounts to €817			Negative	0% (after sorting) around 27% (after recycling) **	0% (after sorting) around 27% (after recycling) **
Czech Republic (*2)	NA	66%* (2015)	NA	NA	€277 (netto)	NA	NA	NA
Greece (*2)	NA	35.2% (2015)	€60 (estimate)	€157 (estimate)	€217	€206	43%	52%

Clarification of abbreviations; MPW=Municipal plastic packaging waste; BPW= Plastic packaging waste from businesses; NA=Not Available.

* The percentage realised in the Czech Republic pertains to collection, because this country has set a collection target rather than a recycling target.

** The cost recovery rate after sorting is 0%. This is due to the average negative revenue of sorted plastic packaging waste. The figure of the cost recovery rate after recycling is based on calculations with the Financial-Economical Model. The calculations pertain to plastic packaging waste from households and from the deposit-refund system only. The cost recovery rate of beverage cartons and metal packaging, in case of plastic collection with PMD, are not included in this calculation.

*** This percentage does not include the deposit-refund flow and pertains to the total amount of domestic plastic packaging waste onto the market and not to the amount licensed.

(*1) The country report has been presented for evaluation to the relevant national organisations to eliminate any factual inaccuracies.

(*2) The country report has been evaluated by the relevant national organisations to eliminate factual inaccuracies.

3 Summary per nation

Based on the aforementioned system characteristics and results, a brief summary for each of the countries is included below. For more information, refer to the individual country reports (attached).

Belgium

In Belgium, Fost Plus acts as a not-for-profit producer responsibility organisation. Out of all domestic plastic packaging waste, only plastic bottles and flasks are collected. Since 1994, these have been collected in blue PMD bags, alongside metal packaging and beverage cartons. Due to the national uniform use of the PMD bags, 29% of all domestic plastic packaging waste is made available for recycling. In addition to the PMD collection, plastic packaging material is collected at container parks (municipal waste collection facilities in the Netherlands). Together with the plastic packaging stream collected via PMD, this stream raises the percentage of the domestic plastic packaging waste that is made available for recycling to 35.4%.

As a result of the uniform system, centralised chain oversight and a focus on the quality of the PMD collection, the collection and sorting costs of the PMD stream are kept manageable. These costs amount to €392 per tonne. The cost of collecting and sorting 159.6 kt of PMD material amounted to €63 million. Because of the centralised sale of the sorted material and because this material mostly consists of PET and HDPE (the most valuable types of plastic packaging material), 66 kt of plastic packaging material yielded €26 million (€391 per tonne). It should be noted that Belgium does not have a deposit-refund system. With its PMD system, Belgium achieves a cost recovery rate of 59%. Allocated by mass, the plastic stream itself even achieves a cost recovery rate of 78%.

One of the system's downsides is also one of its strengths, namely the fact that only the most valuable streams are collected. In Belgium, around 39% of all domestic plastic packaging waste consists of plastic bottles and flasks. As a result, higher recycling targets are not feasible within the current system. The reach of the system is currently being examined and more comprehensive collection methods are being considered.

France

Until recently, a single not-for-profit producer responsibility organisation was active in France. Since 1 January 2017, France has two active for-profit producer responsibility organisations. Out of all domestic plastic packaging waste, only plastic bottles and flasks are collected in France. Since 1992, this stream is collected in the yellow TRI bins alongside paper and cardboard packaging materials, metal packaging materials and beverage cartons. In total, 22.5% of all domestic plastic packaging waste is made available for recycling via this system.

The lack of centralised chain oversight or control of the collection and sorting means that the collection and sorting costs are relatively high, despite the fact that France uses a uniform collection system. The French yellow-bin system facilitates municipalities in the sale of the sorted material, which mainly consists of PET and HDPE (the most valuable types of plastic packaging material). Using the French yellow-bin system, municipalities are able to realise an average revenue of €256 per tonne. It should be noted that France does not have a deposit-refund system.

Because France is gradually transitioning from selective collection to a broader more comprehensive collection, the percentage of plastic bottles and flasks in the total amount of plastic packaging materials on the market will no longer have a limiting effect on the recycling percentage (as opposed to the situation in Belgium).

Using a bonus/malus system in combination with its packaging duties regulation, the French yellow-bin system tries to get producers and importers to focus more on design-for-recycling and prevention. Producers and

importers receive a bonus if they use materials that are easy to recycle and they are issued a malus (penalty) on top of the regular packaging rate if they choose non-recyclable plastic packaging materials. Data on the effects of the bonus/malus system on producers' policies is not available.

Germany

Currently, Germany has ten active for-profit producer responsibility organisations. Since 1991, domestic plastic packaging waste has been collected in yellow bags, alongside metal packaging and beverage cartons. The collection and sorting of these packaging materials is financed entirely by the producer responsibility organisations and the system runs parallel to collection of household waste. Around 71% of all domestic plastic packaging waste (excluding the deposit-refund scheme) is collected using the yellow bags. After sorting, around 40% of the collected plastic packaging waste is made available for recycling. Due to losses during the recycling process, around 30% of all collected domestic plastic packaging waste will actually be converted into recyclate.

As a result of a uniform system, centralised chain oversight, short-term contracts with collectors and sorters and economies of scale regarding sorting facilities, the collection and sorting costs are kept relatively low. This brings the total cost of collecting and sorting to around €220 per tonne. Due to the uniformity of the yellow-bag system, sorters get a good idea of the composition of the yellow bag. They can then set up their sorting lines accordingly.

Because of Germany's extensive deposit-refund system, the majority of the PET bottles (one of the most valuable types of plastic packaging materials) is absent in the yellow bags. This is part of the reason why the revenue generated by the plastic packaging materials from the yellow bag after sorting is negative, as non-public sources reveal. However, data on the revenue generated by the recyclate (after recycling) is publicly available. In Germany, the cost recovery rate of the yellow-bag system from collection until after recycling is around 49%. Allocated by mass, the plastic stream itself achieves a cost recovery rate of 34%.

Non-public sources indicate that some producer responsibility organisations employ differentiated rates for plastic packaging materials. The rates for non-processable plastic packaging materials are higher than those for e.g. PET packaging materials. This is intended to stimulate design-for-recycling.

An important downside of the German yellow-bag system is the lack of transparency resulting from the system's competitive nature. Together with several legal loopholes, this attracts "freeriders." As a result, not all users of the yellow-bag system contribute (evenly) to its costs. Until 2015, producers were allowed to finance their own waste management. These producers were not required to contribute to the costs of the yellow-bag system, yet in practice their waste ended up in the system regardless.

Germany's recycling target of 36% does not stimulate the producer responsibility organisations to recycle more than necessary.

Greece

A single not-for-profit producer responsibility organisation is active in Greece. Since 2004, domestic plastic packaging waste is collected in the blue bins, alongside paper and cardboard, metal packaging, glass packaging and beverage cartons. The producer responsibility organisation facilitates the collection by municipalities by financing the collection infrastructure. Greece's recycling target for plastic packaging is set for the plastic packaging waste streams from households and businesses combined. In Greece, around 35% of all plastic packaging waste is made available for recycling.

The Greek blue-bin system features centralised oversight of the sorting process. With the help of various financial stimuli, there is a focus on the costs and quality of the sorting process. The estimated total costs of

collection and sorting are €217 per tonne. Greece's sorting process is characterised by its low degree of automation and extensive use of manual sorting.

With the help of financial stimuli focused on improved the sorting quality, Greece manages to realise an average revenue of €206 per tonne of sorted domestic plastic packaging waste.

There is a significant degree of contamination during the collection phase. Because the blue bin offers a higher density of collection sites than regular domestic waste, a large quantity of domestic waste is disposed of in the blue bins. This is then picked out during the sorting process.

Czech Republic

The Czech Republic also has a single active not-for-profit producer responsibility organisation. Since 2002, domestic plastic packaging waste and plastic non-packaging are collected throughout the Czech Republic in yellow bins (although many municipalities have been using this system for much longer). The producer responsibility organisation facilitates the collection by municipalities by providing a high density of yellow bins. In the Czech Republic, citizens are informed of the correlation between the waste tax they have to pay and their own waste separation behaviour. The Czech Republic's recycling target applies to the plastic packaging waste streams from both households and businesses combined. It should be noted that this concerns a collection target. The Czech Republic strives to collect 40% of all plastic packaging waste from households and businesses. In 2015, the country managed to collect 66% of all plastic packaging waste.

Despite the lack of centralised chain oversight or a focus on collection and sorting, the Czech Republic manages to limit the net collection and sorting costs of its domestic plastic packaging waste to €277 per tonne (net costs = gross costs – revenue from the material). The Czech Republic's system is also characterised by its low degree of automation and extensive use of manual sorting.


The Czech Republic's system uses differentiated rates for plastic packaging materials put on the market by producers and importers. The rates for domestic plastic packaging materials are higher than those for e.g. plastic transport packaging materials.

4 Interventions

The most valuable interventions that could possibly be applied in the Netherlands have been selected from the country reports. For each intervention, it is listed whether it affects the physical or economic closing of the plastic packaging chain. Next, a comparison with the Netherlands is made for each intervention. Finally, the interventions are placed in the plastic packaging chain.

Overview of interventions

For each intervention, the information between parentheses indicates from which country the intervention in question was “taken” (BE for Belgium; FR for France; CZ for the Czech Republic; GR for Greece; DE for Germany).

Physical 	Economic €
<ul style="list-style-type: none"> *Unified communication & uniform system throughout the country for an extended period of time (all countries). *All plastic in the plastic bin, including plastic non-packaging materials (CZ). *High density of collection containers (CZ). *Financial stimuli for citizens to separate their packaging waste (DE, BE and CZ). *Ambitious recycling target (DE). *Differentiated rates which promote improved recyclability of materials (FR and DE). 	<ul style="list-style-type: none"> *Active inspection for contaminants during collection (BE). *Stimulating a free market for the collection and sorting processes through regular tenders and multiple producer responsibility organisations (DE). *Only collect valuable streams separately (FR and BE). *Financial stimuli for sorters to gain maximum value from the sorting material (GR). *Apply economies of scale to minimise sorting costs (DE). *Low degree of automation and using labour-intensive, low-investment manual sorting (GR and CZ). *Differentiated rates to promote the use materials that are cheaper to sort and process (DE and FR). *Uniform and consistent collection system offers more stable composition of the material (all countries except the Netherlands). *Centralised chain oversight during collection, sorting and commodification (DE and BE).

Comparison with the Netherlands

The impact of the interventions listed above largely depends on the chosen system and the conditions under which the interventions are implemented. Copying any specific intervention directly does not guarantee a similar effectiveness in the Netherlands.



What is the purpose of the intervention: increasing response and reducing contamination

To achieve a higher response, all researched countries have adopted a consistent and uniform collection system for domestic plastic packaging waste, which they communicate about in a unified manner. After many years of hearing the same “message” and following the same unchanging collection instructions, citizens develop a high degree of habituation and faith in the system. This increases the chance that a majority of the population knows how to properly dispose of each type of packaging waste. In such a situation, the composition of the collected material will also become more stable and contain fewer contaminants.

The yellow-bin system used in the Czech Republic relies heavily on the accessibility of the collection facilities. On average, every citizen must be able to dispose of their plastic waste within a radius of 150 metres. This factor appears to contribute to a high response rate.

Most municipalities in Germany and Belgium have implemented a form of pay-as-you-throw. This gives citizens a financial stimulus to separate their packaging waste. This stimulus is one of the factors that contributes to the high response rates in both countries; around 71% of all domestic plastic packaging waste in Germany and 75% of all plastic bottles and flasks in Belgium are collected separately. In the Czech Republic, citizens are informed of the correlation between the waste tax they have to pay and their own waste separation behaviour.

Comparison to the Netherlands:

Since 2008, domestic plastic packaging waste is collected separately. Municipalities are free to decide how to handle the collection process. While one municipality collects plastic packaging material from households in bags, another might opt for the collection of plastic packaging material together with metal packaging material and beverage cartons using collection containers, while a third does not require citizens to separate their plastic packaging waste themselves but allows for mechanical recovery of plastics via mechanical biological waste treatment plants. Furthermore, municipalities can decide whether to offer differentiated rates pertaining to the collection. They are also responsible for communicating with citizens about how to dispose of each type of waste and why. There are significant differences between the levels of response each municipality achieves.



What is the purpose of the intervention: maximising quantity, agreements about non-packaging materials

In the Czech Republic, citizens can dispose of all plastic waste in the yellow bins, including plastic non-packaging materials. This sends a simple message to citizens. As a result, the response regarding plastic packaging material increases and the level of contamination appears to decline. However, clear agreements are needed regarding the financing of the non-packaging materials. In the Czech Republic, municipalities carry the collection and sorting costs of this material.

Comparison to the Netherlands:

In the Netherlands, non-packaging materials cannot be disposed of in the plastic packaging waste stream from households. In practice, around 7% of the plastic packaging waste stream consists of non-packaging materials.



What is the purpose of the intervention: maximising quantity, more ambitious recycling target

In Germany, the low recycling target for plastic packaging materials from households (36%) does not stimulate producer responsibility organisations to recycle more than necessary.

Comparison to the Netherlands:

In 2015, the Netherlands set a recycling target of 45% for plastic packaging waste from both households and businesses. Every year, this target is raised by 1%, bringing it to 52% by the year 2022. The actual recycling percentage was already 51% in 2015. The Netherlands therefore achieves higher recycling percentages than required, despite the aforementioned targets. The Netherlands also does not have a limit for the chain remuneration paid to municipalities.



and € What is the purpose of the intervention: stimulating recyclability


Germany and France employ differentiated rates to get producers and importers to use materials that are easier to recycle. In Germany, for example, the rates for non-processable plastic packaging materials are higher than those for e.g. PET packaging materials. In France, producers and importers receive a bonus if they use

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materials that are easy to recycle and a malus if they opt for non-processable plastic packaging materials. The processing costs of materials that are easy to recycle are lower than those of materials that are more difficult to recycle properly.

Comparison to the Netherlands:

The Netherlands uses a single rate for producers and importers for all plastic packaging materials, regardless of their composition or complexity.

 and € What is the purpose of the intervention: maximising quality

Due to the uniformity of the collection systems used (in all countries except the Netherlands), sorters have a good idea of the composition of the collected material. Sorters can then set up their sorting lines accordingly.

Comparison to the Netherlands:

Dutch municipalities are free to choose their own method for the collection of plastic packaging waste.

Whereas one municipality might choose to collect only plastic packaging materials, another might opt for the collection of plastic packaging alongside metal packaging and beverage cartons. This makes the waste stream relatively complex for sorters.

€ What is the purpose of the intervention: maximising quality, inspection during collection

Collectors in Belgium look at the contents of the PMD bags. Because these bags are transparent, it is fairly easy for the collector to identify the contents of the bag. If the collector determines that the bag contains too many contaminants, a red warning sticker in the shape of a hand is put on the bag and it is not collected. The red sticker implores the person who offered up the bag to remove the contaminants and then offer the bag up for collection once more. This method is used to point out the sorting errors citizens make when separating their packaging waste.

Comparison to the Netherlands:

In the Netherlands, the collection systems municipalities employ are not unified in terms of the composition of the collected material (only plastic material or a combination of plastic and other materials) or the means used to collect the material (bags, containers for each individual household or larger containers used by many). With the exception of some local initiatives, there is no consistent inspection of the contents of the collection medium by collectors.

€ What is the purpose of the intervention: minimising costs, market forces for collection and sorting

In Germany, ten producer responsibility organisations are responsible for the collection and sorting of the yellow bags; tenders are regularly issued. Partly due to this system, the collection and sorting costs in Germany are among the lowest out of all researched countries. In 2015, the collection and sorting costs for domestic plastic packaging waste amounted to around €220 per tonne.

Comparison to the Netherlands,

In the Netherlands, municipalities are responsible for the collection of waste. They can choose to do this themselves or outsource the work to waste management organisations. The sorting of the material is outsourced directly by the municipalities or outsourced via waste management organisations, who then handle the sorting process for several municipalities at once. In 2015, municipalities were paid a chain remuneration of €817 per tonne for the collection and sorting of domestic plastic packaging waste.

€ What is the purpose of the intervention: minimising costs, national chain oversight regarding collection and sorting

Germany and Belgium have implemented centralised chain oversight, as part of which producer responsibility organisation(s) manage or coordinate the collection and sorting processes.

Comparison to the Netherlands:

The Netherlands does not have any centralised chain oversight. Instead, chain oversight is in the hands of each of the around 400 municipalities.

€ What is the purpose of the intervention: selective separation at the source

In 2015, France and Belgium mainly collected the most valuable plastic packaging waste streams separately. Combined with centralised oversight of the collection, sorting and commodification processes, this results in a high cost recovery rate for the Belgian PMD system. France achieves a significantly lower cost recovery rate with its yellow-bin system, partly due to a lack of centralised oversight of the collection, sorting and commodification processes.

Comparison to the Netherlands:

Since 2008, domestic plastic packaging waste is collected separately in the Netherlands. The collection of all types of plastic waste (valuable and less valuable streams) and a mixed stream as the sorting result both contribute to the system's low cost recovery rate.

€ What is the purpose of the intervention: maximising quality, stimuli designed to improve the quality of the sorting process

Greece uses financial stimuli to improve the quality of its sorting process. As a result, Greece achieves an average revenue of €206 per tonne of sorted domestic plastic packaging waste.

Comparison to the Netherlands,

The Dutch system has no or very few stimuli designed to improve the quality of the sorting process above the DKR specifications.

€ What is the purpose of the intervention: minimising costs

Germany is home to around fifty sorting facilities with a combined capacity of just over 2,500 kt. This means the average capacity of each sorting facility is around 50 kt. The optimal sorting capacity, in terms of costs, is around 50 kt. On average, Germany has therefore achieved economies of scale in regard to its sorting plants.

Comparison to the Netherlands:

The Netherlands has two sorting facilities with sorting capacities comparable to those of the German facilities.

€ What is the purpose of the intervention: maximising revenue

In Germany and Belgium, the commodification of the sorted domestic plastic packaging waste is centrally managed. In 2015, Belgium managed to achieve an average revenue of €391 per tonne. For Germany, only data on revenue after recycling is available, which amounted to €590 per tonne in 2015.

Comparison to the Netherlands:

In the Netherlands, municipalities are responsible for the commodification of the material. A municipality can decide whether to handle this themselves or outsource it to waste management organisations. On average, the revenue after sorting is negative in the Netherlands, which means it costs money to deliver the sorted material to recyclers.

Improbable

€ What is the purpose of the intervention: minimising costs & maximising quality, manual sorting

Manual sorting is an important technique in Greece and the Czech Republic, because the various small-scale sorting facilities do not process sufficient quantities of material to justify investments in automation. In many cases, there are no scale advantages. Furthermore, manual sorting is a viable alternative because these countries offer relatively low wages. According to the producer responsibility organisations in question, the manual sorting process results in sorted material of an extremely high quality.

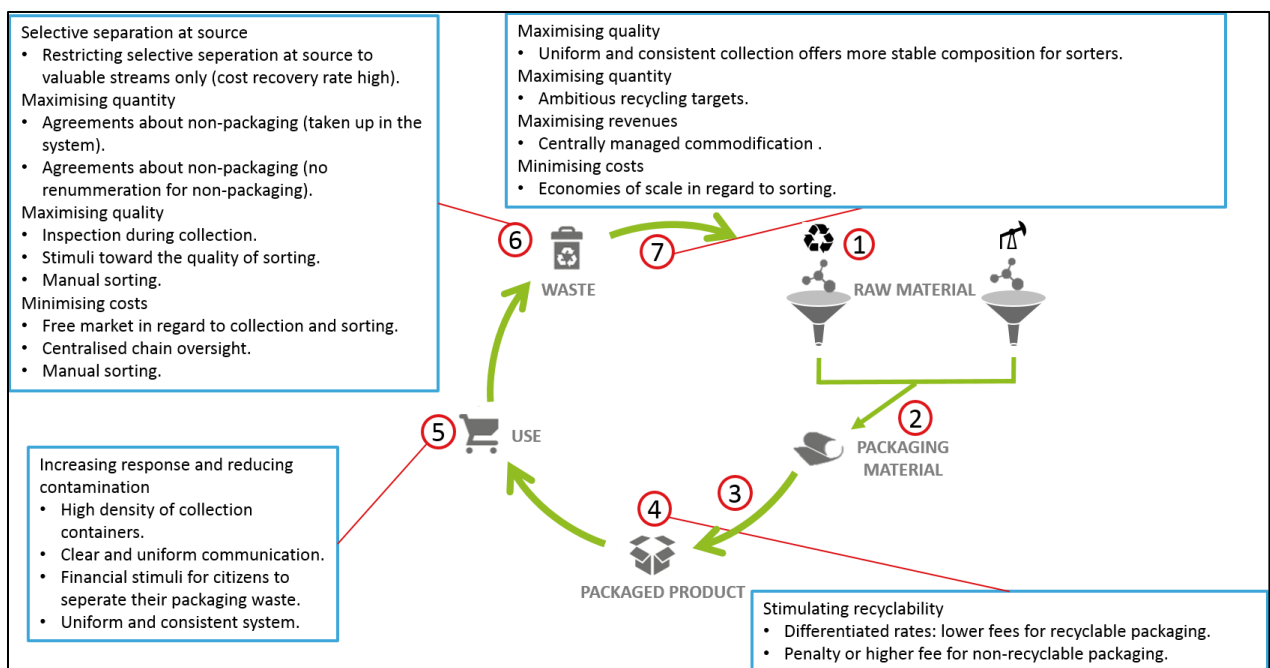
Comparison to the Netherlands:

In the Netherlands, the separately collected plastic packaging waste is mechanically sorted. Quality control is conducted manually. Because of high wages, the implementation of this intervention in the Netherlands is improbable.

Interventions placed in the chain

In the plastic chain project, seven dials have been identified that can be used to close the chain as much as possible. The figure below represents the specific interventions that can be used for each of these dials, based on the International Comparison.

The dials are labelled as follows; 1. Specifications recyclate comparable to virgin, 2. Optimising the ratio of virgin vs recyclate, 3. Creating a market for the recyclate, 4. Design-for-recycling, 5. The role of citizens, 6. Collection and sorting based on quality and 7. Innovation of processing techniques.



5 Conclusions

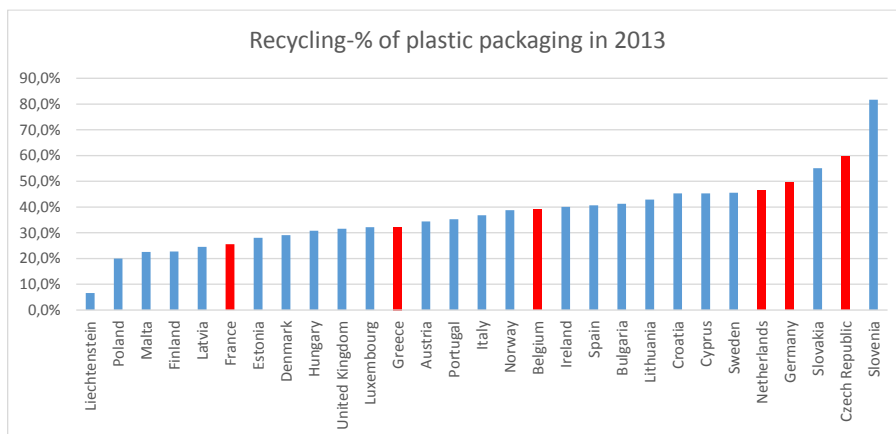
Based on the results presented and the underlying mechanisms the following conclusions can be made:

- Germany, together with the Netherlands are front runners in regard to the achieved recycling rates. Both Germany and the Netherlands have different forms of comprehensive collection systems in place. In an economic sense the Netherlands achieves the lowest cost recovery rate of the examined countries. This is due to the relatively high collection and sorting costs and the relatively low revenues from the sale of the sorted domestic plastic packaging waste.
- Longstanding uniform and consistent collection systems throughout the country combined with unified communication will lead to an optimum in response rate and offer a more stable composition of the collected material. This can be strengthened by financial stimuli towards citizens to sort their packaging waste better and active control on contaminants during collection.
- Mechanical biological waste treatment is hardly applied internationally. The Netherlands could play a front runner role in this field.
- The country reports of Germany and Belgium show that centralised chain oversight during collection, sorting and commodification of domestic plastic packaging waste result in lower costs and higher revenues.
- Stimulating a free market for the collection and sorting processes¹ through regular tenders. For several of the examined countries this has contributed to lower collection and sorting costs than in the Netherlands.
- Selective sorting at the source can result in a high cost recovery rate but limits the feasible recycling rate.
- Differentiated rates which promote improved recyclability of materials is being applied internationally.
- This study shows that the Czech Republic collects plastic packaging and plastic non-packaging materials together in one bin. The costs for the plastic non-packaging are not covered by the producer responsibility. The complexity of the stream will increase with this combination.

¹A prerequisite for stimulating free market for collection and sorting processes is that the concerning market has sufficient volumes available for sorting and/ or recycling.

6 Country reports approach and method

The International Comparison work package analyses three types of collection and recycling systems that are currently common in the EU. A comprehensive collection structure (as used in Germany and the Netherlands), a selective collection structure (as used in Belgium and France) and a collection structure that uses hand pickers to sort the waste material (as used in Greece and the Czech Republic). A separate nation report has been drawn up for each country except the Netherlands. These reports are attached to this document.



The figure on the right shows the recycling percentages for plastic packaging (from both households and businesses) achieved by all European countries in 2013. The recycling percentages of the countries for which a report has been drawn up are highlighted in red.

The various country reports are drawn up based on desk research and interviews with the (largest) producer responsibility organisations in the respective countries. In some cases, other organisations or persons were interviewed as well to acquire additional data and insights. Every country report has been presented for review to the organisations or interviewees in question.

For each country, the report describes how that country handles its producer responsibility and what the country's performance pertaining to the stream of domestic plastic packaging materials is. These performances have to do with the closing of the plastic packaging chain in terms of raw materials and in an economic sense. Lessons can be learned from these performances and the underlying mechanisms, which may possibly be applicable in the Netherlands in the form of interventions. The final product of this International Comparison is therefore the aforementioned list of interventions pertaining to the closing of the plastic chain in terms of raw materials and in an economic sense.

Attachment: Country reports

The reports on Belgium, France, Germany, Greece and the Czech Republic have been added as attachments.

Belgium

The country report has been evaluated by the relevant national organisations to eliminate factual inaccuracies.

Summary

- Since 1994, Belgium has been using a PMD system (Plastic, Metal and Drink cartons) for the selective collection of plastic flasks and bottles.
- In 2015, Belgium achieved a recycling percentage of 35.4% for plastic packaging materials from households and 55.5% for plastic packaging materials from businesses. Together, this amounted to a combined recycling percentage of 41.3%.
- In 2015, the PMD system achieved a recycling percentage of 29% of plastic packaging materials from households.
- Of the total amount of plastic bottles and flasks from households, 79% was collected through the PMD system. With this figure, Belgium appears to have reached the maximum recycling percentage it can achieve with the PMD system.
- In 2015, the revenue from this plastic stream from the PMD bags amounted to €25.8 million, while the costs (allocated by mass) were €33.1 million. This means the cost recovery rate was around 80%. The PMD system as a whole has a cost recovery rate of around 60%.
- In Belgium, a lot of people consume a lot of their water from bottles and the country does not offer a deposit-refund scheme. For that reason, a relatively high percentage (39%) of the stream of plastic packaging materials consists of plastic bottles and flasks.
- Should the PMD system be expanded to include other plastic packaging materials (as is the case in the Netherlands), this may result in an increase of the recycling percentage to 47% for plastic packaging materials from households and an increase of the costs of the PMD system to €100.2 million. Because the revenue is not expected to rise along with the recycling percentage and the costs, the system's cost recovery rate would decline significantly.

Introduction

In Belgium, European directive 94/62/EG was implemented by way of producer responsibility. Throughout Belgium, plastic packaging waste is collected from businesses and households. The national organisations Val-i-Pac (since 1997) and Fost Plus (since 1994), respectively, are responsible for the collection. Most of the material collected from households in the blue PMD bag consists of plastic bottles and flasks, while multiple types of plastic packaging materials are collected from businesses and consequently made available for recycling. Val-i-Pac and Fost Plus are inspected by the interregional packaging committee (Natuur en Milieu, 2016). Both organisations individually have to meet the national recycling target for plastic packaging materials of 30% (Wikiwaste target Belgium, 2016). In the Netherlands, the waste streams from households and businesses are combined and, together, must meet a recycling target of 45%.

Closing the plastic packaging chain in terms of raw materials

This chapter covers the stream of plastic packaging materials collected from households and businesses. The collection system that is used for most Belgian households is PMD (Plastic, Metal and Drink Cartons). This report will therefore primarily focus on this system when discussing the household stream. The following issues are discussed: the amount of material per stage in the chain, safeguarding the response, safeguarding the quality of the collected material and applications for the recycle. Finally, the amount of material that ends up as litter is discussed.

Material streams for each stage of the chain

Households

In 2015, 230 kilotonnes (kt) of plastic packaging materials was put on the market for households. Of this total, 39% (88.8 kt) consisted of plastic bottles and flasks. This stream is collected using the blue PMD bag. Furthermore, Belgians can also dispose of drink cartons (D) and metal packaging (M) by means of the blue PMD bags.

When sorting the materials from the blue PMD bags, fluid and processing losses account for a total loss of around 2%. In 2015, 159.6 kt (14.24 kg/citizen/year * 11.21 million citizens) of PMD materials was collected and then sorted. Accounting for the fluid and processing losses, this results in 156.5 kt (98.05%*159.6 kt) of sorted PMD materials. (Alen, 2017). In addition to the collection of plastic bottles and flasks by means of the PMD bags, other plastic packaging materials are also collected in container parks (waste collection facilities) and from the pink domestic waste bags. (Gendebien, 2016).

In 2015, the average content of a PMD bag, after sorting, was as follows: 42.5% plastic bottles and flasks, 27.2% metal packaging, 10.8% beverage cartons, 17% residue and 2.5% blue PMD bags. Based on the percentage of plastic bottles and flasks, an estimated 66.5 kt (42.5%*156.5 kt) of plastic bottles and flasks was sorted. During the sorting process, errors are sometimes made and undesirable bottles and flasks (e.g. opaque PET bottles) are removed. When taking these factors into account, the actual amount of collected plastic bottles and flasks is higher. According to (Gendebien, 2016), these losses amount to around 5%, bringing the total amount of collected plastic bottles and flasks to around 69.8 kt (105%*66.5 kt)

In 2015, 65.9 kt of plastic bottles and flasks was made available for recycling. A small percentage of the sorted material is kept in stock by the sorters (66.5 versus 65.9 kt). This means that the PMD system achieves a recycling rate of 29% (65.9/230 kt) of all plastic packaging materials put on the market, while 74% of all plastic bottles and flasks put on the market (65.9/88.8 kt) is being recycled. (Fost Plus key figures, 2016). Around 15.4 kt of the plastic packaging materials collected at container parks and via the pink domestic waste bag is made available for recycling. This brings the total recycling percentage in Belgium to 35.4% ((15.4 kt + 65.9 kt)/230 kt). (Fost Plus key figures, 2016) (Gendebien, 2016).

The following issues stand out:

1. The recycling percentage of 35.4% for domestic plastic packaging waste means that the national target – a recycling percentage of 30% for all domestic plastic packaging materials – was achieved.
2. With the PMD system, 29% of the plastic packaging waste (plastic bottles and flasks) from households is being recycled. The PMD collection alone was not sufficient to achieve the national target.
3. In 2015, 6 kg of plastic packaging materials was recycled per citizen with the PMD system $((65.9 \times 1000) / 11.21 \text{ million citizens})$.
4. In 2015, 74% of the plastic bottles and flasks put on the market in Belgium was recycled with the PMD system.
5. The maximum recycling percentage that can be achieved for the domestic waste stream – using the current system of only recycling bottles and flasks – is 39%. Setting a higher target means other plastic streams have to be collected as well.
6. The quality of the existing PMD collection is such that 94% (65.9/69.8) of the collected plastic bottles and flasks is made available for recycling. This means the sorting loss of around 6% is virtually negligible.

The overview below shows the key figures pertaining to the PMD collection with the blue bags, from putting plastic packaging materials on the market up to the recycling of PMD packaging materials from households (Fost Plus key figures, 2016).

On the market	Collection	Made available for recycling
<ul style="list-style-type: none"> • In 2015, 230 kt of plastic packaging materials was put on the market. • Of this amount, 88.7 kt consisted of plastic bottles and flasks. • 39% of all plastic packaging materials on the market therefore consists of plastic bottles and flasks (88.7/230 kt). 	<ul style="list-style-type: none"> • In 2015, 14.24 kg/citizen/year of PMD material was collected. • With Belgium's 11.21 million citizens (the number used by Fost Plus), this amounts to a total of 159.6 kt of collected PMD material. • On average, 42.5% of the sorted PMD material consists of plastic bottles and flasks. • Accounting for fluid, processing and sorting losses, this amounts to around 69.8 kt of collected plastic bottles and flasks. • The sorted plastic bottles and flasks consist of 78% PET and 22% HDPE. • Of all plastic bottles and flasks on the market, 79% is collected (69.8/88.7 kt). 	<ul style="list-style-type: none"> • In 2015, 65.9 kt of plastic bottles and flasks was made available for recycling. • This results in a recycling percentage of 29% (65.9/230 kt) for plastic packaging materials from households. • In total, 74% (65.9/88.7 kt) of all plastic bottles and flasks put on the market is made available for recycling.

Businesses

In 2015, 95 kt of plastic packaging materials was put on the market for businesses. In total, 69% (65.8/95 kt) of this amount was collected. After sorting, 52.8 kt of plastic packaging material was made available for recycling. This means 56% of all plastic packaging material put on the market was recycled (52.8/95 kt). (Gemmeke, 2016)

The following issues stand out:

1. The recycling percentage of 56% of plastic packaging waste means the national target – a recycling percentage of 30% of plastic packaging materials from businesses – was achieved by a wide margin.
2. The quality of the existing collection is such that 80% (52.8/65.8 kt) of the collected plastic packaging materials was made available for recycling. Sorting losses amount to 20%.

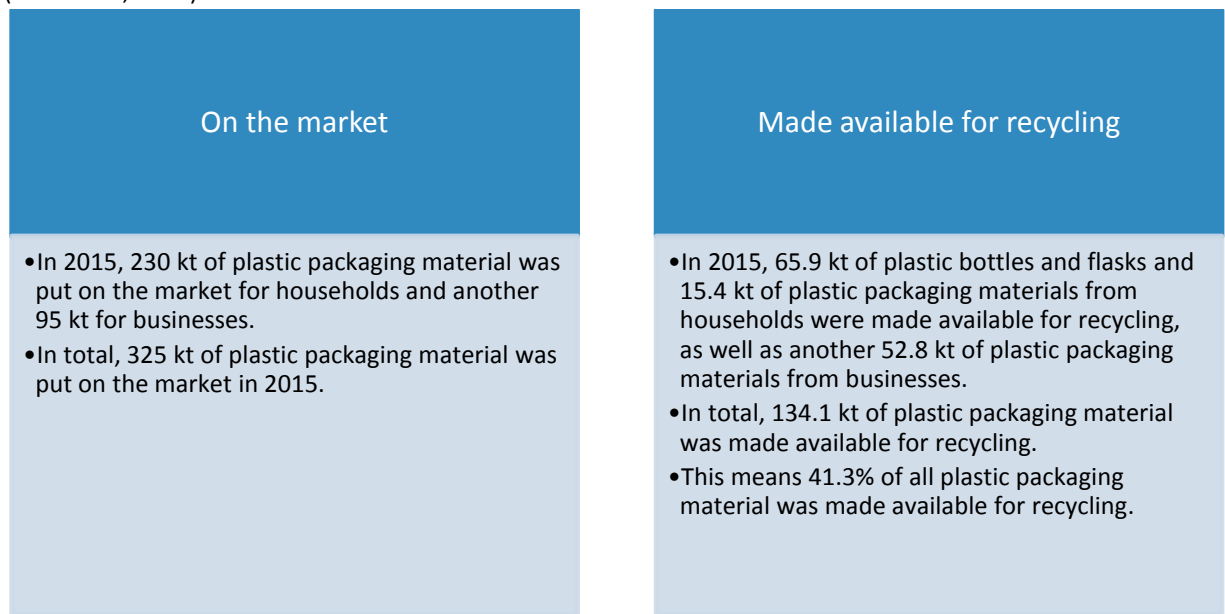
Households and businesses taken together

In 2015, a total of 325 kt of plastic packaging materials was put on the market. After collection and sorting, 134.1 kt of plastic packaging materials was made available for recycling. Belgium therefore manages to recycle 41.3% (134,1/325 kt) of all plastic packaging materials put on the market.

The following issues stand out:

1. In total, 29% (95/325 kt) of the plastic packaging materials put on the market ends up in the waste stream from businesses, while the remaining 71% (230/325 kt) forms the waste stream from households.
2. The domestic stream makes up the largest share of the total amount of plastic packaging material made available for recycling with 61% ((65.9 kt + 15.4 kt)/134.1 kt).
3. In 2015, a total of 12 kg of plastic packaging material was recycled per citizen ((134.1*1000)/11.21 million citizens)).

The overview below shows the key figures, from putting plastic packaging materials on the market up to the recycling of these plastic packaging materials from households and businesses (Fost Plus key figures, 2016) (Gemmeke, 2016).



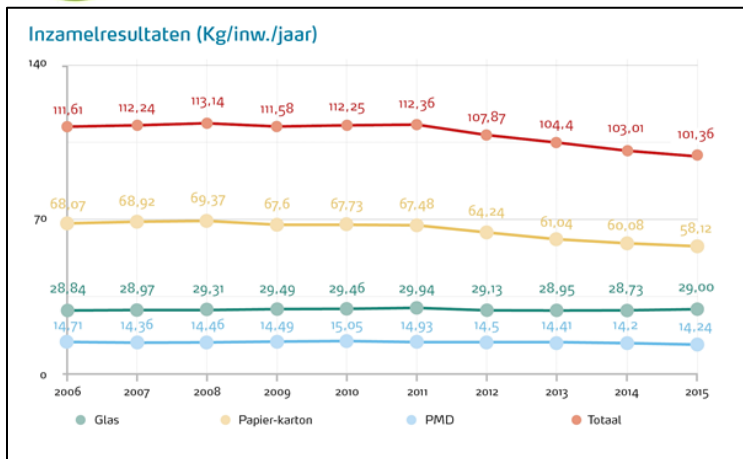
Safeguarding the response

Households

Belgium has various forms of pay-as-you-throw to incentivise citizens to separate their waste (with the exception of Brussels). This system charges citizens for every bag (€1-€2) of domestic waste they put on the street for collection. (Natuur en Milieu, 2016).

The costs of the streams for which producer responsibility applies are covered entirely by producer responsibility organisations. (Natuur en Milieu, 2016).

Since 1994, plastic bottles and flasks are collected in the blue PMD bags throughout Belgium (Fost Plus, 2016).



The total collected amount increased annually, before stabilising in 2003/2004. The figure on the left shows that the total collected amount for PMD (bottom-most line) has remained practically unchanged over the past nine years (Fost Plus key figures, 2016).

This demonstrates that a consistent and uniform approach over the course of many years results in many citizens separating their waste. In addition to the high response rate, the collected

material (bottles and flasks) is of a relatively high quality as well.

Businesses

Businesses that use materials (particularly the so-called unpackers) are paid a fee by Val-i-Pac for every tonne of separated and collected plastic packaging material: the so-called recycling and container premiums.

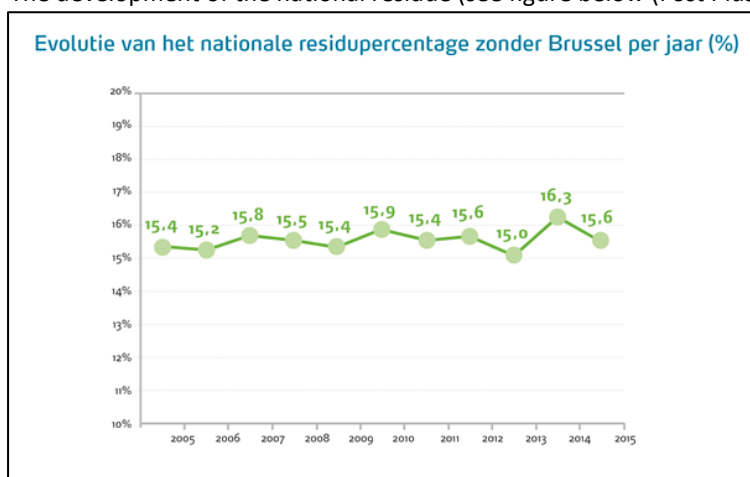
How is the quality of the collected material safeguarded?

Households

In order to increase and safeguard the quality of the collected material, the following measures have been implemented:

1. Proper sorting within households; the collectors inspect the contents of the bags. Because the PMD bags are transparent, it is fairly easy for the collector to identify the contents of the bag. If the collector determines that the bag contains too many contaminants, a red warning sticker in the shape of a hand is put on the bag and it is not collected. The red sticker implores the person who dropped off the bag to remove the contaminants and then offer the bag up for collection once more. This method is used to point out sorting errors to citizens. Several municipalities are conducting trials to further increase their citizens' awareness. (Natuur en Milieu, 2016) (Fost Plus general, 2016).
2. Uniformity; Belgian municipalities are united in municipal associations for the collection of waste (Natuur en Milieu, 2016). Nearly all of the 34 municipal associations use the same system, which ensures the total amount of collected material is of a similar nature and has a high level of quality. Fost Plus coordinates this system. (Natuur en Milieu, 2016).
3. Financial incentive; the municipal associations receive a financial bonus if they manage to keep the residue percentage below 20%. (Natuur en Milieu, 2016).

The development of the national residue (see figure below (Fost Plus key figures, 2016)) demonstrates that the



residue percentage fluctuates between 15% and 16%. This suggests that the aforementioned measures built into the system are effective and indeed result in a low residue percentage.

Businesses

Concerning the waste stream from businesses, market forces are a major factor in safeguarding the quality of the collected material. A collector will pay less or charge more for the collection of poor-quality plastic packaging waste (poorly sorted or contaminated). Vice versa, a collector will pay more or charge less for the collection of properly sorted plastic packaging waste. If a discarder offers plastic packaging waste that cannot be recycled, Val-i-Pac will not pay them a recycling premium. (Gemmeke, 2016).

Applications for the recycle

Households

In Belgium, domestic plastic packaging waste consists of two main streams, namely PET (PolyEthylene Terephthalate) and HDPE (High-Density PolyEthylene). After commodification, these materials are used for (Fost Plus general, 2016):

- PET; new bottles, plastic containers for fruits and vegetables, textile fibres, carpets and stuffing for mattresses, coats and sleeping bags.
- HDPE; storage bins, baskets, chests and racks, drinking bottles, pipelines, cable ducts and tubes, pallets.

This overview shows that PET is used for packaging materials in the “Food and Care” sector and for non-packaging materials. Recycled HDPE is exclusively used for non-packaging materials. It is not known whether the materials are recycled again at the end of their second lifecycle.

Businesses

Plastic packaging waste from businesses consists of 84% Polyethylene (PE) films and is largely sold outside the EU. (Gemmeke, 2016).

Unmanaged waste streams

In Flanders, 25.3 kt of waste was deposited in public trash cans or in the form of litter in 2013. The percentage of litter was 69% or 17.5 kt. (KplusV, 2013).

In Belgium, an annual amount of 2.7 kg of waste per citizen is deposited in trash cans or in the form of litter. (KplusV, 2013). Considering Belgium’s population of 11.2 million citizens in 2013 (Eurostat, per 01-01-2013), this amounts to a total of 30.1 kt for the whole of Belgium (2.7 kg/citizen/year*population) and a total of 20.8 kt of litter (69%).

Estimates pertaining to the percentage of PMD packaging materials (mainly beverage packaging) in the litter range from weight percentages of 19-33%. (OVAM, 2015).

Using the weight percentage of 19%, 4 kt of the total amount of litter consists of PMD packaging materials ($19\% \cdot 20.8$ kt), while the weight percentage of 33% raises this figure to 6.9 kt of PMD packaging materials in the total amount of litter ($33\% \cdot 20.8$ kt).

In 2015, 186.4 kt of PMD packaging materials was put on the market in Belgium. (Fost Plus key figures, 2016). Assuming that the total amount of litter in 2015 did not differ significantly compared to 2013, this means that (for a weight percentage of 19%), 2.1% ($4/186.4$ kt) of all PMD packaging materials on the market ends up as litter². For a weight percentage of 33%, that figure increases to 3.7% ($6.9/186.4$ kt).

These percentages are comparable to those seen in the Netherlands (see key figures outlined in the volumes and packaging chain work package).

² Belgium is currently exploring the possibility of implementing a deposit-refund system for disposable beverage packaging in order to tackle the litter problem.

Closing the plastic packaging chain in an economic sense

This chapter covers various financial aspects of the Belgian PMD system. The costs and their safeguarding, the revenue and the cost recovery rate are explained. Finally, the possible consequences for the costs and the recycling percentage if Belgium were to collect more types of plastic packaging waste are considered.

No key figures are available regarding the plastic packaging waste stream from businesses. The collection and processing of this stream is left to the market. Val-i-Pac does pay a recycling and container premium to the discarder on behalf of the businesses that use packaging materials, under the condition that the discarder properly sorts their packaging waste. The recycling and container premium is €35/tonne, which is enough to cover the average processing costs of the packaging waste.

Costs of the system

Households

In 2015, the costs of collecting and sorting the PMD material amounted to €392.40 per tonne. Multiplying this amount by the total amount of collected PMD material (around 159.6 kt) brings the total costs of collecting and sorting the PMD material to €62.6 million.

The cost overview below contains the key figures pertaining to the collection, sorting and recycling of PMD packaging materials from households in 2015 (Fost Plus key figures, 2016).

Costs

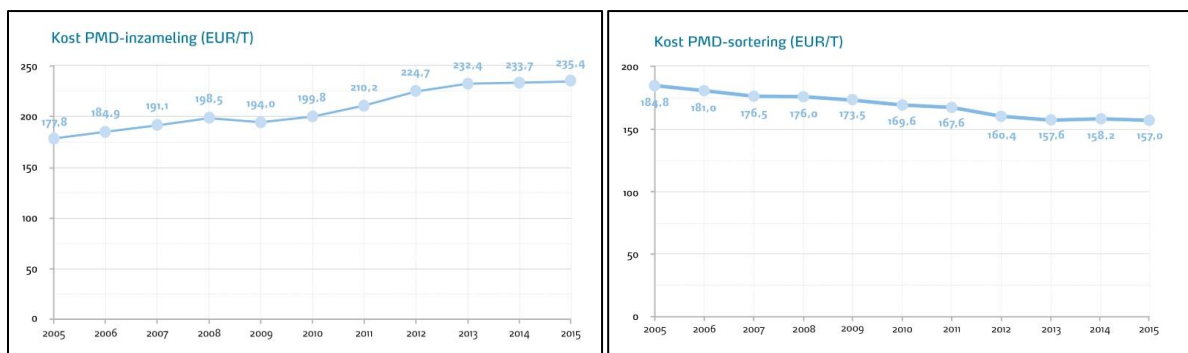
PMD

- In 2015, the total costs of collecting and sorting the PMD materials amounted to €392.4/tonne (€235.4 + €157).
- In 2015, the total cost of collecting the PMD materials was therefore €62.6 million (€392.4/tonne*159.6 kt).

Safeguarding costs

Because of its aforementioned coordinating role, Fost Plus is also involved in the tenders of the municipal associations. According to Natuur en Milieu (2016), this allows the organisation to limit the costs of collection and sorting.

The figure below (left) shows that the collection costs have only increased by **32%** in ten years' time ((€235.40/tonne in 2015 – €177.80/tonne in 2005)/€177.80/tonne). The figure on the right shows that the sorting costs have even gone down by **15%** ((€157/tonne in 2015 – €184.80/tonne in 2005)/€184.80/tonne). The total costs (collection plus sorting) have therefore only increased by **8%** in ten years' time ((€392.40/tonne in 2015 – €362.60/tonne in 2005) – €362.60/tonne).



Revenue from the system

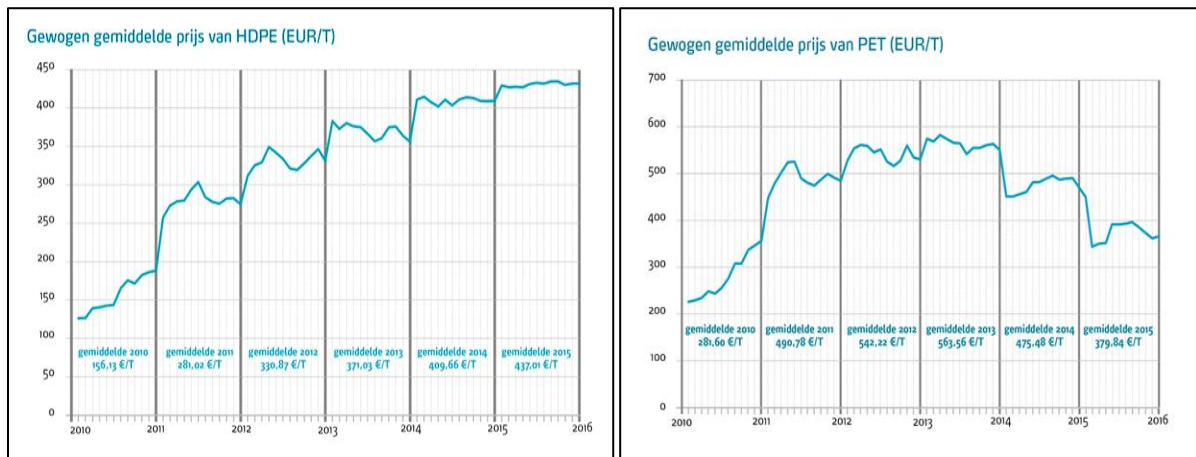
In 2015, the various PMD packaging materials yielded a total of €36.8 million for Fost Plus. The stream of plastic bottles and flasks generated €25.8 million. The other materials in the PMD stream brought in the remaining €10.9 million. Steel, aluminium and beverage cartons brought in €4.3 million, €6.2 million and €0.4 million, respectively (Fost Plus key figures, 2016).

The overview below shows the key figures pertaining to the revenue generated by the collection, sorting and recycling of PMD packaging materials in 2015 (Fost Plus key figures, 2016).

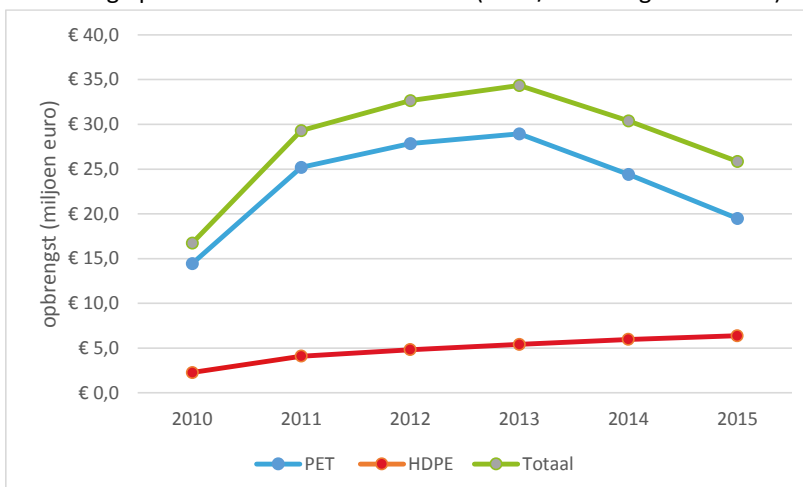
Revenue

- In 2015, the yield of the PMD packaging materials was €36.8 million in total.
- Of this total, €25.8 million was generated by the stream of plastic bottles and flasks.
 - PET resulted in €19.6 million
 - HDPE resulted in €6.23 million
- In 2015, the average revenue per tonne of plastic bottles and flasks was €391 (€25.8 million/65.9 kt).

The figures below show the price fluctuations of HDPE and PET over the years (Fost Plus key figures, 2016).



Because 78% of the plastic packaging waste collected through PMD consists of PET, the revenue of the plastic stream is susceptible to price fluctuations on the PET market. This is demonstrated by the difference between the average price for PET in 2014 and 2015 (€100/tonne higher in 2014).



To get an idea of the effect these price fluctuations have on annual revenue, the amount of recycled PET and HDPE in 2015 has been multiplied by the aforementioned prices.

The system's cost recovery rate

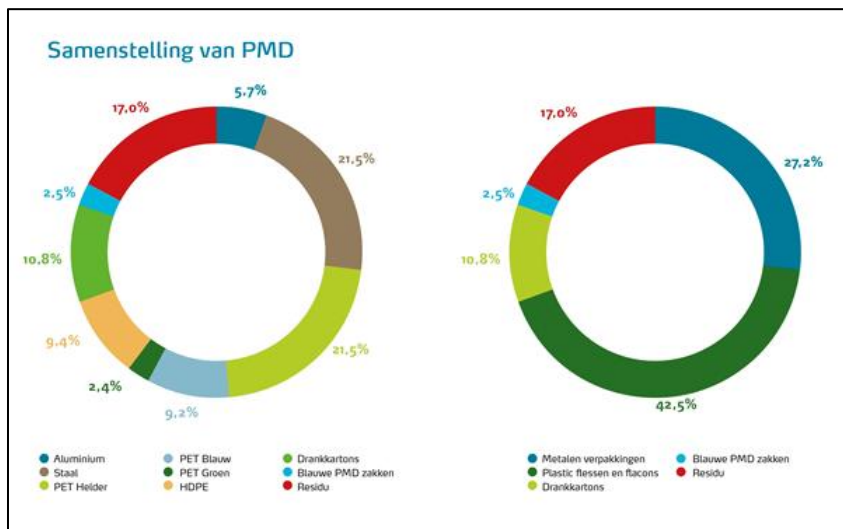
A measure for the extent to which the chain is closed in an economic sense is the cost recovery rate. This is calculated by dividing the system's revenue by the costs. Based on the aforementioned figures, the cost recovery rate of the PMD system can only be examined from the point of collection up to the recycler's front gate. For this part of the chain, the revenue from the PMD system set against the costs of the PMD results in a cost recovery rate of **58.7%** (€36.7/€62.6 million) in 2015.

What follows is a detailed calculation to determine the cost recovery rate of the plastic packaging stream within the PMD stream.

To allocate the costs of PMD based on mass, the various materials must each carry part of the cost of the non-packaging materials. The materials' weight percentages are used for this calculation.

The various materials are: plastic bottles and flasks, metals and beverage cartons. In addition to those materials, the PMD bags also contain non-packaging materials, namely the residue (17%) and the blue bags themselves (2.5%). This makes up 19.5% of the total composition of the PMD bags. These two streams do not generate any revenue, yet they do contribute to the total costs of the system. The costs of these two streams are allocated to plastic bottles and flasks in proportion to weight.

As shown in the figure below, the share of plastic bottles and flasks is 42.5% of the 80.5% PMD (the remaining 19.5% consists of residue and the PMD bags themselves). We therefore allocate 10.3% $((42.5\%/80.5\%)*19.5\%)$ of the residue and the PMD bags to plastic bottles and flasks, which means plastic bottles and flasks carry 52.8% $(42.5\% + 10.3\%)$ of the costs.



This brings the costs of plastic bottles and flasks to €33.1 million in 2015 $(52.8\% * €62.6 \text{ million})$.

If the revenue from the plastics alone (PET and HDPE) is set against the aforementioned costs, the resulting cost recovery rate is **78.1%** (€25.8/€33.1 million).

Consequences of expanding the plastic stream within PMD

In 2015, 74% of all plastic bottles and flasks put on the market in Belgium was recycled. This figure demonstrates that the existing system is approaching its maximum feasible recycling percentage. In light of the upcoming increased European recycling targets for plastic packaging materials, Belgium will have to start collecting other plastic packaging streams as well in order to meet those targets.

To research the effects of this measure on the costs of the system, Fost Plus conducted a study in 2012 into the possible consequences of expanding the system to include the collection of other plastic streams (Fost Plus, 2012). Four different scenarios were considered. One of these scenarios revealed that, if Belgium were to collect the same plastic streams as the Netherlands (soft and hard plastics, from households and at container parks), this would result in a 60% increase of the costs.

Based on the costs of the PMD system in 2015, this would result in a total cost of €100.2 million ($(60\% * €62.6 \text{ million}) + €62.6 \text{ million}$). If these costs are then set against the revenue, the cost recovery rate would drop from 58.7% to 37% ($€36.7 / €100.2 \text{ million}$). This calculation assumes that the revenue generated by the new streams is negligible.

If Belgium were to collect the same plastic streams as the Netherlands, the recycling percentage in Belgium might increase by 32% (Fost Plus, 2012). Based on the recycling percentage of 2015, this might bring the recycling percentage for plastic packaging materials in Belgium up to 47% ($(32\% * 35.4\%) + 35.4\%$). The total amount of plastic packaging material made available for recycling can then increase from 81.3 kt to 107.4 kt ($47\% * 230 \text{ kt}$).

As mentioned, four possible scenarios for expansion of the collection system were considered. Belgian citizens preferred scenario 1, which involves collecting the same plastic streams as the Netherlands (hard and soft plastics, from households and at container parks) (Fost Plus, 2012).



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France

The country report has been presented for evaluation to the relevant national organisations to eliminate any factual inaccuracies.

Summary

- France does not have a separate recycling objective for plastic packaging materials; instead, it has a general objective of 75% of all domestic packaging waste. In 2014, 66.8% of all domestic packaging waste was recycled.
- There is no objective for plastic packaging waste from businesses. This country report only pertains to plastic packaging waste from private households, because data has been made available about this topic by Eco-Emballages. At the moment, no separate data on plastic packaging waste from businesses in France is available.
- Since 1992, France has been using a yellow bin for the selective collection of plastic bottles and flasks and the collection of all beverage cartons, metal packaging and paper and cardboard packaging from households.
- In 2014, France achieved a recycling percentage of 22.5%; less than a quarter of all plastic packaging materials that were put on the market for households was eventually recycled.
- Of all plastic bottles and flasks that were put on the market for households, 54% was recycled. France therefore has room to increase the recycling percentage it achieves with the yellow bin system.
- In 2014, revenue from the plastic waste stream from yellow bins amounted to approx. €63.7 million and the cost of collecting and sorting the waste stream was approx. €254 million (allocated by mass). A cost recovery rate of approx. 25% was achieved with the collection of plastic bottles and flasks from households. The entire yellow bin system offers a cost recovery rate of approx. 19%.
- The French people consume a lot of water from bottles and the country does not have a deposit system in place. That is why the share of plastic bottles and flasks within the total plastic packaging waste stream is relatively high at 42%.

Introduction

In France, the European guideline 94/62/EG was implemented through producer responsibility. The plastic packaging waste is collected from households throughout France. This process has been in the hands of the national organisation Eco-Emballages since 1992. Eco-Emballages is inspected by the ADEME (Lemoux, 2016). Eco-Emballages has to meet the national objective of 75% recycling of domestic packaging materials (Wikiwaste objective France, 2016). At the moment, France does not have a separate objective for plastic packaging waste.

Closing the plastic packaging chain in terms of raw materials

This chapter covers the stream of domestic plastic packaging in the French yellow bins (TRI). The following issues are discussed: the amount of material per stage in the chain, safeguarding the response, safeguarding the quality of the collected material and applications for the recycle. Finally, the amount of material that ends up as litter is discussed.

Material streams per stage of the chain

In 2014, 1,105 kilotonnes (kt) of plastic packaging materials was put on the market for households. Of this amount, 42% consisted of plastic bottles and flasks (463 kt). This stream is collected with the yellow bins. Furthermore, citizens can also deposit beverage cartons, metal packaging and paper and cardboard packaging in the yellow bins.

After sorting 249 kt of plastic bottles and flasks was offered for recycling in 2014.

During the sorting process, errors are sometimes made and undesirable bottles and flasks (e.g. opaque PET bottles) are removed. When taking these factors into account, the actual amount of collected plastic bottles and flasks is higher. According to (Adeline, 2017), these losses amount to around 5%, bringing the total amount of collected plastic bottles and flasks to around 262.1 kt ($(249 \text{ kt}/(1-5\%))$).

In 2014 22.5% (249/1,105) of all plastic packaging materials put on the market for households was recycled. Of all plastic bottles and flasks put on the market for households, 54% is recycled (249/463). (Eco-Emballages and Adelphe, 2015).

The following issues stand out:

1. Using the current selective system – bottles and flasks – the maximum achievable recycling percentage lies below 42%. If higher goals are set regarding plastic packaging materials from households, it will be necessary to also collect other plastic waste streams.
2. Given the fact that 22.5% of plastic packaging materials is recycled, the European objective of 22.5% recycling of domestic plastic packaging is achieved (France does not have its own national objective regarding plastic packaging materials).
3. An average of 3.8 kilogrammes of plastic packaging was recycled per inhabitant with the yellow bin system in 2014 (249 kt/66 million inhabitants).
4. 54% of all plastic bottles and flasks put on the market for households in France was recycled in 2014.
5. The quality of the current collection and sorting process is such that approx. 95% of the material being collected is actually made available for recycling. The estimated sorting loss is 5%.

The overview below shows the key figures, ranging from the material put on the market for households up to the recycling of yellow bin packaging materials from households (Eco-Emballages and Adelphe, 2015) (Lemoux, 2016).

On the market	Collection	Made available for recycling
<ul style="list-style-type: none"> • In 2014, 1,105 kt of plastic packaging was put on the market for households. • Of this total, 463 kt consists of plastic bottles and flasks. • 42% of all plastic packaging materials on the market therefore consists of plastic bottles and flasks (463/1,105kt). 	<ul style="list-style-type: none"> • On average (per Adeline, 2017), 5% of the plastic bottles and flasks is lost during the sorting process. • The total amount of collected plastic packaging is therefore approx. 262.1 kt (249 kt*105%). • The collected plastic packaging consists of 71% PET and 29% HDPE and PP. • Of all plastic bottles and flasks put on the market for households, 57% is collected (262.1/463 kton). 	<ul style="list-style-type: none"> • In 2014, 249 kt of plastic bottles and flasks were offered for recycling. • This means a 22.5% recycling rate is achieved for plastic packaging materials from households (249/1,105 kt). • Of all plastic bottles and flasks on the market, 54% is offered for recycling (249/463 kt).

Safeguarding the response

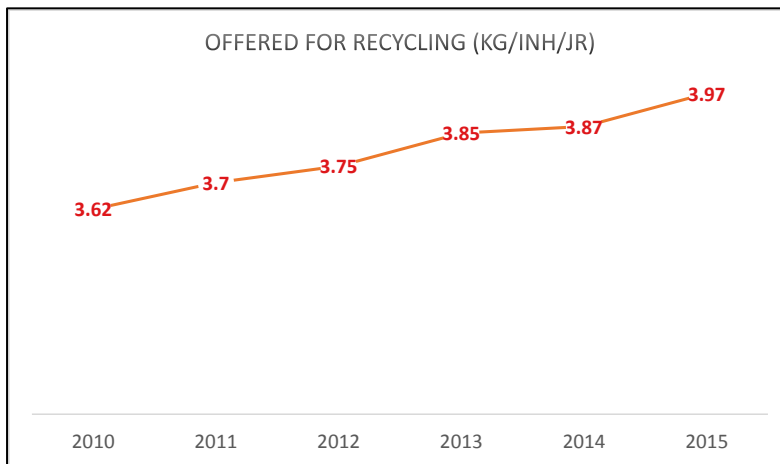
France does not have a deposit system in place. There are some local initiatives, but a system with national coverage was deemed unfeasible/undesirable for logistical and environmental reasons (excessive transport requirements) (Lemoux, 2016).

Several French municipalities have introduced a Diftar system. The most recent figures date back to 2013, when 5.4 million citizens (approx. 9% of the French population) used this system. However, France recently adopted a law which states that every municipality must introduce a Diftar system. It is as of yet unclear when this law will enter into force, exactly.

Furthermore, there is a considerable financial incentive for municipalities to collect packaging materials. In France, 80% of the net cost (gross cost minus material revenue) of the streams for which producer responsibility applies must be covered by the producers themselves, these costs are necessary to attain the overall recycling rate of 75%. The remaining 20% is to be paid by municipalities. This regulation was introduced because Eco-Emballages (on behalf of businesses that use packaging materials) is not in control of the entire process and therefore does not wish to carry all costs.

The total costs of the yellow bin system amounted to €1,031 million in 2014. After deduction of material revenue (€218 million), the net costs were €812 million. Eco-Emballages (on behalf of businesses that use packaging materials) paid €608 million; municipalities paid the remaining €204 million (€812-€608). In 2014, Eco-Emballages therefore paid 75% of the net costs of the collecting and sorting process that is part of the

yellow bin system. The reimbursement per tonne of plastic bottles and flasks offered for recycling is €600/tonne. This amount remains unchanged for a six-year period (2011-2016). (Lemoux, 2016) (Eco-Emballages history, 2016).



Since 1992, plastic bottles and flasks have been collected in yellow bins throughout France (Eco-Emballages history, 2016). Despite the fact that the collection process has been the same for years, the diagram shows that the response is not flattening out.

In 2010, 228 kt of material was offered for recycling. In 2015, this number was 13% higher with 257 kt. (Eco-Emballages, 2016).

Kg/inhabitant/year based on kilotonnes offered for recycling per year (Eco-Emballages, 2016) divided by the number of inhabitants in that same year (INSEE, 2016).

How is the quality of the collected material safeguarded?

In order to raise the quality of the collected material to a high level and then maintain that level, the following safeguards have been implemented (Eco-Emballages and Adelphe, 2014) (Lemoux, 2016):

1. The bottles and flasks must be sorted in accordance with strict quality requirements (98% purity).
2. Recyclers oversee compliance with this requirement and negotiate discounts from sorters if the purity is insufficient.
3. Recyclers report the adjusted amounts (that do meet the standards) to Eco-Emballages, which pays the reimbursement based on these adjusted amounts.
4. Eco-Emballages also conducts its own inspections.

As part of its packaging duties regulation, Eco-Emballages employs a bonus/malus system. Producers and importers who use fewer materials in their packaging, use packaging that is easier to recycle or make the packaging lighter are given a discount on their declaration. This also applies to producers and importers who add a disposal guideline to their packaging.

Since 2012, producers and importers who put bottles and/or flasks on the market that disrupt the recycling process or which cannot be recycled are “penalized” with higher fees and therefore a higher declaration. Plastic packaging which are not included in the selective collection are not punished with a malus, but instead encouraged with bonuses. (Lemoux, 2016) (Natuur en Milieu, 2016).

By “stacking” bonuses, a producer can get a discount of up to 24% on their annual declaration. (Eco-Emballages and Adelphe, 2015). The differentiation is explained in more detail in the table below.

Data on the effects of the bonus/malus system on producers’ policies is not available. Eco-Emballages does believe, however, that the system contributes to the process of increasing the sustainability of the packaging materials used by businesses. (Lemoux, 2016). This means that the bonus/malus system contributes to the development of lighter packaging materials that are easier to recycle and contain clear disposal guidelines for civilians.



<p>MALUS 1 Packaging that disrupts recycling process.</p> <p>+50% green dot fee</p>	<p>MALUS 2 Packaging that can not be recovered or recycled.</p> <p>+100% green dot fee</p>	<p>BONUS 1 Adding a disposal guideline.</p> <p>8% discount on annual declaration</p>	<p>BONUS 2 Reduction in weight or easier to recycle.</p> <p>8% discount on annual declaration</p>
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Applications for the recycle

The domestic plastic packaging waste stream in France consists of two main streams, namely PET (PolyEthylene Terephthalate) and HDPE (High-Density PolyEthylene). After commodification, these are distributed and applied in a wide variety of ways. There are conscious efforts to service various markets in order to avoid vulnerability to market changes. At the moment, there is increased demand for rPET, because bottlers want to include recycle in their products. This is likely a result of the CSR obligations that various businesses entered into and communicated in their annual reports or via their websites. (Lemoux, 2016).

Unmanaged waste streams

In 2014, 88 kt of waste ended up as litter in France (Vacances Propres, 2015). Estimates regarding what share of this total amount of litter consists of packaging materials are not available and not known by the national organisation (Vacances Propres) that is responsible for the theme of litter (Carpentier, 2016).

Closing the plastic packaging chain in an economic sense

This chapter covers various financial aspects of the French yellow bin system. The costs and their safeguarding, the revenue and its safeguarding and the cost recovery rate are explained. Finally, the expansion of the yellow bin system is discussed.

Costs of the system

In 2014, the cost of collecting and sorting yellow bin materials amounted to €1,031 million (Eco-Emballages and Adelphe, 2015). In 2014, 249 kt of plastic bottles and flasks, 615 kt of paper and cardboard, 107 kt of metal and 40 kt of beverage cartons were offered for recycling (1,011 kt in total). (Eco-Emballages en Adelphe, 2015). When sorting the material collected in the yellow bins, an estimated 10 to 20% of the material is lost (this concerns residue, non-packaging materials and sorting losses) (Adeline, 2017). Employing a material loss percentage of 15%, this means that an estimated total of 1,189 kt (1,011 kt/85%) of yellow bin materials was collected and sorted in 2014. This brings the cost per tonne of collected and sorted yellow bin material to an estimated €867/tonne (1,031 million/1,189 kt).

Safeguarding costs

Municipalities are responsible for the collection of the various waste streams and they are also owners of the collected material. There is no system of centralised or national supervision on cost efficiency.

Revenue from the system

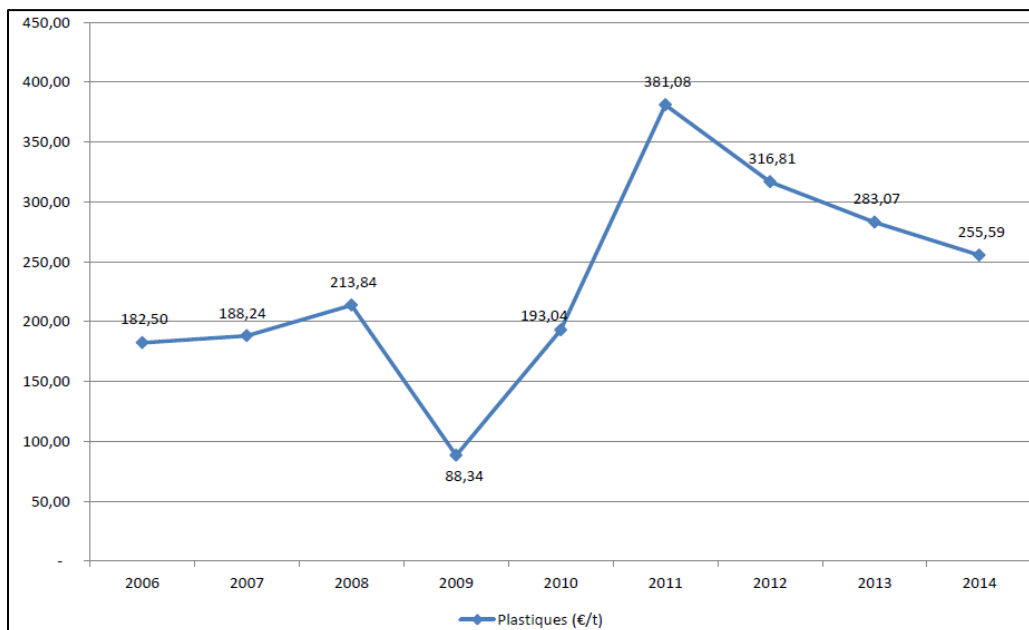
In 2014, the various yellow bin materials yielded €194 million, while the four-year average is €218 million. The stream of plastic bottles and flasks generates roughly €63.7 million in revenue (€256/tonne). (Eco-Emballages and Adelphe, 2015).

The overview below shows the key figures pertaining to the revenue generated by the collection, sorting and recycling of yellow bin packaging materials in 2014 (Eco-Emballages and Adelphe, 2015).

Revenue

- In 2014, the yield of the yellow bin materials was €194 million in total.
- Of this total, approx. €63.7 million was generated by the stream of plastic bottles and flasks (€256/tonne * 249 kt).
 - The average revenue per tonne was €256/tonne in 2014.
 - 249 kt of plastic bottles and flasks was offered for recycling.

The figure below shows the price fluctuations of the average revenue (per tonne of plastic bottles and flasks offered for recycling) over time (Eco-Emballages and Adelphe, 2016).



Safeguarding revenue

The separately collected and sorted domestic packaging waste is marketed by the municipalities themselves in France. Municipalities have a choice between roughly two different contract forms for each type of packaging material, namely:

- Option 1 “Filières.” A nationally defined price is offered for every tonne of sorted packaging material (which meets the quality requirements in terms of its composition). This price is set by the industry every three months. A “Filières” contract has a three-year duration. This contract form offers municipalities assurances in terms of the sale and revenue of their material and they do not have to go through the trouble of selling it themselves. Roughly 45% of the French municipalities choose this option.
- Option 2 “Federations” and option 3 “Individual.” For these contract forms, municipalities sign individual contracts with waste processors or recyclers. This option offers potentially higher revenue for the material, but compliance with the quality requirements is monitored more strictly. Contracts may be terminated at any time. Roughly 55% of the French municipalities choose this option.

In all cases, the sorted packaging material must meet the quality requirements. Regardless of what contract a municipality chooses, it is entitled to the reimbursement offered by Eco-Emballages for every tonne of recycled packaging material. (Marta Cabral, 2013) (Lemoux, 2016) (EIMPack, 2011).

Eco-Emballages has a website (a kind of Ebay) where municipalities can offer their sorted packaging material. Recyclers can bid on the available amounts. This method stimulates the free market and helps less experienced municipalities get a fair price for their sorted packaging waste. (Lemoux, 2016).

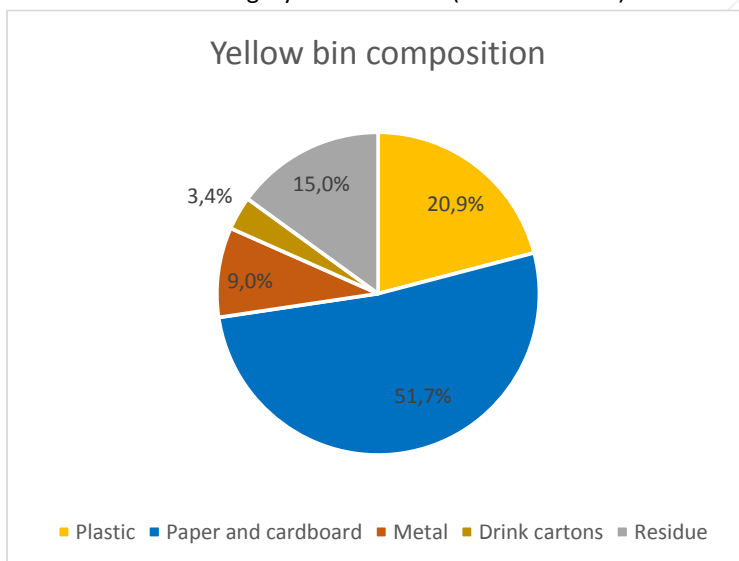
The system's cost recovery rate

A measure for the extent to which the chain is closed in an economic sense is the cost recovery rate. This is calculated by dividing the system's revenue by the costs. Based on the aforementioned figures, the cost recovery rate of the yellow bin system can only be examined from the point of collection to the recycler's front gate. For this part of the chain, the revenue of the yellow bin system offered a cost recovery rate of **19%** (€194/€1,031 million) in 2014.

What follows is a detailed calculation to determine the cost recovery rate of the plastic packaging stream within the yellow bin system.

To allocate the costs of the yellow bin based on mass, the various materials must all carry part of the cost of the non-packaging materials and the residue. The materials' weight percentages are used for this calculation. The various materials are: paper and cardboard, plastic bottles and flasks, metals and beverage cartons. In addition to those materials, the yellow bin also contains residue and non-packaging materials. In total, the latter two categories are estimated to make up 15% of the whole. This stream does not generate any revenue, yet it does contribute to the total costs. The costs of this stream are allocated to plastic bottles and flasks in proportion to weight.

As shown in the diagram below, plastic bottles and flasks make up 20.9% of the 85% of yellow bin materials (the remaining 15% consists of residue, non-packaging materials and sorting losses). We therefore allocate 3.69% ($(20.9\%/85\%)*15\%$) of residue, non-packaging materials and sorting losses to plastic bottles and flasks, which means this category carries 24.6% ($20.9\% + 3.69\%$) of the costs.



The cost of plastic bottles and flasks therefore amounted to €254 million in 2014 ($24.6\% * €1,031$ million).

If the revenue of just the plastics (PET and HDPE) is divided by these costs, the cost recovery rate is **25%** (€254 million / €1,031 million).

Consequences of expanding the plastic stream in the yellow bins

In 2017, Eco-Emballages is up for renewed accreditation by the French government. The national recycle objective for domestic plastic packaging materials is expected to be set at approx. 45% (twice as high as the current European objective). At the moment, 42% of all plastic packaging on the market consists of plastic bottles and flasks (463/1,105 kt). With the existing collection system (just bottles and flasks), it would not be possible to meet these new national objectives.

Recently, the expansion of the current system has been recorded in legislation. By 2022, all of France must have transitioned from the selective collection (just bottles and flasks) of plastic packaging waste to the collection of all plastic packaging material from households. During the six transition years, France will be adopting the expanded system in phases.

The appearance of the system will remain unchanged, yet the range of plastic packaging materials that civilians can deposit in the yellow bins will be expanded. This choice was made to make it easier for civilians to adjust to the new system. Given the fact that civilians can now dispose of all of their plastic packaging material separately, Eco-Emballages expects both an increase of the total amount of collected plastic packaging material and an increase of the collected amount of bottles and flasks (increased response).

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Germany

The country report has been evaluated by the relevant national organisations to eliminate factual inaccuracies.

Summary

- Germany has been using a system with yellow bags for the collection of all plastic and metal packaging, beverage cartons and other light packaging materials from households since 1991.
- In 2003, Germany implemented an extensive deposit-refund scheme for most non-returnable beverage packaging.
- In 2015, Germany achieved a recycling percentage of 28.4% for plastic packaging materials from households (excluding the materials from the deposit-refund scheme).
- In 2014, the revenue from the plastic stream from yellow bags amounted to €189 million, while the costs (allocated by mass) were circa €559.4 million. This means the cost recovery rate was circa 34%. The yellow-bag system as a whole has a cost recovery rate of around 49%.

Introduction

In Germany, European directive 94/62/EG was implemented by way of producer responsibility. The plastic packaging waste is collected separately from households throughout Germany. At the moment, ten private national organisations are in charge of organizing this collection process. All packaging materials are collected from households using the duale system. As part of the duale system, the plastic packaging materials are collected in the “gelbe sack” (yellow bag). Non-refillable beverage packaging consisting of plastic bottles and cans fall under a deposit-refund scheme. The ten organisations report annually to the Chamber of Industry and Commerce (Natuur en Milieu, 2016). In Germany, the national recycling target for domestic plastic packaging materials is 36% (Wikiwaste target Germany, 2016) of the licensed packaging. 60% of the plastic packaging waste is meant to be recovered (by recycling or energy recovery), of which 60% must be offered for recycling (Fraunhofer Institut, 2014).

No targets have been set for the waste stream from businesses, but as these are generally high-value fractions, a high recycling rate is achieved. (Wikiwaste target Germany, 2016) (Schmitz, 2017).

Closing the plastic packaging chain in terms of raw materials

This chapter covers the stream of plastic packaging materials collected via Germany’s yellow bag system. The following issues are discussed: the amount of material per stage in the chain, ensuring response, safeguarding the quality of the collected material and the possible applications for the recyclate. The amount of material that ends up as litter is the final item that is discussed.

Material streams for each stage of the chain

In the market; households and businesses

In 2015, 3,250 kilotonnes (kt) of plastic packaging materials entered the market (Consultic, 2016). Of this total, 3,035 kt were disposed of as waste. This concerns plastic packaging materials for both households and businesses. The exact reason for the disparity between the total amount of plastic packaging materials that entered the market and the amount disposed of as waste is unknown.

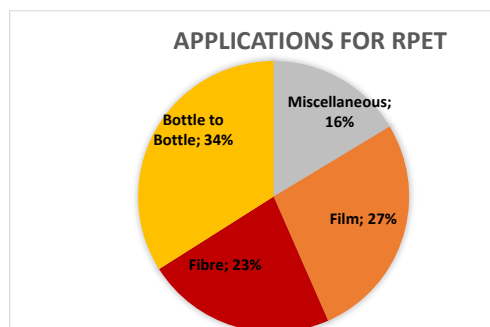
Of this amount circa 2,031 kt is domestic plastic packaging waste (Schmitz, 2017). In 2014, 1,150 kt of plastic packaging waste was collected from households (Leibniz-Institut für Wirtschaftsforschung, 2016). Another part of the 2,031 kt is made up of material originating from the deposit-refund scheme.

Most beverage packaging, regardless of volume, fall under the deposit-refund scheme, meaning a small deposit is charged for every unit (see table).

With deposit	Without deposit
Water bottles, soda bottles, beer bottles and bottles of mixed alcoholic beverages	Juice bottles, milk bottles (>50% milk), wine bottles and liquor bottles

Source: (Gesellschaft für Verpackungsmarktforschung, 2016).

In 2015, 410.7 kt of plastic bottles with a deposit were put on the market. Of this total, circa 98% was made available for recycling after collection. The diagram on the left shows the various applications for the recycled PET (Gesellschaft für Verpackungsmarktforschung, 2016).



Taking the deposit-refund scheme into account the amount of plastic packaging waste that can be collected by the yellow bag system is 1,620.6 kt (2,031.3-410.7kt).

The plastic packaging materials for businesses amounts to 1,004.1 kt (3,035 kt – 2.031,3 kt), or 33% of the total amount of plastic packaging waste.

Collection; households (excluding deposit-refund scheme)

The total amount of waste material collected in the yellow bags in 2014 was 2,490 kt (Leibniz-Institut für Wirtschaftsforschung, 2016). According to Schmitz, this amount and the composition of this stream remained virtually the same in 2015. Germans can dispose of all lightweight packaging materials in these yellow bags. In practice, this means plastic packaging materials, beverage cartons and metal packaging materials are disposed of in the yellow bags.

In 2014, 1,150 kt of plastic packaging materials was collected with the yellow bags (Leibniz-Institut für Wirtschaftsforschung, 2016). In 2015 877.1 kt was licensed (DIHK, 2016).

By way of the yellow bag system 71% (1,150 kt/1,620.6 kt) of all domestic plastic packaging waste (excluding deposit-refund scheme) was collected in 2015.

Offered for recycling; domestic (excluding deposit-refund scheme)

After sorting, 460 kt of plastic packaging materials were made available for recycling in 2014. This means that 40% (460 kt/1,150 kt) of the total amount of collected plastic packaging materials was made available for recycling. The remaining 60% is mainly used for energy recovery (Consultic, 2016).

During the recycling process, around 30% of the material is lost and used for energy recovery. This means that 320 kt of post-consumer plastic granulate is put on the market (Leibniz-Institut für Wirtschaftsforschung, 2016).

With the recycling of 460 kt of plastic packaging the yellow bag system achieves a recycling percentage of 28.4% (460 kt/1,620.6). Of the total amount licensed, 52.4% (460 kt/877.1 kt) is recycled.

The following issues stand out:

1. Of the amount of domestic plastic packaging licensed a recycling percentage of 52.4% is achieved, this means that the national target of 36% is achieved. Of all the domestic plastic packaging put on the market (excluding the deposit-refund scheme) a recycling percentage of 28.4% is achieved.
2. Of all plastic packaging materials put on the market for households, circa 71% is collected in the yellow bags (this does not include the amount of plastic bottles which is collected through the deposit-refund scheme).
3. Of all plastic packaging materials collected in the yellow bags, 28% (320 kt/1,150 kt) will actually enter the market as recyclate. The recyclate originating from the deposit-refund scheme is not included in this amount.



The overview above shows the key figures, ranging from the amount of material put on the market to the recycling of packaging materials from the yellow bags.

Ensuring response

Germany's constituent states employ various forms of pay-as-you-throw to incentivise citizens to separate their waste. This system charges citizens a fee each time their grey bin is emptied.

Since 1991, yellow bags are used throughout Germany to collect plastic packaging materials (Fraunhofer Institut, 2014). Separate waste collectors contracted by producer responsibility organisations collect the yellow bags. The costs of the streams for which producer responsibility applies are therefore covered entirely by producer responsibility organisations (bio by Deloitte, 2014).

In Germany, at least 36% of all licensed plastic packaging waste must be made available for recycling. With a recovery target of 60%, at least 60% of the total amount recovered must be made available for recycling in order to achieve the recycling target. Once this target has been met, the producer responsibility organisations are free to process the remainder as they see fit. In practice, this means that these organisations act based on the value of the material. Valuable streams are sold to recyclers, while there are strong incentives to offer lower and middle-class plastic packaging waste for energy recovery (Fraunhofer Institut, 2014) (Schmitz, 2017). The table below shows plastic waste recycling percentages over the years (source; Eurostat, 2017). These figures represent aggregated data of domestic and corporate waste. The data shows remarkably stable numbers between 2008 and 2013. The data therefore appears to confirm that, when it comes to recycling percentages, the producer responsibility organisations do not tend to go very far beyond the legally required minimum amount.

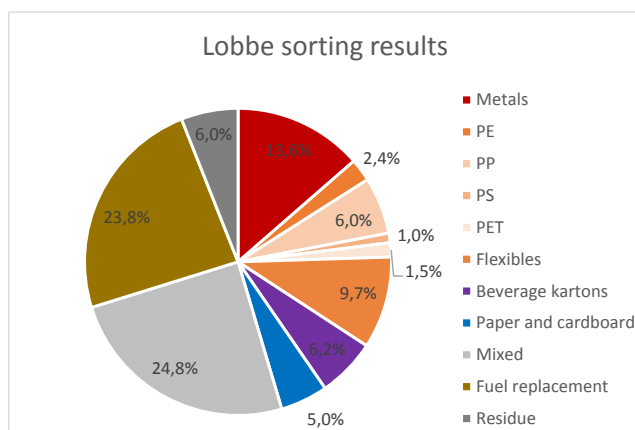
Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Recycling %	52.8	44.4	39.1	41.3	42.7	47.3	48.4	49.4	48.5	49.5	49.4	50.2

How is the quality of the collected material safeguarded?

In order to elevate and safeguard the quality of the collected material, the following measures have been implemented:

1. Uniformity: throughout Germany, more or less the same collection system is used. This means the collected materials are comparable in terms of their nature and quality. The producer responsibility organisations coordinate and finance this system (Natuur en Milieu, 2016) (bio by Deloitte, 2014).
2. During the collection process, collectors pay attention to the contents of the yellow bags and bins – although this does require continuous management (Schmitz, 2017).

Because of Germany's extensive deposit-refund scheme, virtually all beverage bottles (PET) and cans are "missing" from the yellow bag stream. Because these valuable materials are not part of this waste stream,



sorters can focus on sorting the remaining streams as efficiently as possible. The uniformity of the system gives sorters a good idea of the composition of the yellow bags and lets them arrange their sorting processes accordingly. To illustrate the point, the potential sorting results of a modern sorting facility in Iserlohn (of Lobbe) are shown in the figure on the left. In general, circa 55% (Mixed, Fuel replacement and Residue) is used for energy recovery, while 45% is made available for recycling.

Applications for the recycle

Germany has a "Der Blaue Engel" label. One of the conditions of using this label is that the manufacturer can demonstrate that their product consists of 80% regranulate (Info on the quality of regranulate, 2016).

Unmanaged waste streams

In Germany, no national organisation carries responsibility for the management of litter. Municipalities are responsible for keeping their cities clean, as well as for any monitoring efforts. The lack of coordination of monitoring at a national level results in measuring methods differing from one municipality to the next. Municipalities do report annually to Germany's Lander (constituent states), mainly regarding the amounts of material picked up by sweeping the streets. North Rhine-Westphalia (the state with largest population), for example, does not collect any data on the composition of this waste (Schroter, 2017) (Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen, 2014). North Rhine-Westphalia's aforementioned waste overview for 2014 reveals that 147 kt's worth of waste was collected by sweeping streets throughout the entire state in 2014. This amounts to an average of 8.3 kg/citizen/year (17.64 million citizens/147 kt). Of course, a large percentage of this amount will consist of sand and other natural materials (Schroter, 2017).

Closing the plastic packaging chain in an economic sense

This chapter covers various financial aspects of the German yellow-bag system. The costs and their safeguarding, the revenue and its safeguarding and the cost recovery rate are explained. Finally, several future developments are discussed.

No key figures are available regarding the plastic packaging waste stream from businesses. The collection and processing of this stream is left to the market.

The costs of the system

In 2014, the costs of collecting the yellow-bag materials amounted to circa €140 per tonne, while the costs of sorting this material were around €80 per tonne (Schmitz, 2017). In the context of this report, only the revenue after recycling (so not after sorting) is available. This means that the costs of processing the waste material will have to be included as well in order to calculate the cost recovery rate of the yellow bag system. The table below lists the key expenses and sums.

	Costs per tonne of yellow bag material collected (2011). (Bundeskartellamt, 2012)	Costs per tonne of yellow bag materials collected (2014) (Schmitz, 2017)	Total costs based on the figures for 2014 (2,490 kt collected)
Collection costs	€139	€140	€348.6 million
Sorting costs	€97	€80	€199.2 million
Miscellaneous costs	€45	€45 (the assumption is that this amount remains virtually unchanged compared to 2011)	€112.1 million
Subtotal	€281	€265	€659.9 million
Processing costs	?	?	€90.1 million (€750-€659.9 million)

Based on the costs of collecting and sorting a tonne of material in 2014 and the estimated costs of miscellaneous activities (communication and other costs), the total costs amount to €659.9 million. In 2014, the system costs of the yellow bag system – from collection to processing – were circa €750 million (Leibniz-Institut für Wirtschaftsforschung, 2016). This means that the processing costs amount to €90.1 million (€750-€659.9 million). Excluding miscellaneous costs, the costs of collecting and processing the yellow bag materials in 2014 amounted to circa €637.9 million (€750-€112 million).

Safeguarding costs

In 2005, the cartel watchdog in Germany decided that the monopoly position held by producer responsibility organisation Duales System Deutschland (DSD) was no longer desirable. As a result of opening up the market, Germany today has ten active producer responsibility organisations. Every corporation that puts packaging materials on the market must join one of these ten organisations. In this way the collection efforts and infrastructure of the dual system are financed (Natuur en Milieu, 2016).

The market share of the producer responsibility organisation determines that organisation's contribution to the total costs of the dual system. German municipalities and cities are allocated between the various producer responsibility organisations by means of a draw. Each organisation signs contracts with waste collectors in the areas that fall under its responsibility. After collection, the collected material is divided among the producer responsibility organisations and the local government (municipality/city) using an allocation key (based on market share). This approach was chosen because the local government is the owner of non-packaging materials. The amount of non-packaging materials collected in the yellow bags is estimated to be circa 20% (Istituto superior Tecnico, 2012) (Schmitz, 2017).

Since opening up the market, the costs of the dual system have declined significantly (left figure below), while the amount of material collected in the yellow bags has remained virtually the same (right figure below). As a result, the costs of the system have been roughly halved (Bundeskartellamt, 2012).

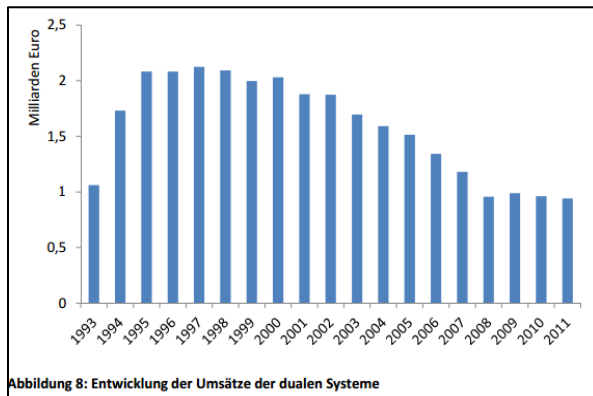


Abbildung 8: Entwicklung der Umsätze der dualen Systeme

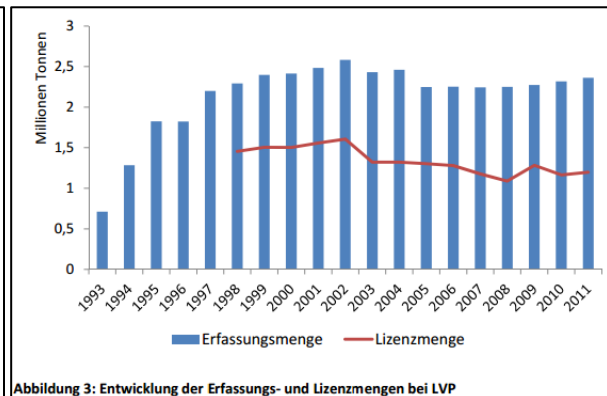
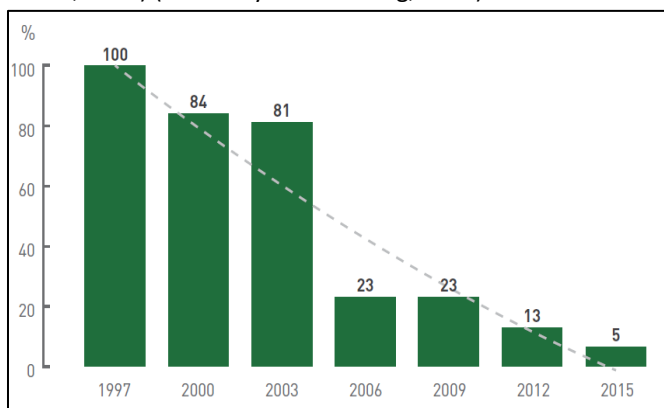


Abbildung 3: Entwicklung der Erfassungs- und Lizenzmengen bei LVP

Source of both figures: (Bundeskartellamt, 2012).

All producer responsibility organisations handle the contracting for the collection of waste material in their respective areas, using three-year contracts. The diagram below represents the developments regarding the recovery costs for the largest and oldest producer responsibility organisation in Germany, DSD. Compared to 1997, the costs in 2015 were 95% lower. The largest decline was achieved between 2003 and 2006 (Natur en Milieu, 2016) (Duales System Holding, 2015).



Source: (Duales System Holding, 2015)

Between 2003 and 2011, DSD reported a 76% decline in the costs of collecting and sorting as a result of increased competition in the market. This increased competition pertains both to the introduction of a competitive system and to increased competition between waste management organisations. The latter is a result of the fact that DSD began using shorter-term contracts for waste collection and sorting from 2004 onwards (bio by Deloitte, 2014).

Prior to 2004, DSD used ten-year contracts for waste collection and sorting. In addition to the introduction of a competitive system, the aforementioned development is seen as one of the primary reasons for the decline in the costs (bio by Deloitte, 2014).

The collected material allocated to the various producer responsibility organisations using an allocation key (for more details, see above) is subsequently sorted. This sorting is either done in the organisation's own sorting facilities or outsourced to external sorting companies. In the latter case, these sorters are often given short-term contracts of three-years (Cimpan, 2015).

Due to the system's competitive nature, the rates used by the various producer responsibility organisations for producers and importers are not publicly available. Non-public sources indicate that some producer responsibility organisations use differentiated rates for plastic packaging materials. The rates for non-processable plastic packaging materials are higher than those for e.g. PET (PolyEthylene Terephthalate) or HDPE (High-Density PolyEthylene) packaging materials.

Germany has circa 50 sorting facilities that have a combined total capacity of just over 2,500 kt (Schmitz, 2017) (Bundesvereinigung der Deutschen Ernährungsindustrie, 2016). This means the average capacity per sorting facility is circa 50 kt. The optimum sorting capacity, in terms of costs, is circa 50 kt (Cimpan, 2015); hence, on average, Germany has achieved optimum scale benefits within its sorting process.

Revenue from the system

In 2014, the marketing of plastic materials from the yellow bag stream resulted in a total revenue of €189 million for the producer responsibility organisations. This sum represents the revenue for the material after recycling, not after sorting. The average revenue per tonne, after recycling, amounted to €590 (€189 million/320 kt) in 2014. In addition to the revenue from the plastic material, metals brought in a revenue of around €125 million. Beverage cartons, on the other hand, did not bring in any revenue at all. This brings the total revenue from the yellow bag materials to circa €314 million (Leibniz-Institut für Wirtschaftsforschung, 2016).

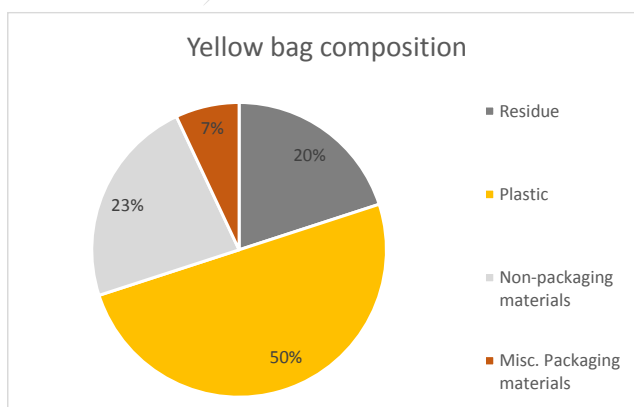
Among other things, the revenue is used by producer responsibility organisations to offer producers and importers reduced licensing fees. The recycling revenues are influenced by the quality of the material, which depends on the manner of collection and the thoroughness of sorting. Because the PROs control the whole value chain, they can ensure that the quality of the processed materials are as high as possible. (Schmitz, 2017).

The system's cost recovery rate

A measure for the extent to which the chain is closed in an economic sense is the cost recovery rate. This is calculated by dividing the system's revenue by the costs. Based on the aforementioned figures, the cost recovery rate of the yellow bag system can be examined from the point of collection until after recycling. For this part of the chain, the revenue from the yellow bag system set against the costs results in a cost recovery rate of **49.2%** (€314/€637.9 million) in 2015.

What follows is a detailed calculation to determine the cost recovery rate of the plastic packaging stream within the yellow bag stream.

To allocate the costs of the yellow bag based on mass, the various materials must each carry part of the cost of the non-packaging materials. The materials' weight percentages are used for this calculation. The materials that are identified (see figure below) are: plastic packaging materials, metals, composite packaging and beverage cartons (the latter three fall under the category of "miscellaneous packaging materials"). In addition to those materials, the yellow bags also contain "non-packaging materials," consisting of non-packaging materials (23%) and residue (20%). In total, this category makes up 43% of the total composition of the yellow bag material. These two streams do not generate any revenue, yet they do contribute to the total costs. The costs of these two streams are allocated to plastic packaging materials in proportion to weight.



As shown in the figure below, the share of plastic packaging materials is circa 50% of the 57% yellow bag materials (the remaining 43% consists of non-packaging materials and residue). We therefore allocate 37.7% $((50\%/57\%)*43\%)$ of the non-packaging materials and the residue to plastic packaging materials, which means plastic packaging materials will carry 87.7% $(50\% + 37.7\%)$ of the costs.

This brings the costs of plastic packaging materials to €559.4 million in 2014 $(87.7\% * €637.9 \text{ million})$.

Composition based on the following sources (Cimpan, 2015) (Bundeskartellamt, 2012).

If the revenue from plastics alone is then set against the aforementioned costs, the resulting cost recovery rate is **33.8%** (€189/€559.4 million). The cost recovery rate of the plastic packaging stream (allocated by mass) is therefore lower than the cost recovery rate of the yellow bag system as a whole. This is due to the significant revenue earned from metals and the high percentage of non-packaging materials and residue in the yellow bags.

Future developments

New packaging legislation has been drawn up and has recently been approved by the German Bundesrat. The law will come into effect at the beginning of 2019. Two important propositions are included, namely the introduction of a Central registry and the gradual increase in recycling percentages for plastic packaging materials over the coming years:

- Central registry: until 2015, some producers were able to keep their waste management in their own hands as a result of several legal loopholes. This meant that these producers did not contribute to the dual system, even though in practice their waste ended up in this system anyway. Due to the competitive nature of the market, there is a lack of transparency which, in turn, leads to freeriding. The proposed Central registry is intended as an implementation measure to create independent monitoring of the market and keep an eye on the various packaging streams. It will take the form of a cooperative alliance between the government, businesses that use packaging materials, and producer responsibility organisations (Schmitz, 2017).
- Recycling percentage for plastic packaging materials: the recycling percentage for domestic and corporate plastic packaging waste together is to increase from 58.5% in 2019 to 63% in 2022. According to a study commissioned by DSD the increased recycling targets do not appear to lead to a significant increase in costs (Schmitz, 2017).
- The initiative to oblige municipalities to allow non-packaging materials to be disposed of in the yellow bags was not approved. Municipalities are free to choose for this expansion.

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Greece

The country report has been evaluated by the relevant national organisations to eliminate factual inaccuracies.

Summary

- In 2004, Greece introduced a blue bin system for households, with which plastics, metal, beverage cartons, paper and glass are collected.
- In 2015, Greece achieved a recycling percentage of 35% for plastic packaging materials from households and businesses.
- In 2015, revenue from the plastic waste stream from the blue bins amounted to €8,8 million, while the costs were €17 million (allocated by mass). This means a cost recovery rate of circa 52% was achieved. The blue bin system as a whole has a cost recovery rate of circa 43%.

Introduction

In Greece, European packaging directive 94/62/EG was implemented through producer responsibility schemes. Plastic packaging waste is collected throughout Greece from both households and businesses. This process has been in the hands of the national organisation HERRCO since 2004. HERRCO is subject to inspection by the Greek Ministry of Environment and Energy (HERRCO, the cooperation, 2017). HERRCO has to meet the national objective and achieve 22.5% recycling of plastic packaging waste from households and businesses (Wikiwaste target for Greece, 2017).

Closing the plastic packaging chain in terms of raw materials

This chapter covers the stream of plastic packaging waste from households and businesses together. In Greece, plastic packaging waste is collected from households using blue bins. The following issues are discussed: the amount of material at each stage in the chain, ensuring response, safeguarding the quality of the collected material and the possible applications for the recyclate. The amount of material that ends up as litter is the final item that is discussed.

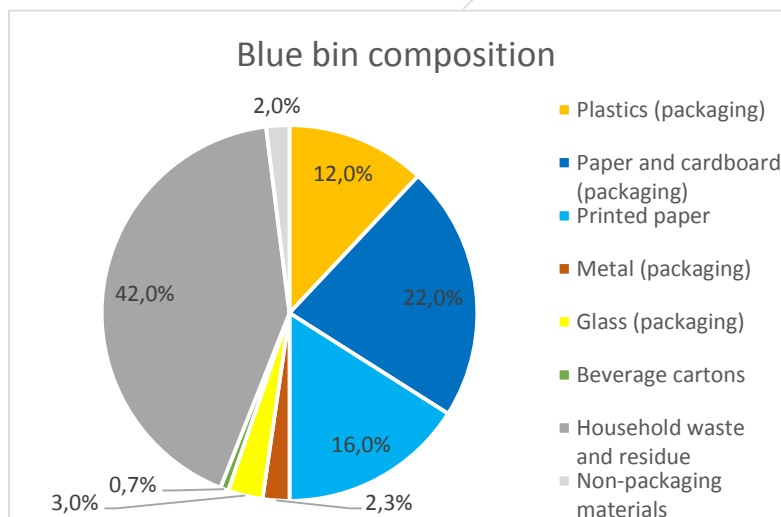
Material streams for each stage of the chain

In the market; households and businesses

In 2015, circa 183.7 kilotonnes (kt) of plastic packaging materials entered the market. It has not been possible to split up this amount by destination (households or businesses) or by type of plastic, because this data is not available. Plastic packaging materials are collected from households using the blue bin system. Additionally, citizens can use the blue bins to dispose of beverage cartons, metal packaging materials, paper and cardboard packaging materials, and other kinds of paper and glass packaging materials.

Collection; households and businesses

In 2015, 380 kt of material was collected through the blue bins. In Greece, the contamination rate of the blue bins is high (see figure below). This is partially attributable to the fact that one blue bin is shared by 70 citizens, which is significantly more than the green bin (comparable to the grey bin or bag used in the Netherlands). Therefore Greek citizens dispose of household waste in the blue bins as well. For businesses, no collection data is available.



The figure on the left shows that of the total of 380 kt of collected material, only around 213 kt (56%*380 kt) actually consisted of blue bin materials.

Composition based on the total sorting output for 2015 (Arvanitis, 2016).

Offered for recycling; households and businesses

In 2015, 42.8 kt of plastic packaging materials from households and 21.9 kt of plastic packaging materials from businesses were made available for recycling. This means that 35% $((21.9 + 42.8)/183.7 \text{ kt})$ of all plastic packaging materials that entered the market were made available for recycling (Arvanitis, 2016).

The following issues stand out:

1. The recycling percentage of 35% of all plastic packaging materials from households and businesses lies well above Greece's national objective of a 22.5% recycling percentage for plastic packaging materials.
2. The waste stream from households accounts for the majority (66%) of the total amount of plastic packaging materials made available for recycling (42.8/ 64.7 kt).

In the market	Made available for recycling
<ul style="list-style-type: none"> • In 2015, 183.7 kt of plastic packaging materials entered the market for households and businesses. 	<ul style="list-style-type: none"> • In 2015, 42.8 kt of plastic packaging materials from households and 21.9 kt from businesses were offered for recycling. • In total, 64.7 kt of plastic packaging materials were offered for recycling. • This means that 35% of all plastic packaging materials put on the market was offered for recycling.

Ensuring response

Households

Greece does not offer any financial incentives to stimulate civilians to separate their waste. HERRCO calls on the Greek population to separate its waste, on their own initiative, as it sees waste management as a sign of development (HERRCO FAQ, 2017).

The Greek government does have a landfill tax in place for municipal waste (ranging from €30 to €45 per tonne) that is intended to stimulate municipalities to work on their waste separation. Partially due to the relatively low amount, this tax is not particularly effective (Arvanitis, 2016). However, if a municipality chooses to work with HERRCO, HERRCO finances the collection system (waste bins, collection trucks and the construction and staffing of the transshipment sites). The municipality has to pay the costs of the logistical aspects of the waste collection process (the collection itself, staff, fuel, etcetera) (HERRCO, municipalities, 2017).

Businesses

Waste management companies that collect packaging waste are paid a fee by HERRCO per tonne of separately collected packaging waste. This fee amounts to €35 per tonne of plastic packaging waste collected separately (Arvanitis, 2016) (HERRCO, the cooperation, 2017).

How is the quality of the collected and sorted material safeguarded?

Households

In order to raise the quality of the collected material to a high level, all municipalities employ the same system. Furthermore, on average, one blue bin is available for every 70 citizens. Municipalities collect the blue bin materials, even though they do not inspect the contents and are not the owners of the material.

Quality is an important focus for sorters in particular.

After collection, the material is offered to certified sorters. At that moment, the sorters become the owners of the material. The household waste and residue remain the property of the municipalities; they are therefore responsible for the costs of disposal.

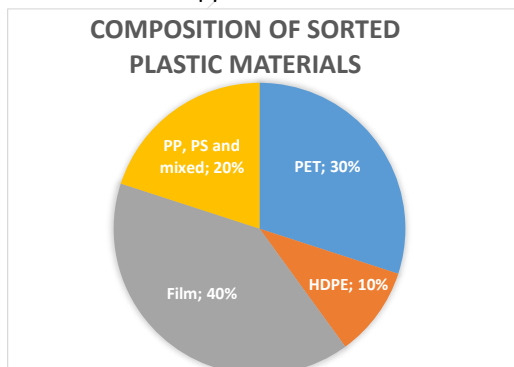
During the contract negotiations between the sorters and HERRCO a rate, which consists of the net sorting costs, is determined. This amount reflects a pre-agreed difference (in euro/tonne) between the sorting costs and the revenue from the material after sorting. In 2015, the average rate was €74 per tonne for plastic packaging waste and €42.18 per tonne for all blue bin materials taken together.

With this system, HERRCO offsets some of the sorters' costs, while also stimulating the sorters to (further) improve their sorting efforts. By doing so, sorters can get a better price for the material on the market and increase their revenue. This reduces the difference between the sorting costs and the revenue. Regarding the quality of sorting, HERRCO has a bonus/malus system in place which rewards or fines sorters depending on the percentage of packaging found in the residue. (Arvanitis, 2016).

Greece does a lot of its sorting locally (partially due to the significant costs of transport, due to the country's many islands and mountains). As a result, Greece has a total of thirty sorting facilities. Circa four of these have a capacity of over 30 kt, while the others are smaller. These smaller facilities manually sort the blue bin waste stream, while in the larger facilities this process is automated. Greece does 70% (based on weight) of its sorting manually. Plastic packaging materials are sorted into four streams. HERRCO believes this manual sorting process improves the quality of the sorted material (Arvanitis, 2016). In Greece, manual sorting is an important 'technique' (option), because the various small-scale sorting facilities do not process sufficient volumes of material to justify investments in automation. In many cases, there are no scale advantages to be had. Furthermore, manual sorting is a feasible alternative as wage costs are not a limiting factor (Arvanitis, 2016).

Applications for the recycle

The sorted plastic packaging waste from the Greek households consists of four main streams (see the diagram below), namely PET (Polyethylene Terephthalate), HDPE (High-Density Polyethylene), Films and a stream consisting of PS (Polyphenylene Sulphide), PP (Polypropylene) and mixed materials. Films, PS, PP and mixed materials are usually exported. PET and HDPE appear to be mostly reused within Greece itself. There is no data available on the applications for the various materials (Arvanitis, 2016).



Composition based on interview (Arvanitis, 2016).

Unmanaged waste streams

No national organisation carries responsibility for the management of litter. No national figures are available. (Arvanitis, 2016).

Closing the plastic packaging chain in an economic sense

This chapter covers various financial aspects of the Greek blue bin system. The costs and their safeguarding, the revenue and its safeguarding and the cost recovery rate are explained. No key figures are available pertaining to the stream of plastic packaging waste from businesses. Collecting and processing of this stream is left to the market.

The costs of the system

Households

In 2015, the costs of collecting the blue bin materials were estimated at €60 per tonne (Arvanitis, 2016). This means the total collection costs of the blue bin system were €22.8 million ($€60 \times 380$ kt).

The sorting costs are also based on estimates. The sorters and HERRCO set a rate, the net sorting costs, for each type of material at the start of the contract year. This amount reflects the difference (in euro/tonne) between the material revenue and the sorting costs. In 2015, the average rate was €42,18 per tonne for all blue bin materials taken together. In this average, the sorting costs for the residue that are not covered by revenue, are discounted. The resulting total net sorting costs for all blue materials amount to €9 million ($€42,18 \times 213$ kt). The combined material revenue for all blue bin materials was €24,4 million in 2015. The gross sorting costs, €33.4 million ($€9 + €24.4$ million), were calculated by adding the total revenue to the net sorting costs. Per tonne of material, the total gross sorting costs were €157 ($€33.4 \text{ million} / 213 \text{ kt}$) (Arvanitis, 2016). The estimated total costs of collection and sorting therefore amount to €56.2 million ($€22.8 + €33.4$ million).

Safeguarding costs

Municipalities are responsible for the collection of the various waste streams. There is no centralised or national oversight regarding their cost efficiency.

By making sorters the owners of the material and by determining fixed net sorting costs with these parties every year, HERRCO manages to keep the sorting costs manageable. This method has even resulted in a decline of the sorting costs. The aforementioned weighted average for all materials was €42 per tonne in 2015, where in 2009, that figure was €66 per tonne (Arvanitis, 2016).

In 2015, producers and importers paid HERRCO €66 per tonne ($€0.066/\text{kg}$) for plastic packaging materials (Arvanitis, 2016).

Revenue from the system

In 2015, the plastic packaging materials from the blue bin stream resulted in a revenue of €8.8 million (Arvanitis, 2016). This means the average revenue per tonne of plastic packaging material was €205 ($€8.8 \text{ million} / 42.8 \text{ kt}$). The combined material revenue for all blue bin materials was €24,4 million in 2015 (Arvanitis, 2016).

Safeguarding revenue

The same incentive designed to improve the quality of the sorting process also has an effect on the safeguarding of the revenue (see “How is the quality of the collected and sorted material safeguarded?”). The more effective the sorting process becomes, the more valuable the sorted material will be. The logical result is increased revenue when the material is subsequently sold.

The system’s cost recovery rate

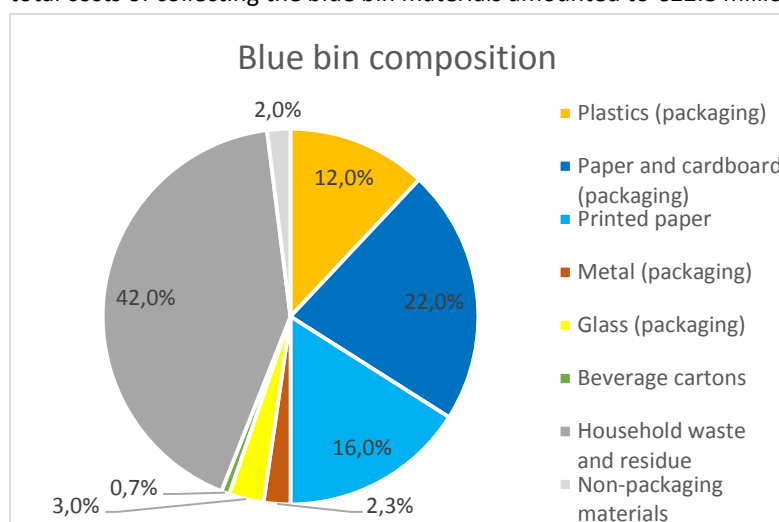
A measure for the extent to which the chain is closed in an economic sense is the cost recovery rate. This is calculated by dividing the system’s revenue by the costs. Based on the aforementioned figures, the cost recovery rate of the blue bin system can only be examined from the point of collection to the recyclers front gate. For this part of the chain, the revenue of the blue bin system resulted in a cost recovery rate of **43%** ($€24.4 / €56.2$ million) in 2015.

What follows is a detailed calculation to determine the cost recovery rate of the plastic packaging stream within the blue bin system.

To allocate the costs of the blue bin system based on mass, the various materials must all carry part of the costs of the non-packaging materials and the residue (household waste). The materials' weight percentages are used for this calculation. The materials we distinguish between are: paper and cardboard, printed paper, plastic packaging materials, metal packaging, glass packaging materials and beverage cartons. In addition to those materials, the blue bins also contain household waste, residue, non-packaging materials and sorting losses. In total, the latter category (residue + non-packaging materials) accounts for 44% of the total. This stream does not generate any revenue, yet it does contribute to the total costs. The costs of this stream are allocated to plastic packaging materials in proportion to weight. The costs of collection and sorting are calculated separately; this makes it necessary to allocate first and add up costs later.

Collection costs plastic packaging materials allocated

The estimated costs of collecting the blue bin materials amounted to €60 per tonne in 2015. Consequently, the total costs of collecting the blue bin materials amounted to €22.8 million (€60*380 kt).



As the figure on the left demonstrates, plastic packaging materials make up 12% of the 56% that is blue bin materials (the remaining 44% consists of household waste, residue, non-packaging materials and sorting losses). We therefore allocate 9.43% $((12\%/56\%)*44\%)$ of the household waste, residue, non-packaging materials and sorting losses to plastic packaging materials, which means plastic packaging materials carry 21.43% $(12\% + 9.43\%)$ of the

collection costs. The collection costs of plastic packaging materials then amount to €4.9 million in 2015 $(21.43\% * €22.8 \text{ million})$. In 2015, the collection costs per tonne of plastic packaging material offered for recycling were €114 (€4.9 million/42.8 kt).

Calculated sorting costs for plastic packaging materials

As mentioned before, the gross sorting costs of the sorting process can be calculated by adding the material revenue to HERRCO's contribution to the net sorting costs. In 2015, the difference between the material revenue and the sorting costs of plastic packaging materials – as set by the various parties – was €74 per tonne, on average. As such, total amount is €3.17 million $(€74 * 42.8 \text{ kt})$. The material revenue from plastic packaging materials in 2015 was €8.8 million. The gross costs are therefore €11.97 million $(€8.8 + €3.17 \text{ million})$. The resulting gross sorting costs are €280 $(€11.97 \text{ million}/42.8 \text{ kt})$ per tonne.

The costs of "sorting" the residue are discounted from these costs. Because the municipalities are the owners of the residue (which mainly consists of household waste), they are responsible for the costs of transporting and landfilling this stream (Arvanitis, 2016).

Total costs of plastic packaging materials

The estimated costs of collecting and sorting plastic packaging materials are €394 per tonne $(€114 + €280)$ or €16.9 million $(€394 * 42.8 \text{ kt})$ in total.

Cost recovery rate for plastic packaging materials

For this part of the chain, the revenue from the stream of plastic packaging materials from the blue bins resulted in a cost recovery rate of **52%** (€8.8/€16.9 million) in 2015.

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Czech Republic

The country report has been evaluated by the relevant national organisations to eliminate factual inaccuracies.

Summary

- In the nineties, the Czech Republic introduced a yellow bin system for households for the collection of all plastic waste material.
- In 2015, the Czech Republic achieved a recycling percentage of 62% for plastic packaging materials from households and businesses.

Introduction

In the Czech Republic, European directive 94/62/EG was implemented by way of producer responsibility. Plastic packaging waste is collected from households and businesses throughout the Czech Republic. This process has been in the hands of national organisation EKO-KOM since 2002. EKO-KOM is subject to inspection by the Ministry of the Environment (EKO-KOM, About us, 2017). EKO-KOM has to meet the national target of 40% recycling of domestic and corporate plastic packaging materials. This figure is in fact the Czech Republic's collection target; hence, the national target is to collect 40% of all plastic packaging waste from households and businesses (Balner, 2017).

Closing the plastic packaging chain in terms of raw materials

This chapter covers the stream of plastic packaging waste from households and businesses together. In the Czech Republic, these materials are collected from households using yellow bins. The following issues are discussed: the amount of material per stage in the chain, ensuring response, safeguarding the quality of the collected material and the possible applications for the recycle. The amount of material that ends up as litter is the final item that is discussed.

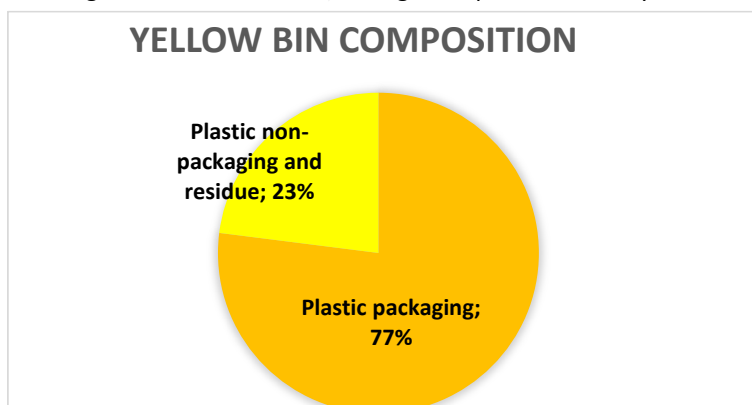
Material streams for each stage of the chain

Households and businesses

In 2015, 213 kilotonnes (kt) of plastic packaging materials entered the market. It has not been possible to split up this amount by destination (households or businesses) or by type of plastic, because this data is not available. In the Czech Republic, plastic packaging materials and plastic non-packaging materials are collected from households by means of yellow bins. The separate collection of plastic waste has been employed in the Czech Republic long before EKO-KOM's inception. The first manual sorting plant for the plastic waste stream was commissioned as early as 1992 (Balner, 2017).

In 2015, 91 kt of plastic packaging materials was collected from households mainly by use of the yellow bins, this is after subtraction of the residue and non-packaging materials (27 kt). An additional 50 kt of plastic packaging material was collected from businesses. This brings the total amount of plastic packaging materials that is collected to 141 kt (50 kt + 91 kt). This means the Czech Republic manages to collect 66% (141/213 kt) of all plastic packaging materials put on the market. (Balner, 2017).

The diagram below shows the average composition of the yellow bin.



This diagram shows that, on average, 77% of the material deposited in the yellow bins is packaging material. The rest consists of non-packaging material (which can be disposed of in the yellow bins as well) and residue.

Composition based on analysis of collected plastics in in 2015. (Balner, 2017)

During the sorting of the plastic packaging material which was collected by means of the yellow bins, between 10% and 15% of the material is lost (this is due to sorting losses and because residue is separated). This means

that of the total amount of plastic packaging material collected in the yellow bins, circa 80 kt was made available for recycling. During the sorting process of the plastic packaging materials from the corporate waste stream, it is estimated that on average 2% is lost. This means that of the total amount of plastic packaging material about 49 kt are made available for recycling. (Balner, 2017). This brings the total amount of plastic packaging materials made available for recycling to 129 kt (80 kt + 49 kt). It follows that the Czech Republic manages to recycle circa 60.5% of the total amount of plastic packaging materials put onto the market.

The following issues stand out:

1. By collecting 66% of plastic packaging waste from households and businesses, the country exceeds its national target of collecting 40% of all plastic packaging waste by a wide margin.
2. It appears that the guidelines for waste separation are abided by closely. On average, 77% of the contents of the yellow bins consists of plastic packaging materials, while the other 23% mainly consists of plastic non-packaging materials.
3. The Czech Republic manages to make 60.5% of all plastic packaging materials that initially entered the market available for recycling.
4. The household waste stream contributes 62% (80 kt/129 kt, so the majority) to the total amount of plastic packaging materials made available for recycling.

The overview below shows the key figures, ranging from the amount of material that entered the market to the recycling of plastic packaging materials from households and businesses (Balner, 2017).

In the market	Collection	Offered for recycling
<ul style="list-style-type: none"> • In 2015, 213 kt of plastic packaging materials entered the market. 	<ul style="list-style-type: none"> • In 2015, 91 kt of plastic packaging waste from households and 50 kt of plastic packaging waste from businesses were collected. • In total, 141 kt of plastic packaging materials were collected from households and businesses. • This means that, in total, 66% (141 kt/213 kt) of all plastic packaging materials was collected. 	<ul style="list-style-type: none"> • After subtraction of the estimated sorting losses, 80 kt of plastic packaging materials from households and 49 kt of plastic packaging materials from businesses were made available for recycling. • In total, 129 kt of plastic packaging materials were made available for recycling. • This means the country achieved a 60.5% recycling percentage.

Ensuring response

Households

The Czech Republic does not have a system in place for financially incentivising its citizens to separate their waste. Separate collection is promoted by systematic education and positive communication campaigns. On average the municipal waste tax in the Czech Republic, amounts to €18 per inhabitant per year. That this amount can remain relatively low is partly due to the fact that the Czech people separate their waste relatively well. Municipalities spread the message to their citizens that proper waste separation helps keep waste taxes down. (Balner, 2017). Research commissioned by EKO-KOM states that 72% of the inhabitants separate their waste (EKO-KOM, About us, 2017). To improve the people's waste separation and to make doing so as easy as possible, EKO-KOM aims for a high density of collection bins. At the moment every 130 inhabitants in the Czech Republic are serviced by a collection point, where inhabitants can discharge their separated waste. Furthermore, it is EKO-KOM's policy to keep the average distance a citizen has to cover in order to separate their waste below 150 metres. At the moment, that average distance is just 100 metres (bio by Deloitte, 2014) (EKO-KOM, About us, 2017).

Municipalities started collecting all plastic waste material from households by means of the yellow bins in the early nineties. Given the high response, it appears that a consistent and uniform approach over a period of many years has paid off. Furthermore, the sorting loss of 10% to 15% indicates that the collected plastic packaging materials are of a relatively high quality (Balner, 2017).

Businesses

Businesses are required to sign contracts with private waste collectors for the collection of their packaging waste. Given the fact that most packaging materials have a positive market value, many businesses are motivated when it comes to offering their packaging waste separately. Some municipalities make the collection bins for households available for SMEs (e.g. restaurants, small retail establishments and cafes) for a fee (Balner, 2017).

How is the quality of the collected and sorted material safeguarded?

Households

In order to elevate the overall quality of the collected materials, all municipalities employ the same system. Furthermore, on average, there is a yellow bin for every 130 citizens. Municipalities and private waste collectors collect the yellow bin materials and monitor the bin contents.

Municipalities are the owners of the packaging materials when the material is collected. Ownership passes on to the companies operating the sorting plants. It is these companies which sell the sorted material on the market. (Balner, 2017) (bio by Deloitte, 2014).

Businesses

For the corporate waste stream, market forces are a major factor when it comes to safeguarding the quality of the collected materials. A waste collector will pay less or charge more for the collection of plastic packaging waste of poor quality (poorly sorted or contaminated). On the other hand, a waste collector will pay more or charge less for properly sorted plastic packaging waste.

In the Czech Republic, a lot of the sorting is done locally. This is a remnant of the past, when each city wanted to have its own sorting facility. As such, there are around 120 sorting facilities to be found in the Czech Republic. The majority of these installations are small-scale operations. These small facilities manually sort the materials from the yellow bins. The plastic packaging materials are sorted according to demand. On average there are six to eight main streams in which plastic packaging material is sorted. EKO-KOM claims this manual sorting process is what is behind the high quality of sorted materials. Manual waste sorting is an important method in the Czech Republic, because the many small-scale sorting facilities lack a sufficient volume of sortable materials to justify investments in automated facilities. In many cases, there are no scale advantages to be had. Furthermore, manual sorting is a feasible alternative as wage costs are not a limiting factor. (Balner, 2017).

Applications for the recycle

The sorted domestic plastic packaging waste in the Czech Republic consists of six main streams, namely PET (PolyEthylene Terephthalate) by colour, Polyolefin jars (HDPE; High-Density PolyEthylene), Film by colour and mixed plastics.

PET is used for the production of new bottles or as fibres (e.g. in the automotive industry by Skoda). Polyolefins are mainly used to produce other plastic products. The mixed materials are processed by a Czech recycling organisation in for example substitutes for timber or concrete. Data on the composition of the sorted plastic packaging waste is not available (Balner, 2017).

Litter

No national organisation carries responsibility for the management of litter. No national figures are available (Balner, 2017).

Closing the plastic packaging chain in an economic sense

This chapter covers various financial aspects of the Czech yellow bin system. The net costs and their safeguarding are explained. Given that no separate data is available on costs and revenues, the cost recovery rate cannot be calculated.

No key figures are available regarding the plastic packaging waste stream from businesses. The collection and processing of this stream is left to the market.

The costs of the system

Households

In the Czech Republic, the producer responsibility organisation (EKO-KOM) only reimburses the net costs of the collection and sorting of domestic packaging materials. This concerns the gross costs minus the revenue earned from the sale of the sorted packaging materials (bio by Deloitte, 2014).

In 2015, the average net costs of the collection and sorting of domestic plastic packaging waste amounted to €277 per tonne (Balner, 2017). The total net costs were €25.2 million (€277*91 kt). The costs of processing non-packaging waste were paid by the municipalities.

Safeguarding costs

Municipalities are responsible for the collection of the various waste streams. There is no centralised or national monitoring regarding cost efficiency.

EKO-KOM signs system contracts with waste sorters. This stimulates these parties to sort more materials and to improve the quality of the sorted streams via the payment of fees (Balner, 2017).

EKO-KOM employs various rates for plastic packaging materials. In 2015, the rate that producers and importers had to pay for plastic packaging materials (rigid as well as flexible) was €192 per tonne (€0.192/kg). (EKO-KOM Fees, 2017).

Revenue from the system

No relevant data is available.

Safeguarding revenue

The same incentive designed to safeguard the costs of the sorting process also affects the safeguarding of the revenue. The more effective the sorting process is, the more valuable the sorted material will be. As a result, revenues will be higher once the material is sold.

The system's cost recovery rate

Insufficient data is available to calculate the cost recovery rate.

According to EKO-KOM, the cost per citizen of the separate collection of all packaging materials is €5 per year. (EKO-KOM Results, 2017) (bio by Deloitte, 2014). This amounts to a total of €52.5 million (€5*10.5 million citizens) for all Czech packaging materials.

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