

PlastiCircle: *Improvement of the plastic packaging waste chain from a circular economy approach*

Grant Agreement No 730292



PlastiCircle Deliverable

D7.1 LIFE CYCLE DEFINITION AND DESCRIPTION

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Abstract

D7.1 includes the initial life cycle models of the current household plastic packaging waste management system of the three participant cities in the project (Alba Iulia, Utrecht and Valencia) as well as an average European scenario in general. These diagrams comprise a holistic vision of the plastic packaging waste from households, including collection, transport, sorting and valorisation of the waste management systems analysed. These diagrams show the main waste flows considered in each stage of the models.

The information has been compiled both from the partners involved and from European reports/statistics, respectively. This would serve as the framework to define the system boundaries for the Life Cycle Assessment (LCA) development. These diagrams will be also the basis for activities related to the assessment of economic and social issues.

Partners

ORGANISATION	COUNTRY	ABBREVIATION
INSTITUTO TECNOLOGICO DEL EMBALAJE, TRANSPORTE Y LOGISTICA	SPAIN	ITENE
STIFTELSEN SINTEF	NORWAY	SINTEF
PICVISA	SPAIN	PICVISA
AXION RECYCLING LTD	UK	AXION
CENTRO RICERCHE FIAT SCPA	ITALY	CRF
GEMEENTE UTRECHT	NETHERLANDS	UTRECHT
FUNDACION DE LA COMUNITAT VALENCIANA PARA LA PROMOCION ESTRATEGICA EL DESARROLLO Y LA INNOVACION URBANA	SPAIN	INNDEA
MUNICIPALITY OF ALBA IULIA	ROMANIA	ALBA IULIA
MESTNA OBCINA VELENJE	SLOVENIA	VELENJE
SOCIEDAD ANONIMA AGRICULTORES DE LAVEGA DE VALENCIA	SPAIN	SAV
POLARIS M HOLDING SRL	ROMANIA	POLARIS
INDUSTRIAS TERMOPLASTICAS VALENCIANAS, S.A.	SPAIN	INTERVAL
ARMACELL BENELUX S.A.	BELGIUM	ARMACELL
IMPERBEL N.V	BELGIUM	DERBIGUM
CONSORZIO PER LA PROMOZIONE DELLA CULTURA PLASTICA PROPLAST	ITALY	PROPLAST
HAHN PLASTICS LTD	UK	HAHN
ECOEMBALAJES ESPANA, S.A	SPAIN	ECOEMBES
FUNDACIO KNOWLEDGE INNOVATION MARKET BARCELONA	SPAIN	KIMbcn
PLASTICSEUROPE	BELGIUM	PLASTICS-EU
ICLEI EUROPEAN SECRETARIAT GMBH EUROPASEKRETARIAT GMBH	GERMANY	ICLEI
CALAF INDUSTRIAL	SPAIN	CALAF

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Abbreviations

BB	Bring Banks
CA	Civic Amenity
D-t-D	Door-to-Door
LCA	Life Cycle Assessment
LPW	Light Packaging Waste
MS	Member State
MSW	Municipal Solid Waste

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Publishable summary

PlastiCircle aims to develop and implement a holistic process to increase recycling rates of packaging waste in Europe. This will allow to reprocess again plastic waste in the same value chain (i.e. Circular economy; closure of plastic loop). This process is based on four axes: collection (to increase quantity of packaging collected), transport (to reduce costs of recovered plastic), sorting (to increase quality of recovered plastic), and valorisation in value-added products to efficiently close the loop of plastics (i.e. foam boards, automotive parts like engine covers/bumpers/dashboards, bituminous roofing membranes, garbage bags, asphalt sheets/roofing felts and urban furniture like fences/benches/protection walls).

In order to evaluate the sustainability of the whole PlastiCircle approach, a Life Cycle Assessment (LCA) will be developed to compare the current situation in the three cities of the project and in the European Union with the expected situation once the PlastiCircle approach has been implemented. The initial step to develop the LCA are the Life cycle models included in this deliverable, which represents the current household plastic packaging management systems of the three pilots developed in the project in the cities of Alba Iulia (Romania), Valencia (Spain) and Utrecht (The Netherlands), and an average scenario in the European Union (EU).

These models will be the basis for the further sustainability assessment of the current and improved systems developed in the project. The life cycle of each one of the four models considered in the project, is described by a LCA diagram that graphically represents the different stages related to the end of life of the plastic packaging waste including the collection and treatment.

1. Introduction

The PlastiCircle project aims to develop and implement a holistic process to increase packaging waste recycling rates in Europe. This will allow plastic waste to be reprocessed in the same value chain (i.e. Closure of plastic loop). This is aligned with the strict objectives being established by the European Commission (Circular Economy Package; objective to recycle 75% of packaging waste by 2030).

To reach this target, PlastiCircle focuses on innovation in the different stages associated with the treatment of plastic packaging waste (i.e. main plastic waste fraction) and specifically on: collection (to increase the amount of packaging collected), transport (to reduce the costs of recovered plastic), sorting (to increase the quality of recovered plastic), and recovery in value-added products (i.e. PET foam boards for wind turbines/roofing structures/sandwich panels, automotive parts like engine covers/bumpers/dashboards, bituminous roofing membranes, garbage bags, asphalt sheets/roofing felts and urban furniture like fences/benches/protection walls).

To analyse the expected environmental, economic and social changes between the current and the improved models developed in the project, it is necessary to consider a LCA approach based on life cycle diagrams.

Thus, the objective of this deliverable is the description of the life cycle of the four-different plastic waste management systems considered within PlastiCircle project:

- Management of household plastic packaging system of Alba Iulia (Romania).
- Management of household plastic packaging system of Utrecht (Netherlands).
- Management of household plastic packaging system of Valencia (Spain).
- Average household plastic packaging system of EU in general (EU-28).

Preliminary diagrams of the current plastic packaging management system of the three pilots' cities and EU in general were prepared with information given by the partners involved in each model, according to their expertise and knowledge in this matter:

Table 1. Partners involved in the information loop of the life cycle diagrams

Life cycle models diagrams' territory	Partners involved in the information loop
Alba Iulia	-MUNICIPALITY OF ALBA IULIA
Utrecht	-GEMEENTE UTRECHT
Valencia	-SOCIEDAD ANONIMA AGRICULTORES DE LAVEGA DE VALENCIA
EU in general (EU 28)	-ECOEMBALAJES ESPANA, S.A -PLASTICSEUROPE

These diagrams will be the basis for the execution of LCA studies of the four life cycle models considered. LCA results will permit the identification of the potential

environmental impacts of the new pilots, at the early development stage and during all production processes. This evaluation method will allow considering the adequate measures for the reduction of these impacts from the beginning. According to the results achieved in WP2, WP3, WP4, WP5 and WP6, current diagrams will need further updates. However, the diagrams presented in this deliverable will be the basis for the data collection needed to complete the initial sustainability assessment of the systems considered.

1.1 Scope

The work in WP7 is focused on the evaluation of the sustainability of the whole PlastiCircle approach. The analysis includes the three pillars of sustainability: society, environment and economy.

A LCA will be used to know social, economic and environmental aspects of the initial life cycle waste management systems of the three pilot case studies and Europe in general and compare these results with improved models incorporating the whole PlastiCircle concept.

The assessment considers all waste from households recovered together with plastic packaging and all stages included in the household plastic packaging waste management system (collection, transport, sorting and recycling into secondary raw materials). Other packaging materials or waste fractions also are included in the system boundaries, and the impacts related to these waste fractions are taken into account in the assessment. However, since the focus of the project are the plastic packaging materials, an allocation procedure will be used to identify the impacts related to each waste fraction. For those materials which are not plastic (i.e. beverage carton, metal packaging and cardboard), we have applied the avoided impacts approach (subtracting the impacts because of the use of primary raw materials).

Life cycle diagrams of the current situation in the three cities and Europe in general have been built with the information provided by the partners involved. This will be the basis for activities related to sustainability assessment on environmental, economic and social issues. Subsequently, different analyses will be developed to comprehend the social, economic and environmental aspects of the initial model of the waste management systems case studies. As a consequence of this study, partners involved in the project will analyse and develop improvements that could be applied in the different stages of waste management systems under study to minimize the main impacts detected.

1.2 Objective

D7.1 should include the initial life cycle models of the current household plastic packaging waste management system of the three cities (Alba Iulia, Utrecht and Valencia) and Europe in general. These diagrams will include main information related to the collection, transport, sorting and valorisation of the waste management systems analysed. These diagrams show the main waste flows

considered in each stage of the models.

These diagrams will be the basis for activities related to sustainability assessment on environmental, economic and social issues.

PlastiCircle project has established the main targets for WP7, including:

- The evaluation of the impact caused by PlastiCircle project in the society, in the economy and in the environment, compared to the current situation.
- The Analysis and development of innovative and efficient transport systems aligned with the smart container developed in WP2.
- The creation of a full life cycle picture of the PlastiCircle systems developed in the project.

1.3 Methodology

In order to describe the current situation of the household plastic packaging waste management systems in the three cities and Europe in general, D7.1. has focused on the construction of the life cycle models that represent all cases under study. For this purpose, a questionnaire (see *Annex A: Life Cycle Diagram* questionnaires) was developed to be completed by the responsible partners with information of the waste managers operating in these cities. Also, ITENE sent a preliminary 'example diagram' to the partners involved to fill in the information of their municipality. With all the inputs received from the partners these preliminary diagrams were updated. In this deliverable, the updated diagrams are shown, and the life cycle stages of the plastic packaging management system are described. This data collection is the basis for an optimal definition of the systems that will be improved in PlastiCircle project.

In addition, D7.1. reviews the main relevant aspects of each stage considered in the waste management systems (collection, transport, sorting and valorisation) and it presents a description of the whole household plastic packaging waste management systems of the three cities (Alba Iulia, Utrecht and Valencia) and Europe in general.

2. Life cycle definition and description of the plastic packaging management systems considered in the PlastiCircle project

In this section, the life cycle of each plastic packaging waste management system is described with a schematic LCA diagram. Different colours have been used to represent each stage considered in the life cycle of waste management systems. The colours which specify each stage are: orange colour for the collection stage, grey colour for the transport stage, blue colour for the sorting stage and green colour for the recycling stage.

Life cycles of collection systems were built in a cradle-to-grave approach in order to take into account the full set of potential environmental impacts along the whole collection and treatment cycle of the plastic packaging waste. This will enable to estimate the advantages that the new concepts will provide, since these will be applied specifically to waste management systems of plastic packaging generated in the European countries.

The development and integration of novel and innovative technologies to the current plastic packaging waste management systems will allow to obtain higher amounts and better-quality plastic waste to be used in value-added applications. As a result, more cost-effective and sustainable plastic packaging waste management systems will be achieved and implemented across European countries.

2.1 Alba Iulia city

Alba Iulia is a Romanian city, placed in the Transylvania Region, which counts a population of 74.000 inhabitants (2017), with an extension of 103.6 km² and a density of 566 inhabitants/km².

The Population in Alba Iulia lives mainly in flats and individual houses distributed almost equally. According to the statistics provided by the municipality, 31,921 people lived in 172 associations¹ of apartments in flat buildings. Other part of the population lives distributed among 14,548 individual houses.

The Romanian Law of Environment Protection and Local Council Regulation requires sorting the waste in four separate fractions (paper and cardboard, plastic,

¹ One association is composed by several flat buildings

metal and glass) for associations, while for homes a two-system fraction is still in use (wet and dry). The dry fraction, based on a provided "yellow bag" contains recyclable waste.

The national strategy for the separate collection of waste is laid down in [RO Law 211 2011] on the waste regime and in [RO GD 856 2002] on waste management record keeping and the approval of the list of waste. These laws transpose the requirements of the Waste Framework Directive 2008/98/EC into Romanian legislation. [RO Law 132 2010] regulates the separate collection of paper, cardboard, metal, plastic and glass in public institutions, by establishing requirements for the organisation and operation of the separate collection. According to [RO GD 621 2005] the public institutions, associations, foundations and private persons have to collect the packaging waste separately in different containers, properly inscribed and located in special areas, accessible to private persons. In order to meet the targets for the recycling/recovery of packaging waste the collection of recyclable waste like paper and cardboard, plastic and metal and glass is proposed in the Waste Management Plan (1).

Approximately 96 % of the household waste and household like waste is collected using a D-t-D system in a mixed residual waste bin (in households served by the municipal waste collection service). Although the separate collection has increased through environmental campaigns and educational activities, the environmental awareness and readiness to participate in separate collection of the public is still on low level [RO EC Roadmap 2013] (1).

Figure 1 shows life cycle diagram that represents the main waste material flows and stages considered in the current life cycle of the household plastic packaging waste management system of Alba Iulia city.

The life cycle of Alba Iulia city is composed of the following stages:

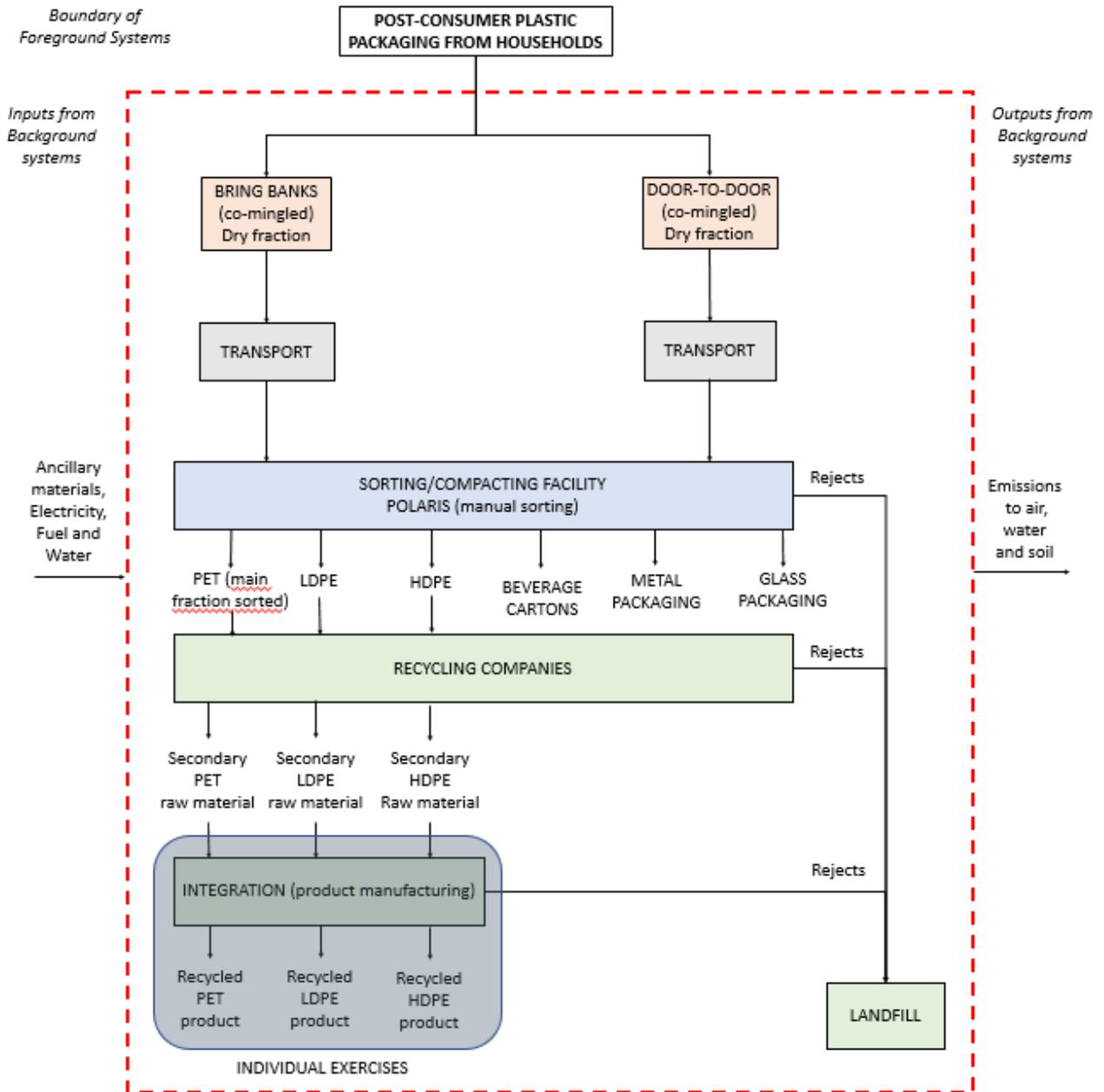


Figure 1. Life cycle diagram of plastic packaging waste management system of Alba Iulia city

2.1.1 Collection

Alba Iulia collects separately the 'dry fraction'² (all recyclables) and the 'humid fraction'³ (garbage) for individual homes. A Door to Door (D-t-D) collection system is used for the waste collection of individual houses, while in the apartments associations, citizens carry their waste to the Bring Banks (BB). More than that, there is an informal sector collecting PET bottles which are left near containers to sell them to other sorting/compacting companies, but this sector will not be considered in the study because of the absence of official data and due to the absence of regulation.

2.1.2 Transport

Post-consumer plastic packaging waste (recyclable waste) and the other waste included in the dry fraction are collected weekly for individual households (D-t-D system) and daily for associations of flat apartments (BB system) and are transported by trucks to Polaris sorting/compacting facility.

2.1.3 Sorting

In the sorting/compacting facilities, the different waste materials are sorted manually because there isn't an automatic sorting station. This situation results into a very low yields and plastic recovery percentage.

Once the different waste materials have been sorted into cardboard, metal, glass and the main plastic packaging materials (PET, LDPE, HDPE), these are stored until they are transported to the facilities of the recyclers of each material. The remaining waste is sent to a sanitary landfill.

2.1.4 Recycling

The Waste service operator (Polaris) sorts a big part of waste manually and sells the recyclable materials to specialized companies, for final collection and recycling.

In the recycling stage, each recycler processes the specific material to obtain pellets of recycled material. These recycled materials can be used by transformers to make new products with recycled material. In the study we only consider the integration processes of the plastic raw materials which are the objective of the project.

² Estimated weight: 80 kg/m³

³ Estimated weight: 280 kg/m³

2.2 Utrecht city

Utrecht is a city in the central Netherlands with a population of 345,080 in 2017 with a population density of 3,658/km². Due to its central position within the country, it is an important transport hub for both rail and road transport.

The city of Utrecht is among the best waste recyclers in the main cities of the Netherlands. Residents can divide their waste into five types of waste (paper; glass; organic waste; plastic / cans / packing (PBP); residual waste or rest). In residential areas with low population density, the collection system is through personalized collection (D-t-D system), but in areas with high population density the collection system is through BB systems and CA located in different areas of the city.

In the Netherlands, the most important strategy implementing separate collection is the National Waste Management Plan (WMP) 2009-2021 [NL LAP 2014]. The main objective of the separate collection of wastes according the WMP is that saving of resources and energy, consequently leading to a reduction of CO₂ emissions. Also, less waste need consequently to be incinerated or landfilled, leading to less impacts on the environment (Chapter 14.1 [NL LAP 2014]).

The Dutch Implementing Act for the Waste Framework Directive [NL IMPL 2011] that was implemented in 2011 is the law transposing the requirements of the WFD into domestic law. Most of the WFD requirements have been transposed into national legal requirements via the Law Management of the Environment [NL WMB 1979], however requirements are most of the times deviating between requirements for households and companies (1).

General rules for collection systems are defined in the national law Article 10.21-10.29 of [NL WMB 1979], as for example the frequency of collection at households (once per week (Article 10.21 [1]; [NL WMB 1979]), the offer to bring large household waste in a certain area (Article 10.22 (1b); [NL WMB 1979]), and other general rules on collection of household wastes (Article 10.26; [NL WMB 1979]). However, these do not elaborate on specific requirements for the design of local collection systems as such. The latter requirements are all laid down in municipality ordinances. Article 10.23 of the Act Management of the Environment [NL WMB 1979] describes that each municipality has to determine such 'municipality ordinance' (1).

Figure 2 shows life cycle diagram that represents the main waste material flows and stages considered in the current life cycle of the household plastic packaging waste management system of Utrecht city.

The life cycle of Utrecht city is composed of the following stages:

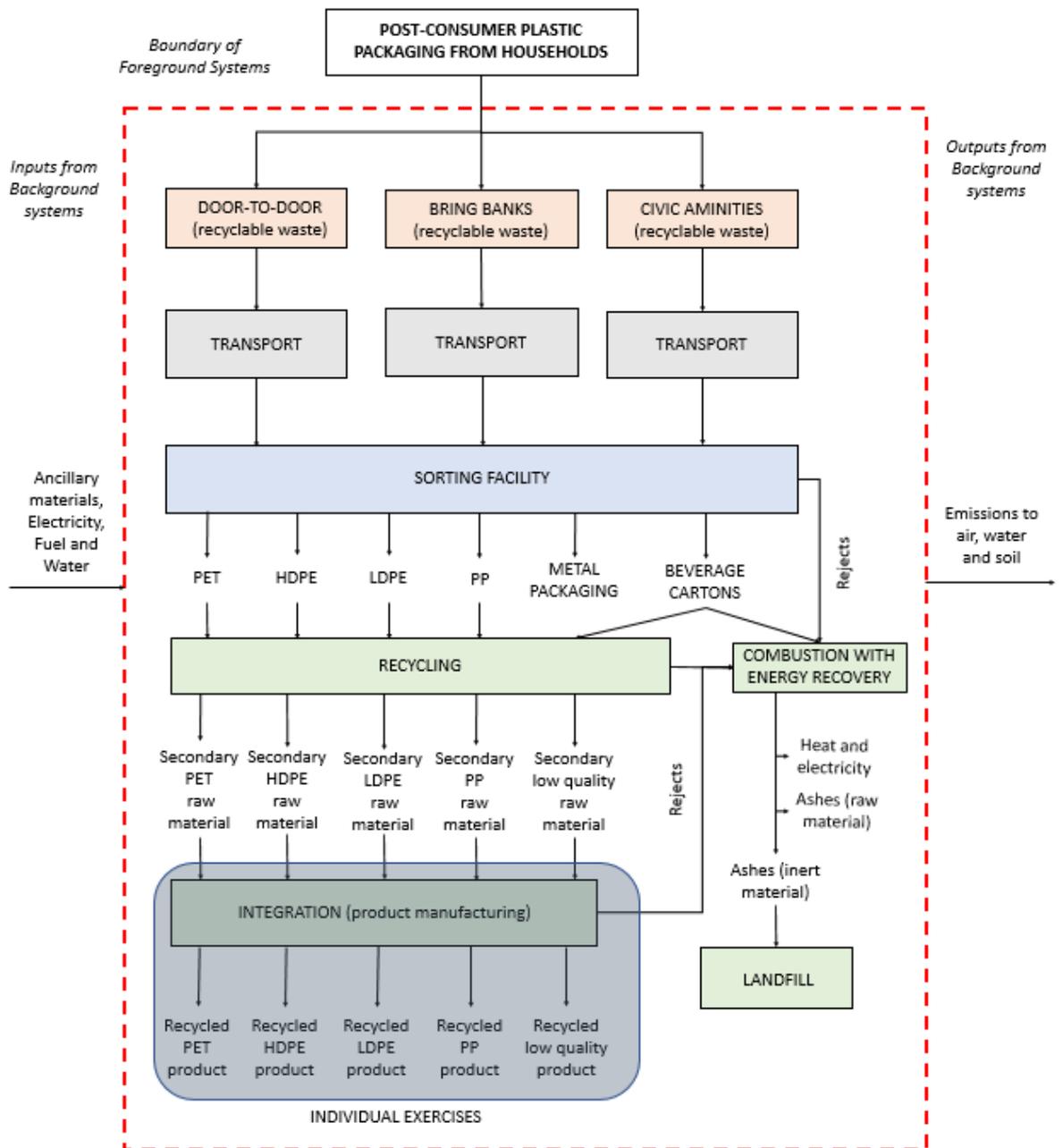


Figure 2. Life cycle diagram of plastic packaging waste management system of Utrecht city

2.2.1 Collection

Household plastic packaging waste is collected in Utrecht city using three different systems depending on the population density area.

D-t-D collection system is used for the waste collection of citizens located in low density population areas using bags, 140 and 240 litter containers.

Plastic packaging is collected co-mingled with other recyclables: metal packaging and beverage cartons.

BB or civic amenities (CA) are used for the waste collection of citizens located in high density population areas.

2.2.2 Transport

Household plastic packaging waste is collected once per week in D-t-D systems. Collection frequency in BB is in the range from one to seven days per week, depending on its location and conditions.

Transport of packaging waste is carried out by trucks with back loading or with top loading, depending on the type of containers that are collected.

2.2.3 Sorting

In the sorting/compacting facilities, the different packaging waste materials are sorted automatically with different equipment.

Once the different packaging waste materials have been sorted into the main flows (metal packaging, beverage cartons, PET, LDPE, HDPE and PP), these are stored until its transportation to the facilities of the recyclers of each plastic material. Depending of the quality of the laminated packaging, sometimes this material has to be sent to energy valorisation facilities, as it happens with the remaining waste, to produce heat and electricity from waste.

2.2.4 Recycling

In the recycling stage, each recycler processes the specific material to obtain pellets of recycled material. These pellets can be used by transformers to make new products with recycled material. In this study it is only considered the integration processes of the plastic raw materials which are the objective of the project.

2.3 Valencia city

Valencia is a city on the east coast of Spain. It is the capital of the autonomous community (Comunidad Valenciana) and the third-largest city in Spain after Madrid and Barcelona. Valencia population is 790,201 inhabitants (2016) with 5,868.56 inh./km² population's density. The city represents the 16% of the population of the Valencian Region.

Collection is being performed using a combination of different methods: D-t-D system for commercial cardboard, BB system for almost every domestic waste (domestic paper & cardboard, glass, light packaging, organic and other waste) and, finally, fixed or mobil CA for other kind of materials (bulky waste, oil, WEEE, etc.).

The two main strategies implementing separate collection are the Spanish Waste Prevention Programme [ES WPP 2013] and the Waste Management Plan [ES WMP 2009]. The National Waste Prevention Plan for Spain was published on November 27, 2013. The coverage of the Waste Prevention Plan is the period 2014-2020.

The autonomous regions of Spain prepare their own plans and programs which have to follow at minimum of the national plan requirements.

A new National Waste Management Plan (PEMAR) regulates also waste management requirements at a national level. The main targets of the Spanish National Waste Management Plan are to stabilise waste generation as a first step and subsequently try to reduce it and to raise the recycling rates of the MSW streams [ES WMP 2009]. There is a current understanding that some regions may have different collection systems. Each municipality has the responsibility to decide how to best fulfil the targets. The first and second National Municipal Solid Waste Management Plans have been instrumental in the development of MSW recycling by introducing several initiatives, from separate collection of recyclables to upgrading recycling facilities, and many more [ES WPP 2013] (3).

In relation to the use of taxes, several Regional Authorities have implemented landfill taxes or fees. However, there are significant differences between them: the type of waste to which it applies, the allocation of the collected taxes, the tax rate, the taxable event and the results obtained. Only Catalonia has implemented a fee for incineration. It should be pointed out that fees for landfill and incineration have played a key role in the changes in municipal waste management in Catalonia, in particular supporting the implementation of separate collection of biowaste and other materials [ES TAC 2015] (3).

The life cycle of Valencia city is composed of the following stages:

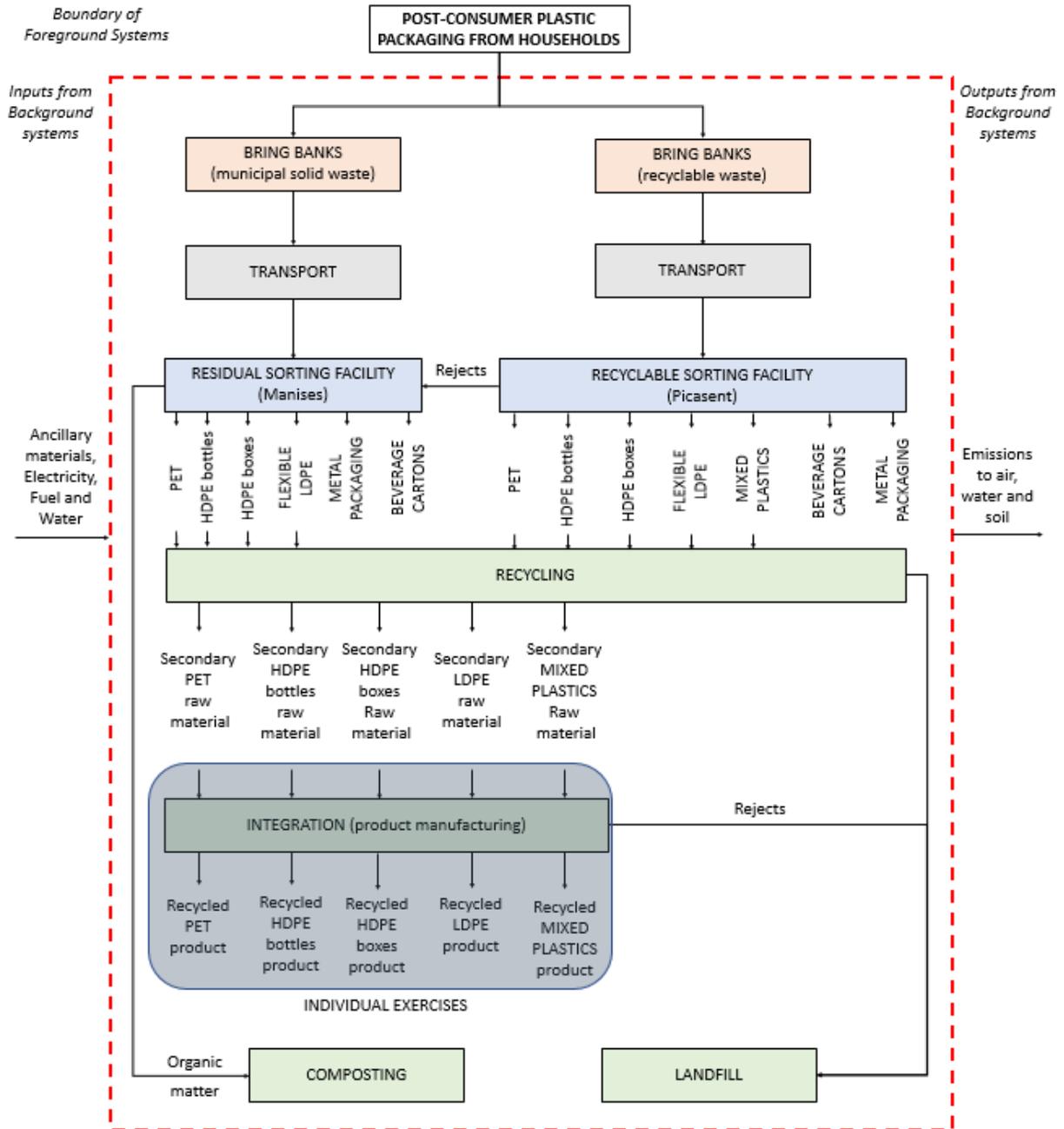


Figure 3. Life cycle diagram of plastic packaging waste management system of Valencia city

2.3.1 Collection

Valencia collects separately the light packaging waste (LPW) (yellow container) from the other recyclables like paper/cardboard and glass. The fraction included in the LPW includes plastic packaging, metal packaging and beverage cartons. Citizens carry their packaging waste to the BB located near to their houses (commonly flats).

2.3.2 Transport

The frequency of collection in Valencia varies depending on the waste stream. It is established an everyday collection for organic and rest fraction and 3 days per week frequency for packaging waste streams (paper and cardboard, LPW and glass). SAV and FCC are the two waste management companies in charge of the collection of the different waste fractions, except for glass packaging, which is collected directly by Ecovidrio.

Different waste fractions are collected by trucks with lateral or back charge, and top load, and then it is transported to the waste treatment plant.

Specifically, MSW is transported from the BB to the MSW treatment plant located in Manises, and Light Packaging Waste is transported from the BB to the Light Packaging located in Picassent.

2.3.3 Sorting

In the Packaging Sorting Plant, the different packaging materials are sorted into different fractions (PET, HDPE bottles, HDPE boxes, Film, Mixed Plastics, metal cans and beverage carton) manually in a pick station and automatically in different sorting stations. This situation results into a high yields and plastic recovery percentage.

In the MSW treatment plant, they recover mainly organic matter, although they also recover some packaging materials (PET, HDPE boxes, HDPE bottles, Film, Metal packaging and Beverage carton).

Once the different packaging materials have been sorted into the main packaging materials (beverage cartons, Metal packaging, PET, HDPE bottles, HDPE boxes, Film and Mixture plastics), these are stored until its transportation to the facilities of the recyclers of each plastic material. Then, the remaining waste is sent to landfill located in Dos Aguas.

2.3.4 Recycling

In the recycling stage, each recycler processes the specific material to obtain pellets of recycled material. These secondary raw materials can be used by transformers to make new products with recycled material. In the study we only consider the integration processes of the plastic raw materials which are the objective of the project.

2.4 Europe in general

Article 10 of the Waste Framework Directive (WFD) sets the general requirement of separate collection and obliges the Member States (MS) to set up separate collection systems for at least paper, metal, plastic and glass by 2015. Article 11 sets the requirements for the European Member States to take measures to promote high-quality recycling through separate collection.

There is a wide variety of ways to collect different waste streams, and experience shows that practical implementation of the obligations differs significantly across 28 EU Member States (EU-28 MS).

To collect recyclables and bio-waste, the systems applied in the EU-28 MS vary widely. Information has been collected also from 'the Assessment of separate collection schemes in the 28 capitals of the EU' (2015), which investigated what collection systems are in place in each capital of the 28 countries of the EU. However, this is not an easy task, as systems also vary at regional and even municipal level in most of the MS, as the choice and practical implementation of waste collection tends to be the responsibility of the municipality or district authorities.

In this deliverable, this information together with information from Plastics Europe and Ecoembes has been collected to develop a general diagram of the waste collection systems in Europe.

To aid analysis, abovementioned systems (co-mingled D-t-D, collection, BB and civic amenity sites) have been categorised as primary systems (applied for the majority of inhabitants) (4).

D-t-D collection in place in the MS vary from one bin up to six separate bins/sacks (including the bin for residual waste).

Single-stream D-t-D collection is performed for paper/cardboard and bio-waste in 14 MS, for glass in seven MS, for plastics in four MS and for metal in three MS.

Co-mingled D-t-D collection is most common for metal and plastic together in one bin (seven MS). Five MS collect more than two fractions in one bin.

The majority of countries apply BB systems for the collection of glass (18 MS, mostly separate for white and coloured glass). Ten MS collect paper/cardboard at bring points. Six MS primarily collect plastic at bring points - in five cases together with metal, but in Sweden in a separate container. Two MS collect metal separately at bring sites. Spain also collects bio-waste within the bring system.

Civic amenity sites are used as additional collection systems, usually accepting the same fractions as collected in the bring containers.

Collection type	Paper	Glass	Plastic	Metal	Bio-waste
Door-to-door (single fraction) 	AT, BE, BG, CY, DE, DK, FI, HU, IT, LU, LV, NL, SI, UK	BG, FI, LU, LV, NL, SI, MT	AT, LV, NL, DK	FI, NL, DK	AT, BE, CZ, DE, FI, EE, IT, HU, LU, NL, SI, SE, IE, UK
Co-mingled ...plastic + metal 			BE, BG, CY, DE, FR, IT, HU, LU, SI		
...3 fractions	RO, MT: paper, plastic, metal UK: plastic, metal, glass				
...all in one bin	EL, IE: paper, glass, plastic, metal				
Bring points 	CZ, EE, ES, FR, HR, LT, PT, PL, SE, SK	AT, BE, DK, CY, CZ, DE, EE, ES, FR, HR, IT, HU, LT, PT, PL, RO, SE, SK	SE ES, HR, LT, PT, PL (all plastic/metal in one container)	AT, EE, SE	ES
Civic amenity sites 	Primary collection: CZ (metal waste), SK (metal and bio-waste) Addition collection of all waste streams: all countries PL: rare distribution of civic amenity sites			LV (metal)	

Figure 4. Overview of collection systems in place in the 28 EU countries (primary systems only) Source: Assessment of separate collection schemes in the 28 capitals of the EU

Plastic is collected within D-t-D systems in 18 countries, of which only four collect plastic as a separate fraction; all others apply co-mingling with one (metal), two or three other fractions. Six MS collect plastic (five of them together with metals) via bring-points. Four MS (CZ, FI, EE, SK) do not currently collect plastic separately from residual waste within main collection system, however this might be possible in civic amenity sites.

The life cycle of Europe in general is composed of the following stages:

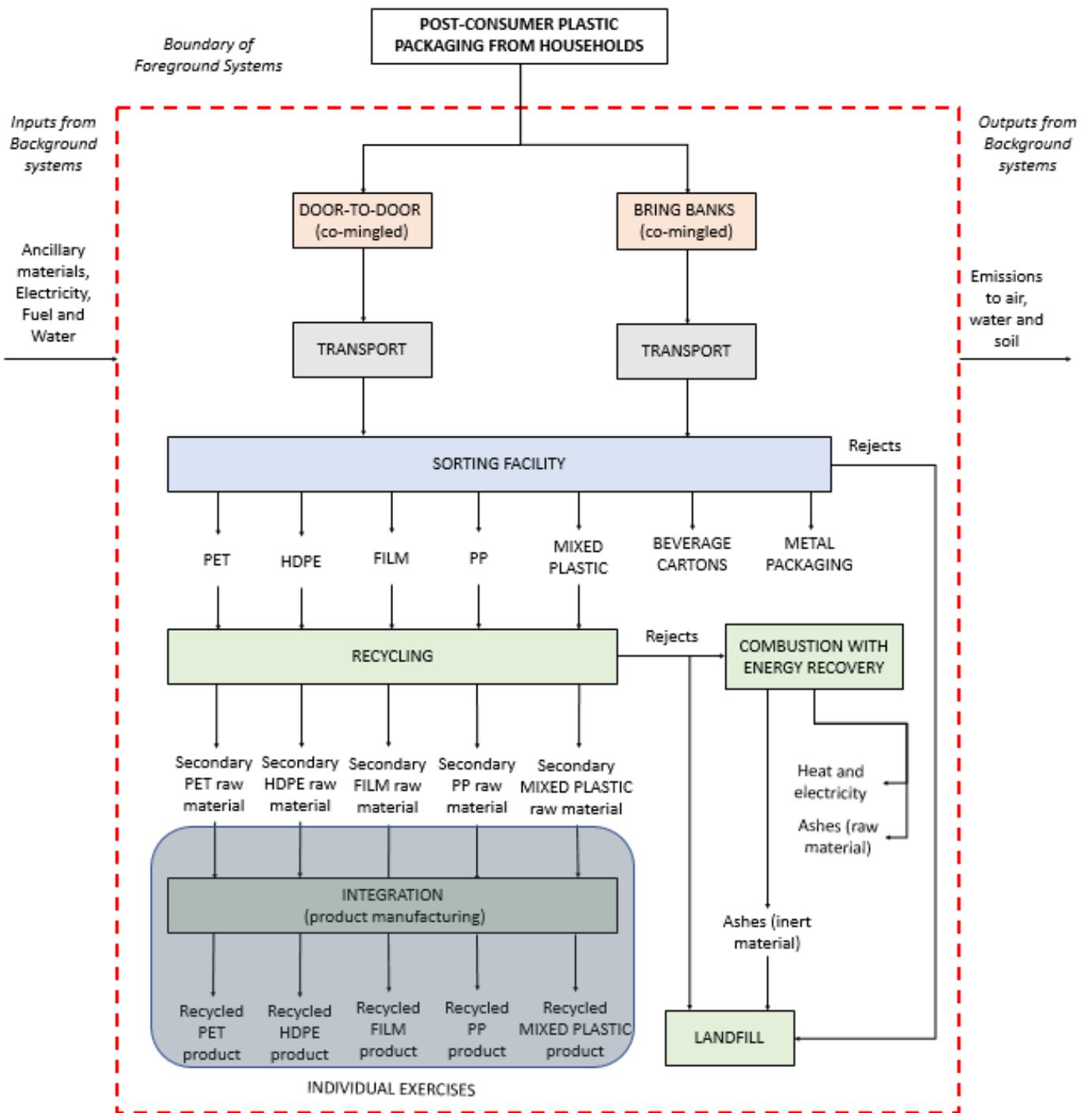


Figure 5. Life cycle diagram of plastic packaging waste management system of Europe in general

2.4.1 Collection

Plastic waste collection yields are approximately equally distributed into D-t-D systems and the bring sites (civic amenity sites yield on average low quantities). In general, D-t-D separate collection of plastic is not widely implemented across the EU capitals (only 8 out of 28) so far, while plastic collection mainly occurs through co-mingled collection and central collection points. Many cities collect packaging as co-mingled material and separate them afterwards in centralised sorting facilities.

2.4.2 Transport

Transport frequency for post-consumer plastic packaging varies widely among Europe. Frequency in BB is higher, usually daily or every two days. However, the most typical collection frequency in EU in D-t-D systems is weekly or bi-weekly (as it happens for instance in Dublin (Ireland), Brussels (Belgium) or Berlin (Germany)). This material is usually transported by trucks to sorting/compacting facilities.

2.4.3 Sorting

Packaging Sorting Plants sort the different packaging materials into different fractions. The most common fractions in which packaging materials sorted are: Metal, Beverage carton, PET, HDPE, PE Film, PP and mixed plastic fractions are automatically sorted with different sorting equipment. This situation results into a high yields and plastic recovery percentage.

2.4.4 Recycling

In the recycling stage, each recycler processes the specific material to obtain pellets of recycled material. These pellets can be used by transformers to make new products with recycled material. In the study we only consider the integration processes of the plastic raw materials which are the objective of the project.

3. Conclusions

Current life cycle waste management systems of the three cities (Alba Julia, Utrecht and Valencia) and Europe in general, include four different stages (collection, transport, sorting and recycling)

D7.1 includes the initial life cycle models of the current household plastic packaging waste management system of the three cities (Alba lulia, Utrecht and Valencia) and Europe in general. These diagrams comprise a holistic vision of the plastic packaging waste from households, including collection, transport, sorting and valorisation of the waste management systems analysed. These diagrams show the main waste flows considered in each stage of the models.

It can be seen in the deliverable that waste management systems vary significantly according to the territory and the socio-demographic conditions. While in Valencia the primary systems of collection are BB, in northern municipalities such as Utrecht, D-t-D systems are more used. The analysis of plastic packaging in Europe shows trendlines in managing this kind of waste among MS.

The information has been compiled both from European reports and from the partners involved. These diagrams will be the basis for activities related to sustainability assessment on environmental, economic and social issues.

4. References

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Annexes

Annex A: Life Cycle Diagram questionnaires

QUESTIONNAIRE ABOUT THE WASTE MANAGEMENT SYSTEM IN YOUR CITY

COLLECTION PHASE: How is the plastic packaging waste collected in your city?

ALLOCATION



Curbside (kerbside) collection



Bring collection systems



Civic amenities

1. Is it collected curbside (and/or) in bring collection points (and/or) in civic amenities?
 - a. In case it is collected door to door, which types of materials are collected?
 - b. In case it is collected in bring points, which type of materials are collected?
 - c. In case it is collected in civic amenities, which type of materials are collected?
2. Frequency of collection

Other comments:

MATERIALS



Separated collection



Commingled Recycling (different recyclables together)



Selective collection: Specific type of plastic separated



Mixed system: Some type of recyclables together



All together in one container: No separation



Other systems

1. Explain the fractions (materials) which can be found in each stream:
2. Is the plastic waste collected separately?
3. Is it collected together with other recyclables like metal cans or liquid packaging board (tetra brik)?
 - a. In case it is collected together with other recyclables, which ones?

Other comments:

TRANSPORT



Different recyclables together in a truck with one compartment



Different recyclables in a truck with several compartments



One truck for each type of waste

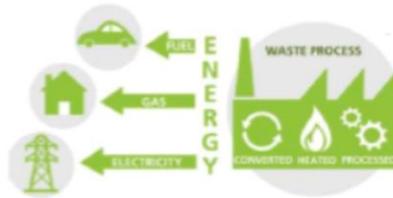
1. Explain the transport of waste in your city:
2. Which type of trucks are there in your city:
3. What type of waste is collected in each truck:
4. The trucks have lateral collection system or back collection system:

Other comments:

END-OF-LIFE



Recycling



Combustion with energy recovery



Landfill

1. Explain the disposal waste phase for the plastic packaging in your city (recycling, combustion with energy recovery, landfill)
 - a. In case it is landfilled, which types of plastic or waste are landfilled?
 - b. In case it is recycled, which types of plastics are recycled? Which products are generated from this recycled plastic?
 - c. In case of plastic combustion, which types of energy are obtained (fuel, heat, electricity...)?

Other comments:



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