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CPA/Electronics and Electrical Equipment (EEE)/Collection & sorting

STATE-OF-PLAY ON COLLECTED AND SORTED PLASTIC WASTE

1 Abstract

Figures

Complete, accurate and reliable figures of collected & sorted WEEE plastics are not available. Plastics in EEE put on the market or in WEEE collected, sorted & treated are not required to be specifically reported and moreover only 1/3 of all the e-waste discarded ends up in the officially reported amounts of collection and recycling systems.
The only available figures are therefore extrapolations based on hypothesis that do not always take into account the high diversity of EEE or national markets characteristics.

Proposed figures are based on the H2020 PolyCE project (Post-Consumer High-tech Recycled Polymers for a Circular Economy).

In Europe, 3.405.582 tonnes of WEEE were collected by the formal channels and treated in 2016:

- Appliances:
    - Large Household appliances (LHA): 1.157.897,88 t (34%)
    - Small Household appliances (SHA): 1.055.730,42 t (31%)
    - Cooling and freezing aplliances (CFA): 647.060 t (19%)
    - TVs and screens: 544.893,12 (16%)
- The total amount of plastic contained in each WEEE stream varies from 13% in CFAs, 14% in LHAs and 16.42% in TVs and screens to 36.4% in SHAs. For each WEEE stream, plastic composition is different;
- 717.000 tonnes of plastics flakes were obtained from the treatment of WEEE collected by the formal channels (which corresponds to about 23% of the current demand for plastic for EEE)
    - ABS:182.410 t
    - PP: 174.081 t
    - PS: 123.991 t
    - "Other" (around 200.000 t) and smaller quantities (<25.000t) of PC, PVC, PE, PA.
- The 717.000 tonnes of plastic flakes coming from WEEE treatment operators are made available to plastic recyclers which obtains more than 560.000 tonnes of plastic recyclates ready to enter into the production cycles.

Collection routes & sorting processes

WEEE is managed by PRO's (Producer Responsibility Organizations) on behalf of producers or by other actors (such as scrap dealers). WEEE are collected by retailers, distributors, (preparation for) reuse centers, & municipal collection facilities.
All WEEE are sorted in various fractions (e.g. Cooling & freezing appliances, White goods, TVs and monitors, Lamps, Other WEEE) at the latest when entering a (pre) treatment site. WEEE undergo disassembly and depollution, shredding, and mechanical sorting.
Plastic is just one of the several output fractions of the WEEE treatment process and the variety of different plastics families within the plastic mix is due to the fact the process itself starts with treatment of many different appliances all together. Only 'Plastics containing brominated flame retardant" have to be specifically removed and selectively treated.

Key messages

- Currently, there is a significant gap between WEEE generated and WEEE collected by the formal channels. To increase the amount of PCR WEEE plastic potentially available in Europe, it is necessary to promote WEEE collection through formal channels. **Increasing the amount of WEEE collected through formal WEEE management channels would enable greater amounts of PCR plastic to be reprocessed** and provide a higher share of the European EEE sectors plastic demand and would make it possible to take advantages of economies of scale benefits in logistic as well as WEEE pre-treatment steps.

- **The entire amount of WEEE collected through formal channels are properly treated**. This means additionally that WEEE plastics are mainly recycled (from 65% to 90%) if processed by WEEE treatment plants of the formal channels.

- At present, the quality of PCR WEEE plastic is low. Consequently, PCR WEEE plastic is mainly downcycled: namely, PCR WEEE plastics are reduced in quality and/or functionality (for example, PCR WEEE plastic are mainly used for applications such as external furniture and planters). Therefore, **PCR WEEE plastics are reduced in terms of value with respect to the original material**.

- One of the main obstacles for WEEE plastic recycling is the high heterogeneity of WEEE flows in terms of products content and in terms of products polymeric composition. This material heterogeneity needs to be assessed also in light of the products' lifecycles evolutions.

- There is a **lack of reliable and comparable data** concerning quantitative and qualitative description of the EEE/WEEE value chain. Therefore, part of the data used in this report are extrapolated from available information.

- In the graph below an overview of the state-of-play on collected and sorted plastic waste material flows as emerged from the results of this investigation.

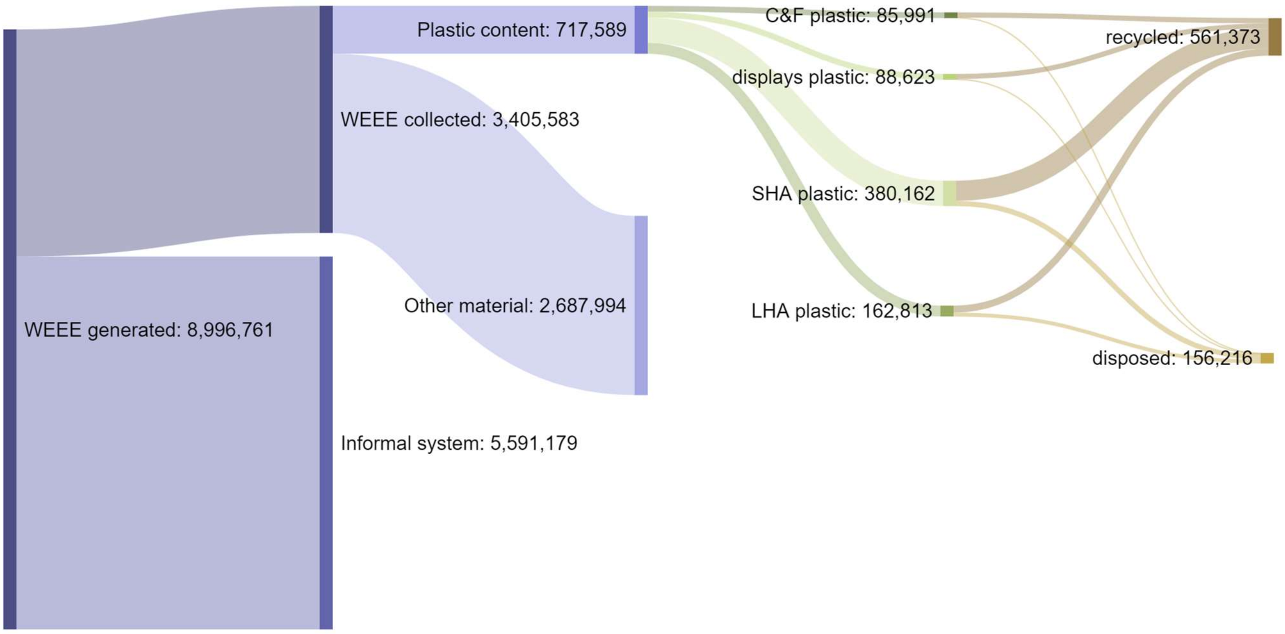

Figure 1. Overview of the state-of-play on collected and sorted plastic waste (in tons) from WEEE in Europe during 2016.

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2 Preliminary information

Main obligations & principles regarding the collection and sorting of WEEE/WEEE plastics

- Collection
    - Disposal of WEEE in the form of unsorted municipal waste has to be minimised, all collected WEEE has to undergo correct treatment and a **high level of separate collection of WEEE** has to be achieved.
    - The **WEEE collection rate** is measured as the volume of WEEE collected in relation to the average amount of EEE put on the market in the three preceding years and is not product or material (plastics) related.

- Treatment
    - All WEEE separated collected have to undergo **proper treatment** which includes the **removal and of 'plastics containing brominated flame retardant"** (WEEE directive, Annex VII).
    - Regarding the separately collected WEEE, producers have to meet **minimum recovery targets** (between 75 and 85% depending on the product category) as well as **preparation for re-use and recycling targets** (between 55 and 80%).
- Records
    - Producers or third parties acting on their behalf have to keep **records on the weight of WEEE, its components, materials or substances** when leaving (output) the collection facility, entering (input) and leaving (output) the treatment facilities and when entering (input) the recovery or recycling/ preparing for re-use facility. Producers keep records on the weight of products and materials when leaving (output) the recovery or recycling/preparing for re-use facility.

<u>Diversity of (W)EEE</u>

- Wide range of products
    - (W)EEE cover a **wide range of products** differing in terms of quantity put on the market, use (B2C, B2B), composition, size, weight, lifespan, residual value, recycling costs,…

<u>(non)-Availability of accurate figures</u>

- WEEE
    - Officially reported figures (from PRO's - Producer Responsibility Organizations - to authorities) do not cover the entire WEEE Market. The research undertaken by the Countering WEEE Illegal Trade (<u>CWIT</u>) project found that in Europe, **only 35% (3.3 million tons) of all the e-waste discarded in 2012, ended up in the officially reported amounts of collection and recycling systems**. The other 65% (6.15 million tons) was either:
        - exported (1.5 million tons),
        - recycled under non-compliant conditions in Europe (3.15 million tons),
        - scavenged for valuable parts (750,000 tons)
        - or simply thrown in waste bins (750,000 tons)

- WEEE plastics
    - There are no specific legal requirements regarding the **reporting of figures related to plastics** in EEE put on the market or in WEEE collected, sorted & treated.

3 The Value Chain of Plastics contained in WEEE

3.1 Role of the Stakeholders

The value chain of Electrical and Electronic equipment (EEE) and its wastes (WEEE) is long and complex. Several actors are involved along the lifecycle of the product starting from the extraction phase of raw materials, continuing through the production step and finishing up activities related to the management of the e-wastes. Many times, the different actors involved along the chain are not even confined within the same national boundaries. Despite the real commitment that individual actors are putting to improve the collection and the recycling of plastics in the electronic waste sector, the e-plastic value chain is still too fragmented.

- **EEE manufacturers** have several responsibilities. Firstly, considering the technical specifications and the functionality requirements of the products, manufacturers design and select the materials used in the EEE put on the market (POM). As a result, manufacturers can adopt design for recycling principles or can promote the use of recycled instead of virgin material (design for recycling approach). Secondly, once EEE turns into WEEE, manufacturers and importers of EEE must comply with the WEEE Directive 2012/19/EU.
- **Consumers** have vital importance within the value chain of plastics contained in WEEE. They have the possibility to choose between different options when disposing WEEE as long as such action comply with the national and local regulation for waste management system. Still, consumers, are generally not sufficiently aware of the available alternatives. It is known that consumers tend to accumulate their WEEE in their houses (it is estimated that about **0.6 kg/inhabitant of small household appliances are left by consumers in old homes**)[1] or, especially when it comes to small WEEE[2], incorrectly trash them in undifferentiated waste bins. The tendency to store WEEE increases with the increasing value of the item itself. The likelihood of improper disposal practices also appears to be negatively correlated with the size of the equipment, with smaller products more likely to be disposed of improperly. Such citizens' behaviors, either by hording or improper disposal, have two main impacts: the **reduction of the available material for reprocessing** and the **potential for environmental damage due to improper treatment**.
- Downstream the WEEE chain we find **operators** that collect, sort (including the equipment that can be refurbished), transport, dismantle and treat WEEE. For an effective capture of plastic materials, the role of **WEEE treatment plants** is particularly important. After the collection phase, WEEE is transported to dedicated WEEE treatment plants that deploy treatment processes according to the specific characteristics of the treated waste stream (Figure 1).

The presence of hazardous substances (as in the case of cooling and freezing appliances that contain volatile fluorocarbons or hydrocarbons (VFCs or VHCs) which need to be removed before other treatment steps) and the composition of the product belonging to a certain waste flow are the main factors that influence the selection of the appropriate treatment process. Some other treatment steps can be identified as common for all WEEE streams, such as manual sorting, disassembly and depollution, shredding, and mechanical sorting. As a matter of fact, plastic is only one of the different output fractions of the WEEE treatment process and is often the outcome of a negative sorting activity, meaning that the target fraction of the sorting is another material (e.g. steel and metals) and that plastic is a

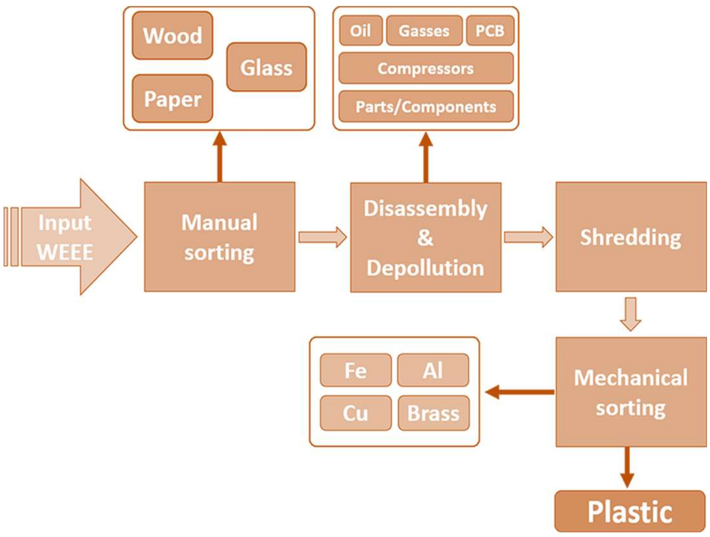

Figure 2. WEEE treatment steps.

[1] ECODOM, Rapporto Sostenibilità 2016, available at: http://www.ecodom-consorzio.it/themes/custom/ecodom/assets/pdf/rapporto-sostenibilita- 2016.pdf.

[2] PROSUM project, available at http://www.prosumproject.eu/.

contaminant that needs to be eliminated through the sorting process. Refining and processing of the output plastic fractions from WEEE treatment operators for the production of a secondary raw material as well as the recovery of spare parts for reuse are the final steps to be considered in the value chain.

3.2 WEEE collection & sorting systems

- Collection routes:
  - WEEE is collected through **retailers, distributors, (preparation for) reuse centers, & municipal collection facilities**.
  - WEEE can be collected **by producers, by PRO's** (Producer Responsibility Organizations) **on behalf of producers or by other actors** (such as scrap dealers)
- Sorting of WEEE:
  - WEEE has to be **separately collected** (which is not always the case : e.g. with other metal products by scrap dealers)
  - WEEE collected by PRO's are sorted out in **several fractions** at the first collection point (e.g. ad hoc collection boxes for lamps, small domestic appliances,… in shops) or later in the collection process. All WEEE are sorted in various streams (e.g. Cooling & freezing appliances, White goods, TVs and monitors, Lamps, Other WEEE) at the latest when entering a (pre) treatment site. WEEE undergo disassembly and depollution, shredding, and mechanical sorting. Plastic is just one of the several output fractions of the WEEE treatment process.

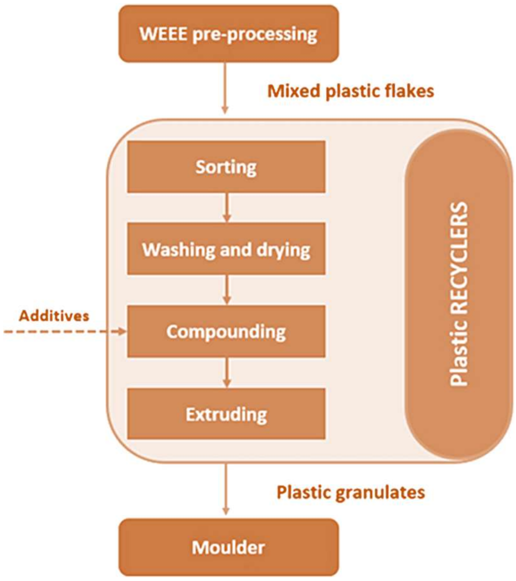

Figure 3. Plastic recycling steps.

3.3 The Recycling of E-waste

The main processing steps for plastic recycling adopted by recyclers include sorting, washing and drying, compounding and finally extrusion. In the process, the input mixed plastic flakes are transformed into plastic granules (Figure 2). Once obtained, the plastic granulates are then used to produce plastic components for new products.

Currently, the **average yield of plastic recycling processes from WEEE is around 60%**.[3] The main constraints are technical and legislative. From a technical point of view, the separation of polymers is made difficult by their similarity in terms of density and the great variety of colors in WEEE plastics. As for the legislative constraints for recyclers within Europe, there are the treatment of WEEE plastic outside European borders, the legal complexity surrounding flame retardant issues and competition with prices outside Europe.

The effectiveness of the reuse and recycling of materials significantly depends on the interconnected relationships of the EEE/WEEE value chain. **Illegal operators can impact on the capture of materials, by improper treatment or illegal exports outside of the EU**. In Europe just 35% (3.3 million tonnes of 9.5 million tonnes) of EEE

[3] F. Magalini, R. Kuehr, J. Huisman, O. Deubzer and D. S. Khetriwal, Material Flows of the Home Appliance Industry, European Committee of Domestic Equipment Manufacturers, Brussels, 2017.

discarded in 2012 ended up in official collection and recycling systems[4]. It is estimated that 1.3 million tonnes of discarded electronics departed the EU in undocumented mixed exports, of which an estimated 400,000 tonnes (30%) comprised electronic waste, the remaining being functioning equipment. It is possible that this WEEE was dumped, traded, or recycled with low recycling standards.

3.4 EEE and WEEE flows and their mass balance as it is today5

Understanding and critically analyzing the WEEE value chain as it is today is fundamental to increase the rate of recycled plastics used in the design of the new EEE. Substantial modifications must be made to the WEEE recycling and recovery chain and attention must be paid to the flows of plastic materials and the relative mass balances. The calculation of the potential quantity of plastic POM is proportional to the quantity of EEE placed on the market just as the availability of e-plastic PCR is directly related to the quantity of WEEE collected. In this study, WEEE input and plastic output from WEEE treatment facilities were calculated. A qualitative assessment was performed, developing a matrix showing the plastic content of the actual EEE and WEEE flows at the polymer level. The specificity of different WEEE streams was considered and the correspondent supply chains compared.

The Italian WEEE collection system was used as a case study concentrating on four out of the five collection streams: cooling and freezing appliances (CFAs), large household appliances (LHAs), TVs and monitors, and small household appliances (SHAs) [6]. Data from ECODOM which is the largest Italian WEEE take-back scheme was used[7]. The research focused on seven main polymers: ABS, PS, polyamide (PA–nylon), PC, polyethylene (PE), PP and polyvinyl chloride (PVC). Polymers containing flame retardants were included in the analysis.

3.5 The Availability of PCR Plastic

In Europe, 3,405,582 tonnes of WEEE were collected and treated during 2016 (19% CFA, 34% LHAs, 16% TVs and screens, 31% SHAs)[8]. The figures regarding the amount of WEEE collected in 2016 by official channels rely on the key figures made available by the WEEEForum and are built on the WEEE take back schemes' declarations. Data referring to Europe regards 17 member states.
Yet, **a considerable gap between WEEE generated and collected exist**. The total amounts of WEEE collected by country or region as a percentage of the total EEE POM in that country or region is defined as ***"return rate"***. The return rate in 2016 averaged **43% in Europe but was considerably lower for small appliances (36%)**. The recast WEEE Directive[6] sets **from 2019 the minimum rates for separate collection of WEEE at 65% of EEE POM or 85% of WEEE generated in the territory of that Member State**. The ***collection rate*** (the percentage of WEEE collected over the total WEEE generated) had a **mean of 38% for Europe** in 2016 (Figure 3). Again, SHAs represent the stream with highest gap between WEEE generated and collected. The figures regarding WEEE generated in Europe are an estimation, elaborated

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[4] CloseWEEE EU Project. Limitations, Barriers, Standards and Regulatory Gaps for Using Recycled Polymers in new EEE [Internet]. 2015. Available from: http://closeweee.eu/wp-content/uploads/2015/03/CloseWEEE-D2. 1-Limitations-Barriers-Standards-and-Regulatory-Gaps-for-Using- Recycled-Polymers-in-new-EEE.pdf.
[5]Ecodom
[6] Plastics Europe, The Facts 2018, Analysis of European plastics pro- duction, demand and waste data, Brussels, 2018.
[7]Eduljee, G.,H., Harrison R., M., Electronic Waste Management 2nd Edition, Chapter 11. Plastics in Electronic Waste: Results from the PolyCE Project, Royal Society of Chemistry, pp. 313-337, 2019
[8] Personal Communication with MGG Polymers

starting from the information available in The Global E-Waste Monitoring 2017 regarding domestic e-waste generated per country in 2016[9].

Real data are not available regarding the composition of the WEEE not managed by the formal systems. However it can be considered similar to the composition of the flows managed by the formal actors. Some differences could occur in specific WEEE families, for example for Large appliances, the majority of ovens or hoods ends up in the informal flows considering the high content of metals.

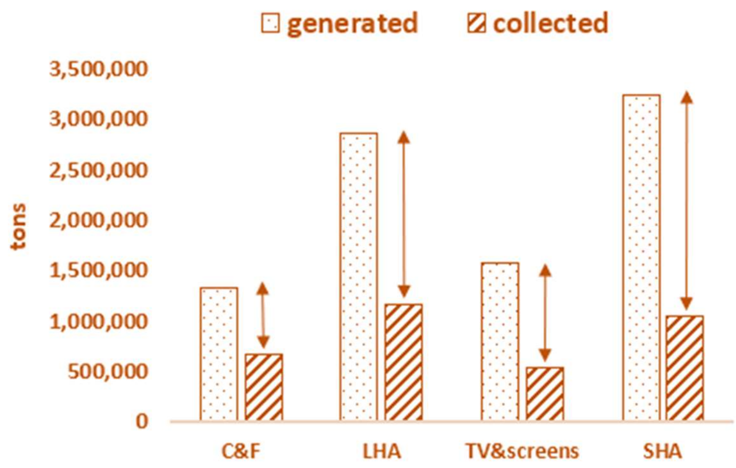

Figure 4. Total WEEE collected versus total WEEE generated in Europe during 2016.

The four different WEEE streams (Polyurethane (PUR) is not considered in the analysis) are summarized in Table 1. **The total amount of plastic contained in each WEEE stream varies from 13% in CFAs, 14% in LHAs and 16.42% in TVs and screens to 36.4% in SHAs.**[10] The plastic content includes plastic parts (*e.g.* pieces/parts of plastic, rubber) as well as the plastic contained in other components (*e.g.* plastic from cables, plastic from compressors) and removed through dedicated treatment steps (manual dismantling, shredding, mechanical sorting, *etc.*).
Plastics that culminate after processing in reduced quality and/or functionality with respect to the original ‘‘downcycled’’ material are included under the heading of ‘‘recycled’’. According to estimates, reuse of PCR plastics in EEE (close loop recycling) is estimated below 1%. Therefore, incorporation of recycled plastics in the EEE market remains negligible [11].
As 7% of SHAs contains brominated flame retardants (BFRs) that cannot be recycled, SHAs have a lower recycling rate comparing to other streams.[18]

The information regarding the plastic content of the different WEEE flow as well as the information regarding the PCR WEEE plastic downstream chain have been reported according to the data collected through the database software WF-RepTool during 2016: the WEEE treatment plants that operate as ECODOM's suppliers are obliged to make detailed information about their treatment performance available through WF-RepTool. The required information consists of the quantitative and qualitative

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[9] K. Baldè, V. Forti, R. Kuehr and P. Stegmann, The Global E-waste Monitor, United Nations University (UNU), International Telecommunication Union (ITU), International Solid Waste Association (ISWA), 2018.
[10] The average plastic composition of different WEEE streams is reported in the annex I.4.
[11] RDC Environment, Material efficiency by marking in EU Ecodesign Marking to identify and recover Critical Raw Materials (CRM) at End-of-Life Marking to control a mandatory plastic Post-Consumer Recycled content (PCR) (2017)

assessment of the input and output fractions of the plants, as well as the further treatment steps of the material. The data provided by WF-RepTool have been validated at European level through a survey assessing similar qualitative and quantitate data in the hands of European take back schemes that are WEEE Forum members.

Real data available regarding WEEE collected in Europe; extrapolation regarding WEEE generated.

Table 1. *Different WEEE streams and the end destination of the plastics.*

WEEE streams	Recycled % of the total treated	Energy recovery WEEE plastic	Disposed
CFAs	90,13%	8,15%	**1,73%**
LHAs	64,87%	20,29%	**14,84%**
TV& screens	86,04%	5,49%	**8,47%**
SHAs	**79,44%**	**6,30%**	**14,26%**

The results from the current study are strengthened with this data and data from the literature, and also validated through interviews and consultations with the various stakeholders operating within the EEE/WEEE sector[12]. During data analysis **it has been evident that tracing plastics through the WEEE value chain is a true challenge**. The PolyCE project has aimed to address this challenge and further validate the results presented in this study. Another key objective of PolyCE has been to determine each polymer's share in the recycled WEEE plastic by evaluating the availability of each type of available polymer from PCR WEEE plastic that can be potentially reused into new EEE. The polymer mix that characterizes the total collected WEEE PCR plastic in Europe is shown in Figure 4.

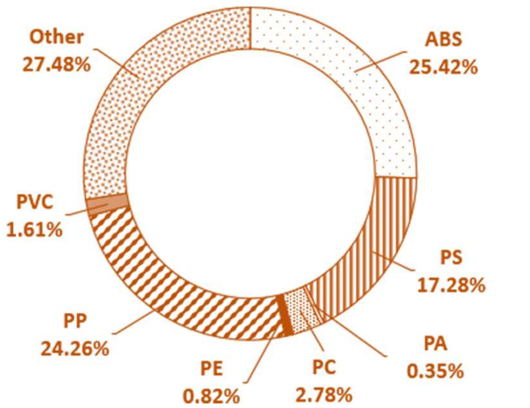


Figure 5. Polymer mix in collected WEEE plastics: Europe.

This polymeric mix has been extrapolated combining the data concerning the average composition of the different waste streams in terms of product (gathered through sampling campaign performed by ECODOM in Italian WEEE pre-treatment plant) and the data reported in literature review studies (for example, performed by the project PROSUM and APPLiA).

Real data available regarding WEEE plastic dowstream chain of collected WEEE in Europe; extrapolation regarding WEEE plastic polymeric composition.

[12] WF-RepTool, available at https://www.wf-reptool.org/.
ECODOM, Rapporto Sostenibilit`a 2016, available at: http://www.ecodom-consorzio.it/themes/custom/ecodom/assets/pdf/rapporto-sostenibilita- 2016.pdf.
PROSUM project, available at http://www.prosumproject.eu/.

There are some "other" plastics categories which are not considered in this study and contain different polymers such as ABS, PS, PA, PC, PE, PP and PVC as well as polymers that were not found during the investigation, but can be significant (e.g. 46% for CRT in TVs and screens, 42% for vacuum cleaners, 28% for mobile phones, 23% for desktop PCs in the SHAs stream and 22% for kitchen in LHAs) (Figures 5 and 6).

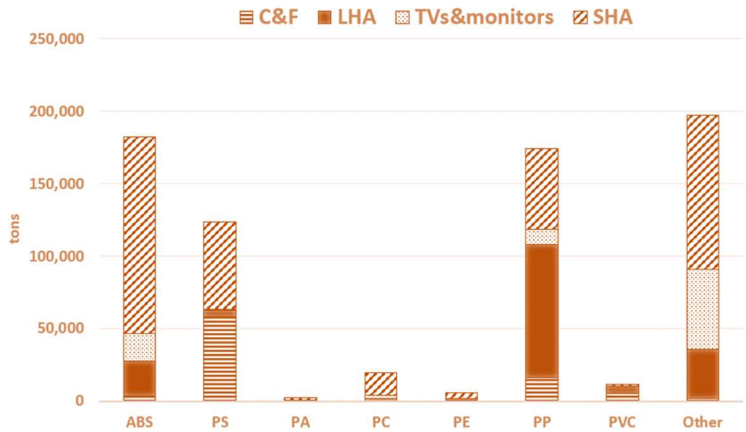


Figure 6. Available WEEE plastics in Europe. The bar chart presents the contribution of each type of waste stream to the total amount of different available WEEE PCR polymer.

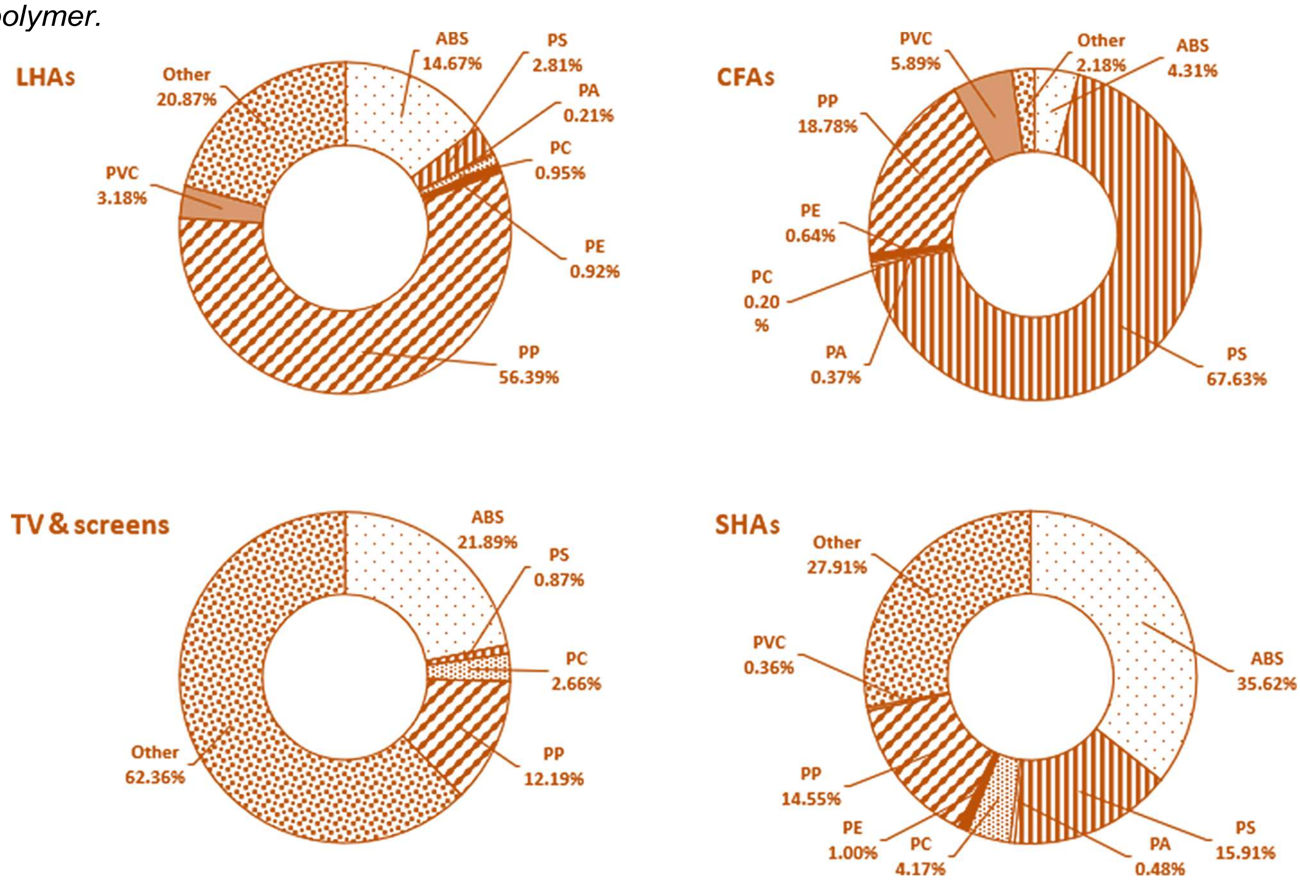


Figure 7. Plastic composition of the four waste streams derived from the research. The charts show the composition of the different polymers in each of the four e-waste streams.

Overall, the analysis shows that in Europe 717,588 tonnes of PCR WEEE plastics were collected (53% from SHAs, 23% from LHAs, 12% from TVs and screens, and 12% from CFA). The total ABS collected was 182,410 tonnes in Europe, of which

74% was derived from small household appliance plastic. ABS is a valuable plastic that is relatively easy to reprocess and recycle back into EEE. This demonstrates that if a significant proportion of SHAs are not being collected (Figure 3) this represents a significant loss in potential capture and therefore recycling of this polymer.

174,081 tonnes of PP were collected in Europe: 53% of this was derived from large household appliances. 123,991 tonnes of PS were collected, ap- proximately half from CFAs and half from SHAs. The CFAs waste stream is composed of 67% of PS; the LHAs waste stream is mainly composed of PP (56%); the TV and screens waste stream is composed of 21.9% of ABS and by more than 62% of other polymers; while the SHAs waste stream is composed of 35% of ABS and 27% of ‘‘other’’ polymers.

4 From linear to circular economy

4.1 European plastic demand and supply

In Europe, the total amount of plastic demand is estimated to be around 51.2 million tons. 6.2% is the demand of the EEE sector and this percentage is equivalent to about 3.2 million tons of plastic[1]. The treatment of WEEE allows to cover this demand with about 717.000 tons of plastic, which corresponds to about 23% of the current demand for plastic for EEE. Among the main reasons hindering the reintroduction of recycled WEEE plastic into the EEE value chain is the gap between WEEE disposed of and WEEE collected which reduces the amount of plastic from WEEE that is available. **It is important to note that the SHA category has the highest plastic content (36.4%) and at the same time the lowest return and collection rate.** It is therefore necessary to promote the collection of WEEE belonging to the SHA flow. Looking at applications, from an OEM perspective, there are several challenges that need to be addressed to effectively use PCR plastics in new applications. Some of them are related to the complexity of the PCR plastic value chain[13], specifically: i. the PCR plastic market is characterized by many suppliers on the market with huge quality variation; ii. there is a low level of technical support regarding PCR plastic; iii. the high-quality recycled grades have a lower price than virgin material. PCR plastic quality is not clearly defined, and quantities are not stable.

4.2 Material Flow and Mass Balance Considerations

Figure 7 shows the data described in section 2.1 to provide an overview of the plastic polymer composition of the WEEE flows studied.

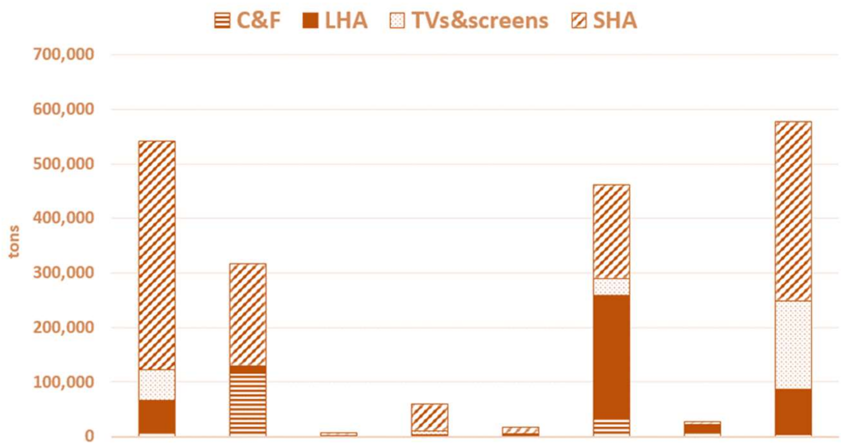


Figure 8. Potentially available WEEE plastic from WEEE generated in Europe: polymers.

With the current treatment of 3 million tons of WEEE in Europe, we know that 717,000 tons of plastic are obtained. Therefore, to show the possible positive impact that can be obtained by improving the collection performance of

WEEE, and taking into account that when WEEE are properly collected through official channels are then also properly treated, if we consider that in Europe approx. 9 million tons of WEEE are produced, then additional 2 million tons of recycled plastic could be obtained.

A qualitative analysis was replicated on the basis of the polymeric composition of the new EEE (not the elements currently present in the WEEE streams but those which will be eliminated in future years). This approach has extrapolated data on the average composition of materials for new household appliances, in particular cooling and freezing and large household appliances[13]. The results of the assessment of future WEEE flows expected are presented in Figure 8.

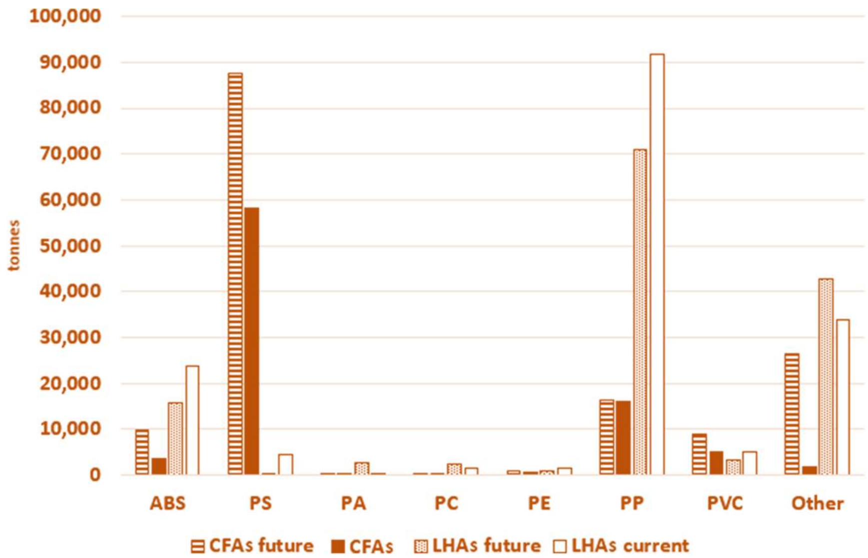


Figure 9. Comparison of current WEEE polymers and future WEEE Polymers for LHAs and CFA.[16]

Analyzing the projection for the future waste streams, it is highlighted that the total amount of WEEE PCR plastic from CFA is expected to increase by 75% compared to the present value, while the total amount of WEEE PCR plastic from LHAs is expected to decrease by 14% compared to the present value. Some variation in the polymeric composition of the different WEEE flows is also expected.

Extrapolation regarding future polymeric WEEE plastic composition.

4.3 WEEE plastic circularity

As presented above, there is a significant amount of WEEE PRC plastic potentially available to be reintroduced in the productive cycle of new EEE products. However, there still some relevant operative and economic barriers to be overcome to reach this goal. These barriers are as follows :

- significant gap between WEEE generated and WEEE collected by the formal channels
- uncertainties related the quality of treatment of WEEE collected through other channels than the formal ones

[13] F. Magalini, R. Kuehr, J.Huisman, O. Deubzer, D. S. Khetriwal, Material Flows of the Home Appliance Industry, 2017

- difficult separation of polymers due to their similarity in terms of density;
- high variety of colors in PCR WEEE plastic flows;
- the high-quality recycled grades have lower price than virgin material, however, PCR plastic quality is not clearly defined and quantities are not stable;
- flame retardant issues (legal complexity and evolving regulation).

The application of PCR WEEE plastic in new product is impeded also by other factors as:

- the quality of PCR plastic varies according to the used source;
- transparent natural colour and food contact grades are scarcely available (mainly black and grey colour currently available);
- using PCR plastic is difficult to obtain high gloss surfaces.

The second CPA EEE deliverable will “Identify untapped potential for collection and sorting”.

- # ANNEX I - data-sources and references

1. Studies/projects

- CWIT
    - The research undertaken by the Countering WEEE Illegal Trade (CWIT) project found that in Europe, only 35% (3.3 million tons) of all the e-waste discarded in 2012, ended up in the officially reported amounts of collection and recycling systems
    - Officially reported figures do not cover the entire market.
    - WEEE is not always properly collected/treated

    - Remark
        - Key issue with regard to the state-of-play on collected and sorted plastic waste in WEEE

- WEEE compliance promotion exercise of 2017 – mapping out key issues for each MS country.
    - Screening of the WEEE management practices in the EU-28 : WEEE Collection pp 41-45
    - Annex A – Factsheets on WEEE management in the EU-28 : Organisation of the collection system (per Member state)

    - Remarks
        - No data on collected and sorted plastic waste in WEEE

- Belgian Plastics market
    - The company Conversio conducted a survey on the Belgian Plastics market in 2019.
    - According to Conversio the plastic content of WEEE is about **26%** which is **significantly higher** that the Belgian PRO (Recupel) overall figures.
    - If we extrapolate these figures to WEEE potentially collected by other actors than Recupel, the difference between data officially recorded by Recupel and Conversio figures is significant (47t vs 18t).

    - Remark
        - Likely high discrepancy between officially reported data (plastics/weee) & reality

Figures based on Conversion 2019, Recupel data & Deloitte[14]

2017	Plastic % in WEEE	Collected WEEE by Recupel (kt)	TOTAL collected WEEE (Recupel, other actors) (kt) - Estimation	Plastic in collected WEEE (kt)

[14] (D)EEE 2016 Bilan de masse et structure du marché en Belgique- https://cdn.uc.assets.prezly.com/3c552b5a-5bd5-42cd-927c-9dcc5ffb225f/-/inline/no/

Conversio analysis	26		182	47
Recupel figures		117		18

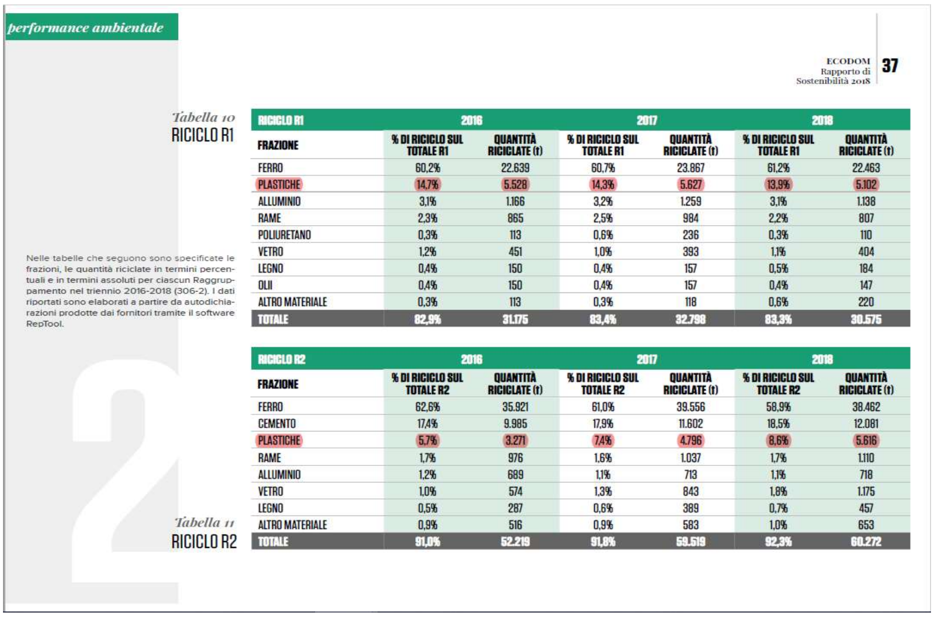
- EERA (European Electronics Recyclers Association) published a brochure describing how WEEE recyclers treat mixed plastics with Best Available Technology in compliance with WEEE and POP regulation. "*In Europe the total quantity of plastics used for the production of electric and electronic products amounts to some 3 Mio MT's per year. 1,2 million MT mixed WEEE plastics arise from the separated collection of WEEE in Europe. About 300.000 tonnes of these plastics are delivered to specialized recycling facilities in Europe and recycled as Post-Consumer Recycled – PCR plastics. 75% of the WEEE plastics are exported from Europe and it is unknown how much is recycled as PCR plastics.*"

- Material Flows of the Home Appliance sector (APPLIA) - Average material composition large home appliances (plastics) : 21.1%
    - Average material composition small home appliances (plastics) : 27.4%
    - Plastic consumption at global level to produce and annually supply home appliances EU market : 0.5%
    - Average material composition of home appliances : p34
    - Share of end use (plastics) : 0.5% (EU home appliances)
    - Materials recovered from home appliance WEEE collected by industry
        - Large home appliances : 0.05Mt plastics (7%)
        - Small home appliances : 0.11Mt plastics (33.1%)
        - Colling & freezing : 0.08Mt plastics (15.5%)
    - Considering 2016 as the reference year and the 4 Mt of home appliances waste estimated as collected across EU : 0,24 Mt of Plastics has been recovered from industry flows + 0.37Mt Recovered from complementary flows = 0.61 Mt

2. WEEE PRO's

Italy - ECODOM

The following tables specify the fractions, the quantities recycled in percentage terms and in absolute terms for each product group in the three-year period 2016-2018. The data reported are processed from self-declarations produced by suppliers through the software RepTool.
2019 updated numbers are R1 (cooling & freezing equipment – 13.8% in 2019), R2 (large household appliances – 8,3%), R3 (TVs & monitors – 15,1%), R4 (Small appliances – 31.5%), R5 (Lamps – 7.2%)



performance ambientale

ECODOM Rapporto di Sostenibilità 2018 37

Tabella 10
RICICLO R1

RICICLO R1	2016		2017		2018	
FRAZIONE	% DI RICICLO SUL TOTALE R1	QUANTITÀ RICICLATE (t)	% DI RICICLO SUL TOTALE R1	QUANTITÀ RICICLATE (t)	% DI RICICLO SUL TOTALE R1	QUANTITÀ RICICLATE (t)
FERRO	60,2%	22.639	60,7%	23.867	61,2%	22.463
PLASTICHE	14,7%	5.528	14,3%	5.627	13,9%	5.102
ALLUMINIO	3,1%	1.166	3,2%	1.259	3,1%	1.138
RAME	2,3%	865	2,5%	984	2,2%	807
POLIURETANO	0,3%	113	0,6%	236	0,3%	110
VETRO	1,2%	451	1,0%	393	1,1%	404
LEGNO	0,4%	150	0,4%	157	0,5%	184
OLII	0,4%	150	0,4%	157	0,4%	147
ALTRO MATERIALE	0,3%	113	0,3%	118	0,6%	220
TOTALE	82,9%	31.175	83,4%	32.798	83,3%	30.575

Nelle tabelle che seguono sono specificate le frazioni, le quantità riciclate in termini percentuali e in termini assoluti per ciascun Raggruppamento nel triennio 2016-2018 (306-2). I dati riportati sono elaborati a partire da autodichiarazioni prodotte dai fornitori tramite il software RepTool.

RICICLO R2	2016		2017		2018	
FRAZIONE	% DI RICICLO SUL TOTALE R2	QUANTITÀ RICICLATE (t)	% DI RICICLO SUL TOTALE R2	QUANTITÀ RICICLATE (t)	% DI RICICLO SUL TOTALE R2	QUANTITÀ RICICLATE (t)
FERRO	62,6%	35.921	61,0%	39.556	58,9%	38.462
CEMENTO	17,4%	9.985	17,9%	11.602	18,5%	12.081
PLASTICHE	5,7%	3.271	7,4%	4.796	8,6%	5.616
RAME	1,7%	976	1,6%	1.037	1,7%	1.110
ALLUMINIO	1,2%	689	1,1%	713	1,1%	718
VETRO	1,0%	574	1,3%	843	1,8%	1.175
LEGNO	0,5%	287	0,6%	389	0,7%	457
ALTRO MATERIALE	0,9%	516	0,9%	583	1,0%	653
TOTALE	91,0%	52.219	91,8%	59.519	92,3%	60.272

Tabella 11
RICICLO R2

3. Eurostat

- Database on WEEE by waste management operation for each country
- Remarks
  - *Official figures reported by MSs*
  - *No data on collected and sorted plastic waste in WEEE*

4. WEEE Forum data

As a result of a 2020 consultation through the WEEE Forum members, the average of plastic composition for different WEEE streams- is reported in the following table.

	Plastic composition of the different WEEE streams (100% is the total plastic fraction)							
WEEE flows	ABS	PS	PA	PC	PE	PP	PVC	Other
C&F	15,88	67,15	0,19	0,10	0,32	12,33	2,95	1,09
LHA	15,50	2,63	0,17	0,92	1,29	59,36	2,03	18,11
TVs&screens	22,17	2,12	0,01	2,74	0,03	6,57	0,01	66,38
SHA	31,02	16,09	0,65	4,66	1,09	16,35	0,87	29,29