(W)EEE Mass balance and market structure in Belgium

Final report

Commissioned by Recupel

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Summary

In 2012, a recast EU Directive on Waste of Electrical and Electronic Equipment (WEEE) was adopted, which requires EU Member States to achieve ambitious WEEE collection targets by 2019. To meet these targets, Member States must collect either 65% of the electrical and electronic equipment (EEE) placed on the market in the three preceding years or 85% of WEEE generated.

However, in Belgium, as well as in Europe as a whole, there are no established methods for determining how much EEE is placed on market or the amount of WEEE that is generated. Without overcoming these knowledge gaps, it will be difficult for Belgium to demonstrate that it will meet the new EU collection targets, or even determine how much additional WEEE must be collected in order to meet them.

Over the past 10 years, Recupel has set up a system for the collection and recycling of WEEE that meets the targets under the current legislation. Meeting the new collection targets will require more than simply additional effort; it will require more detailed information on the amounts of EEE placed on market and WEEE generated beyond current view of Recupel, as well as on the various actors involved in WEEE collection and recycling in Belgium.

It is toward this end that Recupel commissioned this research project on market structure and mass balance of (W)EEE in Belgium. It is the aim of this research project to generate and make available the data necessary for holding fact-based discussions with government and market parties involved in the collection and recycling of WEEE, which will better enable Belgium to meet the new EU WEEE collection targets.

The study uses a statistical model for calculating the amounts of EEE placed on market and WEEE generated. This model was developed by United Nations University (UNU), and it has also been applied in similar studies in the Netherlands and Italy. Beyond Recupel, information about collected and recycled WEEE was gathered via an extensive survey of market parties and from government registries and national statistics, as well as from data from the literature. During the study, a consultation group with representatives from governments and market parties held three meetings to discuss the setup and progress of the study.

The research led to the following insights for 2011:

- The UNU approach delivers a robust calculation of the amount of EEE introduced to the market, 26.2 kg per inhabitant, which is calculated based on national statistics of the production, import and export of EEE. This calculation is consistent with the 25.8 kg per inhabitant calculated based on Recupel's own data combined with the data reported to the government by individual companies (Individual Plans). The share of manufacturers and importers that work as free riders, outside of the system, appears to be minimal. The amount of WEEE generated from the market is calculated at 22.4 kg per inhabitant. This is a sufficiently robust calculation. However, the accuracy can be improved as it is based on a limited set of Belgian data.
- Via Recupel and the Individual Plans, 47% of this WEEE Generated amount is registered. Via the market surveys and other research, this study documents an additional 23% of WEEE generated. The remaining 30% is not yet documented, but recommendations are made below as to how to further fill this important knowledge gap.

The results of the study on (W)EEE mass balance in Belgium in 2011 are summarised in the table below.

Kg/Inh	LHA	C&F	SHA (incl IT)	SCREENS	LAMPS	PROF	Total (kg/inh)	Total (kton)	
EEE Put On Market	8,53	3,26	10,01	1,64	0,24	2,53	26,2	287	
WEEE Generated	6,85	2,43	8,26	2,93	0,20	1,68	22,4	245	
Registered	2,72	1,81	3,36	2,34	0,12	0,13	10,5	115	
Not Registered	**4,13**	**0,62**	**4,90**	**0,59**	**0,08**	**1,55**	**11,9**	**130**	**47%**
Schredders & EERA	0,83	0,08	0,29	0,00	0,00	0,21	1,4	15	
Export Scrap Metal Companies	0,79	0,07	0,26	0,00	0,00	0,20	1,3	14	
Export EEE	0,22	0,14	0,14	0,03	0,00	0,05	0,6	6	
Export WEEE	0,10	0,06	0,06	0,01	0,00	0,02	0,3	3	
WEEE in residual waste	0,00	0,00	1,53	0,00	0,01	0,00	1,5	17	
Documented	**1,94**	**0,35**	**2,28**	**0,04**	**0,01**	**0,48**	**5,1**	**55**	**23%**
Not documented	**2,19**	**0,27**	**2,62**	**0,55**	**0,07**	**1,07**	**6,8**	**75**	**30%**
% Not documented	**32%**	**11%**	**32%**	**19%**	**35%**	**64%**	**30%**	**30%**	

Mass balance of (W)EEE in Belgium in 2011

The data generated by this study will provide a solid foundation for Recupel's discussions with government and market parties regarding measures to be taken to reach the EU's new WEEE collection targets.

Introduction

In our modern society, the use of electrical and electronic equipment (EEE) to meet personal, household and business functions is nearly ubiquitous and increasing yearly. As the use of EEE increases, so does the rate at which these items are discarded. Today, this Waste Electrical and Electronic Equipment (WEEE) forms a significant and quickly growing waste flow that must be collected and recycled responsibly. Due to a number of factors, the collection and recycling of WEEE presents a unique and complex set of challenges. These factors include:

- The heterogeneity of the devices in terms of dimensions, materials, weight, and functionality/application (e.g. refrigerators, tablets, process control devices in production companies)
- The continuous introduction of new products and new applications of devices that all have different compositions and characteristics
- The presence of hazardous components and substances in some devices (e.g. substances that damage the ozone layer, mercury, and other heavy metals) that must be processed correctly
- The possibility of recovering valuable resources such as metals and plastics, but also a number of rare natural resources that are of critical importance due to their limited availability and strategic application (e.g. ruthenium, indium, platinum, and rare earth elements), and of which, EEE contains a significant share of the world's supply
- The large number and diversity of actors and industry sectors involved throughout the life cycle of EEE, from design to reprocessing, and their respective roles, interests and responsibilities
- Developments in the recycling of WEEE and the addition of a specialised WEEE sector that can recycle these devices

Accordingly, directives have been implemented in a number of European countries for more than a decade, including in Belgium and the Netherlands, to tackle the WEEE issue in a coordinated and effective manner. In 2003, a European Directive[1] to harmonize the various existing directives established. In addition to implementing extensive manufacturer responsibility, that Directive also established a WEEE collection target of 4 kg per inhabitant per year, as well as recycling targets for the collected devices. This is the basis for the current legislation in Belgium and for the agreements that the regional governments have signed with Recupel. Based on these agreements, Recupel fulfils the responsibilities of the Belgian manufacturers and importers of devices with which it is affiliated.

In 2012, a recast version of the European Directive was published, which includes new, ambitious targets.[2] These targets are no longer based on a collection target per inhabitant, but instead on a percentage of the amount of EEE placed on market or the amount of WEEE generated.

As Recupel prepares for the implementation of this legislation, it is confronted by two gaps in its knowledge:

1. In Belgium, as in the rest of Europe, there is no common method for determining how much EEE is placed on market in a given year. Similarly, there is no accepted method for determining how much WEEE is generated by the market.
2. The new collection targets are much more ambitious than the current targets and Recupel does not have a clear picture as to the location of the WEEE that is currently not reported to Recupel or governments.

[1] Directive 2002/96/EG concerning waste of electrical and electronic equipment
[2] Directive 2012/19/EG concerning waste of electrical and electronic equipment (revised)

It is necessary to bridge these knowledge gaps in order to determine which measures are needed to ensure the recast WEEE Directive targets imposed on Belgium can be achieved in the future. In order to get a clear picture of the current situation in Belgium, Recupel commissioned this study on the market structure and the mass balance of (W)EEE. This situation sketch is meant to serve as a basis for conversations with government and market parties active in the collection and recycling of WEEE about possible measures to achieve the new EU targets.

This report presents the results of that study. Chapter 1 provides a brief overview of the parties involved in the collection and recycling of WEEE, as well as the challenges they face due to the new EU Directive. Chapter 2 outlines the study's research questions and research design. Chapter 3 addresses the first knowledge gap by presenting a method for the calculation of the (W)EEE generated, as well as the results generated by this method of calculation. Chapter 4 addresses the second knowledge gap by providing an overview of both registered flows and the documented complementary flows. Chapter 5 brings together the results of the different sub-studies and provides an overview of the total mass balance of (W)EEE for Belgium. The study's conclusions and recommendations are presented in Chapter 6.

1. Market structure and challenges

The goals of this study are two-fold. The first goal is to gain insight into the existing market structure for WEEE in Belgium. The second goal is to provide a realistic, scientifically sound estimate of the amount of WEEE available for collection. This estimate is based on the available data and research on the existing market structure. In order to sketch the research framework, the report will present a basic outline of the market structure for the collection and recycling of WEEE in Belgium. Included is a description of Recupel's role and the challenges posed by the new EU Directive.

1.1. The market structure for the collection and recycling of WEEE in Belgium

The market for the collection and recycling of WEEE in Belgium consists of a complex web of interfacing actors, as shown in figure 1 below.

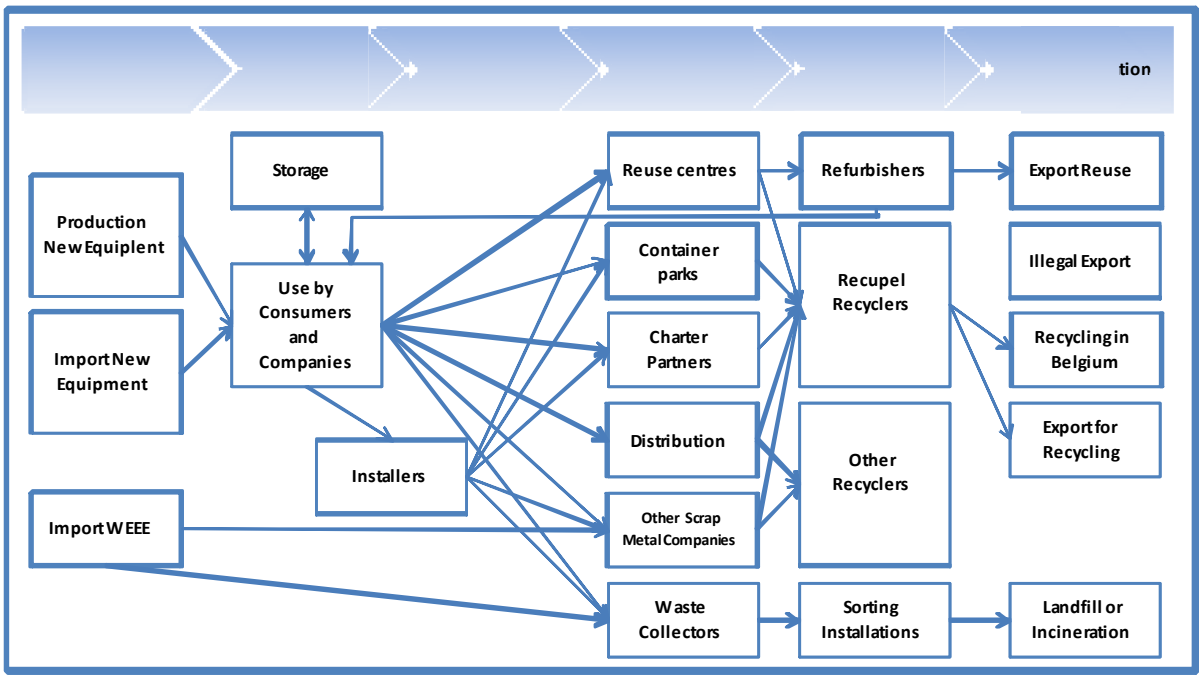

Figure 1: Market structure for the collection and recycling of WEEE in Belgium

The first phase is the 'import and production' phase. Manufacturers introduce EEE to the Belgian market, or importers situated in Belgium import it. Once these devices are introduced to the market in Belgium, they move to the 'use' phase. This phase includes the EEE that is in use, as well as the EEE that is no longer used, but that is stored (rather than discarded) by the user. When the consumer decides to discard the EEE, it becomes WEEE. This transition takes place in the 'discarding' phase.

Consumers and businesses have various options for disposing of their WEEE. This is the 'collection and sorting' phase. Often in the WEEE market, collection and recycling are separate but closely related steps. For example, intact devices that can be reused after repairing, refurbishing[3] and/or cleaning are often sold in Belgium or abroad as second-hand devices.

[3] Refurbishing is a process in which devices that still work well are adjusted so that they work according to new standards. For example, old data is removed from information systems, new software is installed, and old parts are replaced by new ones.

Once WEEE is collected, it proceeds to the 'treatment' phase in order to be recycled. In this phase, processors remove hazardous components and substances from the WEEE and recycle many materials into raw materials that will be used to make new products. This recycling may take place in Belgium or abroad.

A portion of the WEEE that enters the treatment facilities arrives in the form of fractions, where WEEE or WEEE components are mixed with other waste. This is partially sorted prior to processing and recycling. Non-recyclable materials end up in waste incinerators or landfills.

In addition to the WEEE that is collected and processed through the formal, regulated and either reported or not-reported channels listed above, a portion of the WEEE generated in Belgium is exported illegally from the country.

1.2. Recupel

it is the responsibility of the manufacturers and importers of EEE to collect and recycle their equipment in an environmentally responsible manner. Companies can submit an Individual Plan to the government, in which they indicate how they fulfil this requirement. They may also choose to set up a common collection system that will fulfil their collection obligations. In 2001, a group of manufacturers and importers established Recupel. Recupel organises the collection and environmentally responsible recycling of WEEE for its affiliated manufacturers and importers.

Currently, Recupel uses four collection channels:

- Container parks in municipalities where individuals can dispose of their WEEE
- Retailers that sell new devices (on an old-for-new/trade-in basis)
- Reuse centres that process some of the used EEE as second-hand devices
- Private operators that have a charter agreement with Recupel

WEEE collected via Recupel is treated in an environmentally sound manner by companies contracted by Recupel. Hazardous substances and components are removed from equipment, and are then recycled separately. The remaining materials, such as metals, plastic, and glass, are recycled into secondary raw materials and incorporated into new products.

All actors involved with collection and recycling report to Recupel, and Recupel provides a detailed annual report to the government. Figure 2 shows the section of the market where Recupel is active (the scope).

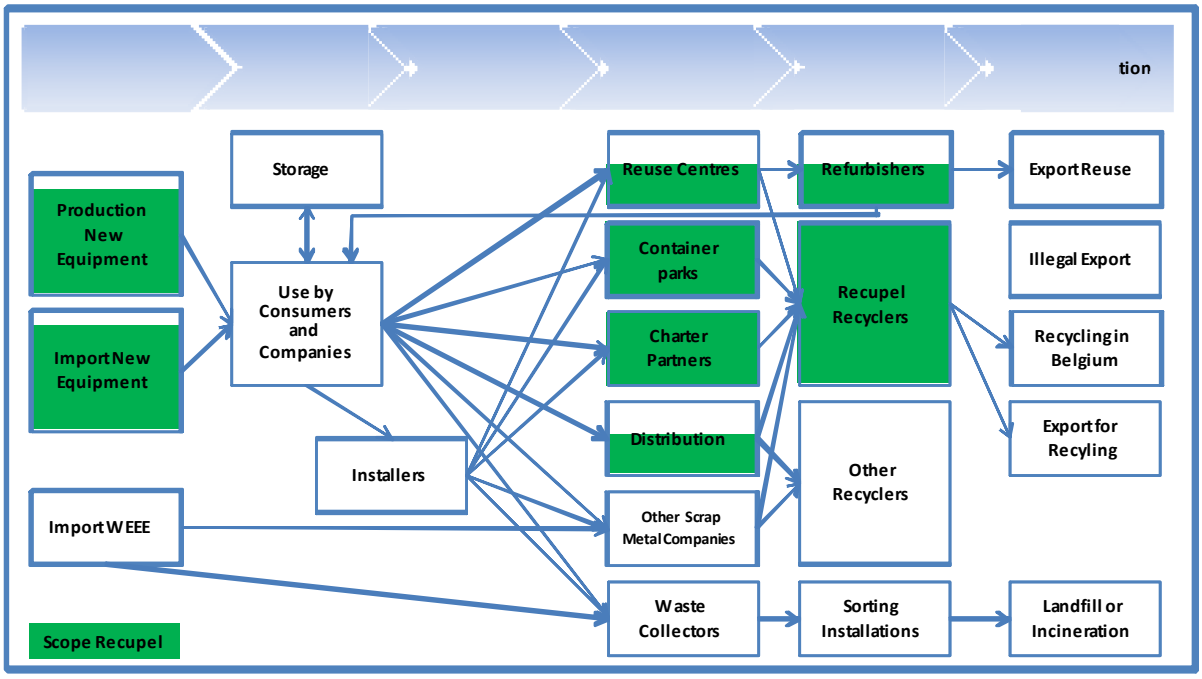

Figure 2: Scope of Recupel

The affiliated manufacturers and importers pay a contribution to Recupel for every device sold in Belgium in order to finance the take-back system. The size of this monetary contribution varies by device, according to the respective recycling costs. The manufacturers and importers notify Recupel of the number and types of devices sold in Belgium; based on that information, Recupel determines the amount of the contribution per company. The contribution, or visible fee, is communicated to the logistics chain and is mentioned separately on purchase invoices.

Since the founding of Recupel in 2001, there has been a continuous increase in the amount of WEEE collected and recycled, as shown in Figure 3 below. Recupel meets the existing EU WEEE collection target of 4 kg per inhabitant.

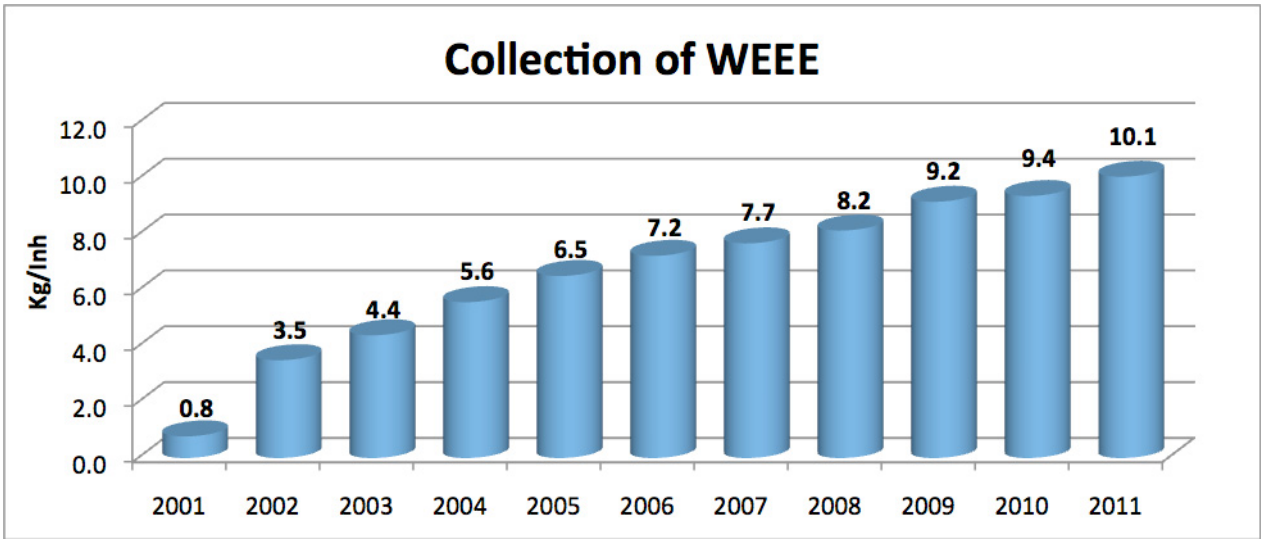

Figure 3: Collection by Recupel 2001 – 2011 (kg per inhabitant)

1.3. The challenge

1.3.1. Ambitious new targets

The revision of European Directive 2012/19/EU, published in 2012, includes ambitious new targets for the collection of WEEE.

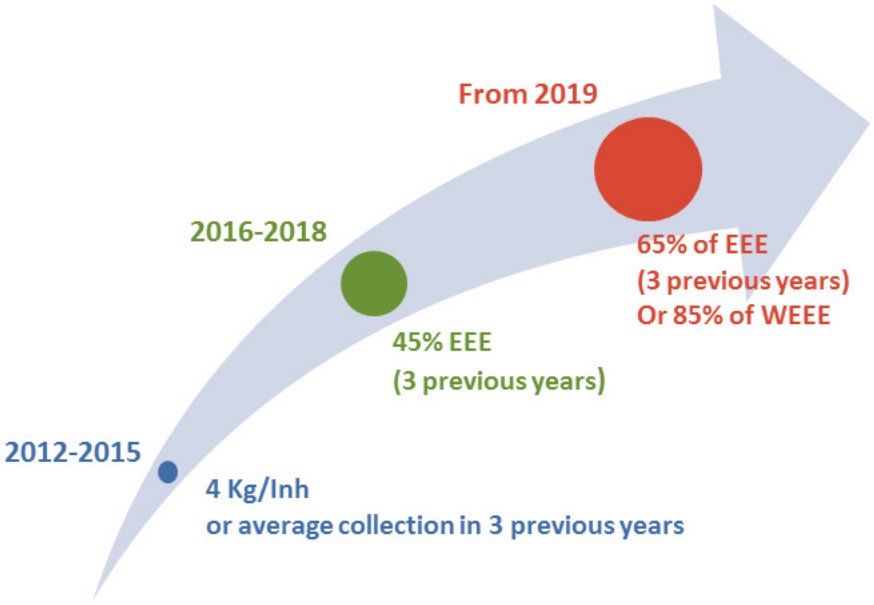

Figure 4: Collection targets from the new EU Directive 2012/19/EU

From 2012 to 2015, the established target is to collect a minimum of 4 kg per inhabitant, or the average quantity that is collected in the three previous years, if that quantity is higher than 4 kg per inhabitant. In 2016, the way in which the target is determined will fundamentally change. From 2016 to 2018, 45% of the average amount of EEE placed on market in the three preceding years must be collected. As of 2019, this percentage will increase to 65%. Beyond 2019, an alternative ways of determining the target bass may be selected: It may be based on 85% of the WEEE generated to be collected in the year concerned.

This target must be achieved by the Member States and it is yet unclear how the target basis will be determined due to the lack of a common methodology, to be developed by the European Commission DG Environment.

1.3.2. Current collection results

Before choosing a methodology for determining the target, it is important to note the current collection results (see Table 1, below).

Households	2008	2009	2010	2011
Collection (Kg/Inh)	8.2	9.2	9.4	10.2
Put on market (Kg/Inh)	22.9	23.3	23.7	24.1
% Collection*	36%	39%	40%	42%
Professional	**2008**	**2009**	**2010**	**2011**
Collection (Kg/Inh)	0.2	0.3	0.2	0.3
Put on market (Kg/Inh)	4.3	3.1	3.0	3.5
% Collection*	4%	9%	7%	7%
Total (Housholds + Professional)	**2008**	**2009**	**2010**	**2011**
Collection (Kg/Inh)	8.4	9.5	9.6	10.5
Put on market (Kg/Inh)	27.2	26.4	26.7	27.6
% Collection*	31%	36%	36%	38%

Table 1: Collection results: WEEE Recupel in relation to EEE placed on market by Recupel members.
* Percentage of total WEEE actually collected by Recupel compared to EEE placed on market by Recupel members

The table above shows the amount of WEEE collected by Recupel in relation to the total EEE placed on market by Recupel members. In order for the data to be nationally representative, the data from the Individual Plans must also be added. As will become apparent later in this report, the Individual Plan data are very limited and have no significant impact on the outcome of current collection results. Recupel currently collects 42% of household WEEE, but only 7% of professional WEEE. This brings the total collection result to 38%. The collection percentage is calculated based on the quantity that is introduced to the market in that same year. This only concerns data reported by companies affiliated with Recupel. Thus, neither the data nor the collection percentages meet the criteria set by the EU Directive. Because Recupel's collection rates are likely higher than those of the Individual Plans, it is likely that future WEEE collection in Belgium will have to increase considerably in order to achieve the new EU targets.

2. Research questions and approach

2.1. Research questions

In order to determine the best methodology for establishing the targets and gain a better understanding of the WEEE volumes that must be collected in order to reach the targets, a number of knowledge gaps must be filled. First, the amount of EEE that is placed on market in Belgium must be determined. There is no established methodology for this in Europe or Belgium. Second, there is no methodology to determine the amount of WEEE generated in a given year. Third, there is currently no visibility of WEEE that is collected by collectors and recyclers not affiliated with Recupel. Currently, this information is reported infrequently or not at all. There is also the possibility that collectors and recyclers affiliated with Recupel collect some WEEE that they do not actually report to Recupel. Finally, both the scope and location of unreported WEEE flows remains unclear.

As a result of these knowledge gaps, the amount of WEEE that must be collected and reported in order to meet the news targets remains unclear. This research will therefore answer the following questions:

1. **What is the amount of EEE placed on market in Belgium?**
   What portion of this EEE is placed on market by companies that are affiliated with Recupel or that have submitted an Individual Plan to the government? What is the share of free riders?

2. **How much WEEE is generated in Belgium?**
   Recupel's data, in combination with the data from the Individual Plans, do not cover the entire market, as even government data are incomplete due to lack of data from other sources.

3. **How much WEEE is being collected and how is it recycled?**
   While considerable data are collected by Recupel and the Individual Plans, it is suspected that WEEE collection and recycling also happens outside of these systems, thus rendering government data incomplete.

4. **Where and how large are the unregistered flows?**

The information required to answer these research questions is depicted schematically in Figure 5.

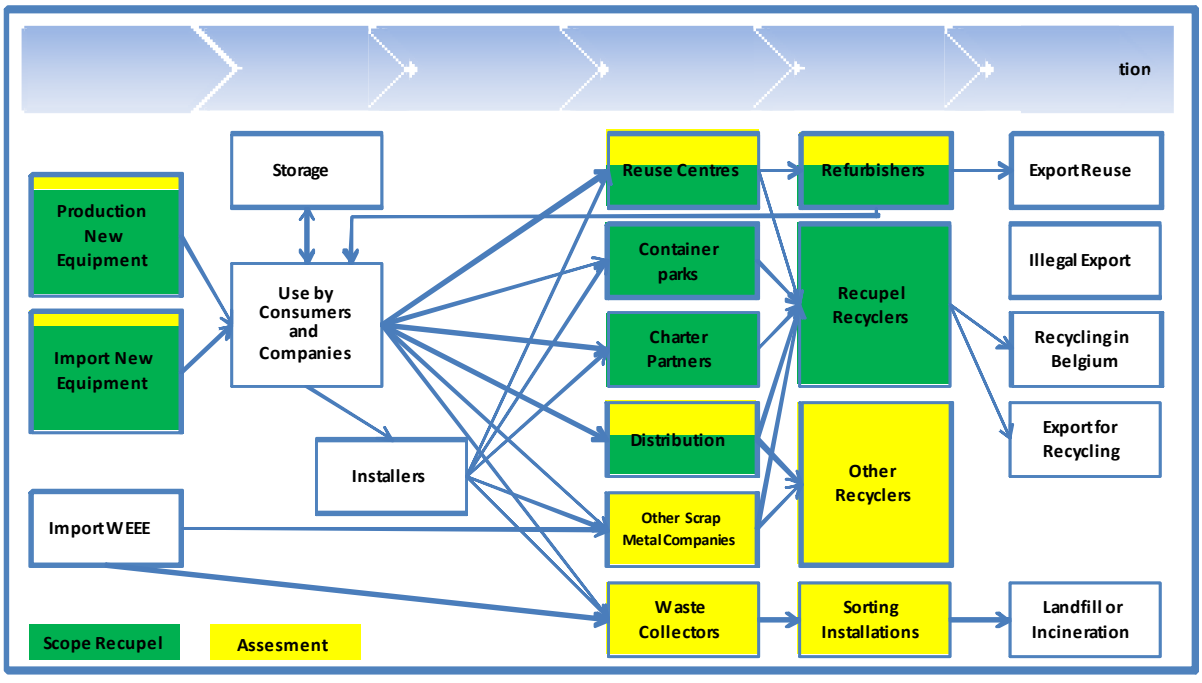

Figure 5: Assessing the data that are currently not represented

2.2. Methodology

In order to answer research questions 1 & 2, which concern how much (W)EEE is generated by the market, a statistical model developed by United Nations University (UNU) is used. This model will hereafter be called "the UNU-model" in this report. This model and its methodology were also used in the Netherlands for comparable research by the same research offices in 2011 and 2012, commissioned by Wecycle. Additionally, the model is being used for similar research in Italy, and it will also be used in France. A detailed description of the model is offered in Chapter 3.

An extensive market survey was conducted in order to gather information and answer research questions 3 & 4, which concern how much (W)EEE is collected/recycled and where this takes place. Chapter 4 contains the details about how the information was gathered.

Finally, the data that the UNU-model generated are compared with the results of the market survey in order to arrive at a total mass balance for (W)EEE in Belgium.

2.3. Research firm & data sources

The research was conducted by FFact Management Consultants (FFact) in collaboration with United Nations University (UNU). FFact is a research firm experienced in research on recycling and waste companies. UNU has conducted considerable research on WEEE flows and has developed a calculation model for this purpose. The researchers who conducted the study in Belgium were also involved in the study in the Netherlands. Bio Intelligence conducted the study in France with support from UNU, and the study in Italy is being undertaken by UNU with support from Politecnico di Milan.

The study uses as many data sources as possible, including:

- National statistics
- Administrative data provided by Recupel and governments
- Studies on equipment ownership, market studies and waste studies
- Data derived from interviews with market parties

2.4. Phasing and supervision

Before the research started, the following were ensured:

- The national statistics needed for UNU's calculations are available in Belgium.
- Recupel's results can be compared to the data from the UNU model.
- The government was prepared to provide data about the companies that conduct the collection and recycling of waste, including WEEE. The data from the Individual Plans could also be used.
- The companies that collect process and recycle WEEE agreed to participate in the study and to mobilise their members to participate in the research.

The conclusion of this pre-study is that the quality and availability of the basic data necessary for conducting the study in Belgium are sufficient, though less than were available in the Dutch study. It was also determined that there was sufficient public support for the research from government and market parties to conduct the study.

From there, the data for feeding the UNU model was gathered, and the market survey and analysis of the remaining information sources were conducted. During the research, the researchers regularly consulted with Recupel and the consultation group. This consultation group, made up of representatives of Recupel, IBGE/BIM, OVAM, OWD, COBEREC and FEBEM, held three different meetings. The first meeting, held in February 2012, served to present the research approach and confirm the consensus between the different organisations in terms of the research goals and methodology. The progress was discussed and the first

qualitative results of the study were presented in July 2012. On 5 March 2013, the study's final results were presented.

It is important to note here that this research is not aimed at providing solutions for greater collection of WEEE, nor is it seeking interventions in unreported systems of WEEE collection. This research, as described in the four research questions, is only aimed at assessing the factual quantity of (W)EEE, which forms the basis for further consultation concerning future actions.

3. From EEE to WEEE

This chapter answers research questions 1 & 2:

1. **What is the amount of EEE placed on market in Belgium?**
   What portion of this EEE is placed on market by companies that are affiliated with Recupel or that have submitted an Individual Plan to the governments? How large is the share of free riders?

2. **How much WEEE is generated in Belgium?**
   Recupel's data, in combination with the data from the Individual Plans, do not cover the entire market, as even government data are incomplete due to lack of data from other sources.

3.1. The UNU-model

3.1.1 International use of the UNU-model

As indicated previously, United Nations University (UNU) has developed a statistical model with which an estimate can be made of the amount of EEE placed on market and the amount of WEEE generated, based on data of sales, stocks and lifespan profiles. This UNU-model (also called the 'UNU WEEE Generated' model) has been used previously in studies in the Netherlands and Italy. A similar study using this model is under way in France and another may soon be undertaken in France and Spain.

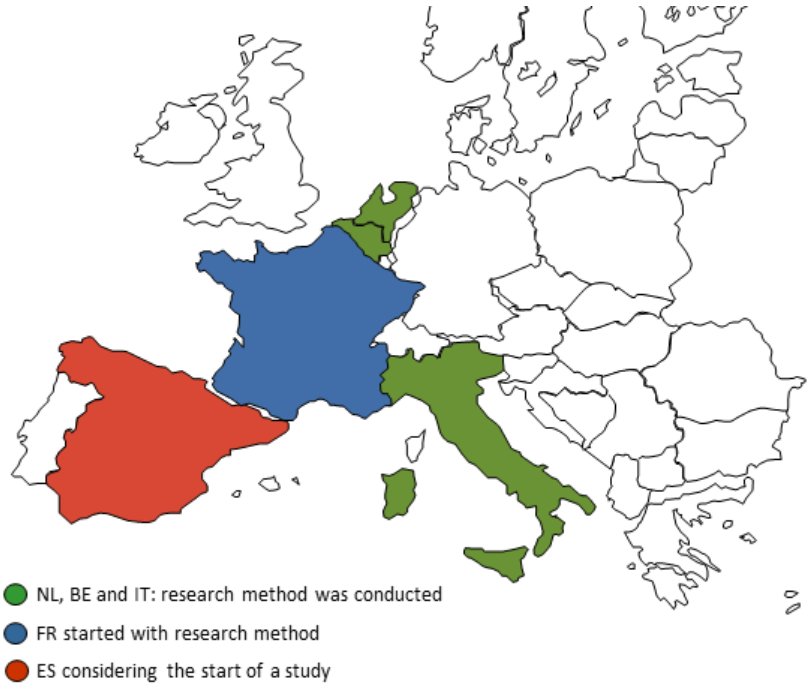

Figure 6: International use of the UNU-model

The fact that this model and its results are used in several different countries offers the possibility of making an international comparison and gaining insight into the model's reliability and accuracy based on similarities and differences between the different countries.

The volume of WEEE generated depends on several factors. The most important factor is of course the amount of EEE that is placed on market. The first step in the analysis is the detailed reconstruction of the historical EEE quantity for different products and collection categories, a task for which UNU developed a model.

The following steps are taken consecutively:

1. EEE is classified into 55 categories (UNU-keys).
2. The scope of what is EEE and what is not is carefully defined.
3. The different data sources are compared and judged on their data quality and representativeness.
4. By means of studies of stock levels in households and companies, as well as accompanying lifespan profiles, an estimate is made of the quantity of WEEE generated.
5. Finally, the plausibility of the original EEE data is verified.

3.1.2 Classification of EEE in 55 categories (UNU-keys)

Due to the complex and heterogeneous character of (W)EEE flows, consistent classification is necessary in order to guarantee compatibility of the (partial) results and clearly define the scope of products. UNU has divided all EEE into categories, which enables data analysis from a product-focused perspective (functionality) for market introduction and a processing-focused perspective for collection. The UNU list categorises all different EEE products on an aggregated level (per collection category) as well as on an individual product level (per individual device type). The detailed list (see Appendix A) is based on 55 subcategories (Wang et al., 2012).

These 55 UNU-keys include:

- all possible EEE and WEEE products (approximately 900 different product types), including a B2B/B2C ratio in the sales channel
- the 6 or 7 collection categories as they are listed now in the revised EU Directive (with a specific category for professional devices)
- the 10 product categories of the old EU Directive that are now employed in practice
- the 17 UNU subcategories used by the WEEE Forum (WEEE Forum, 2010)
- the 36 categories that are now used by Recupel for determining the EEE quantities of the participants

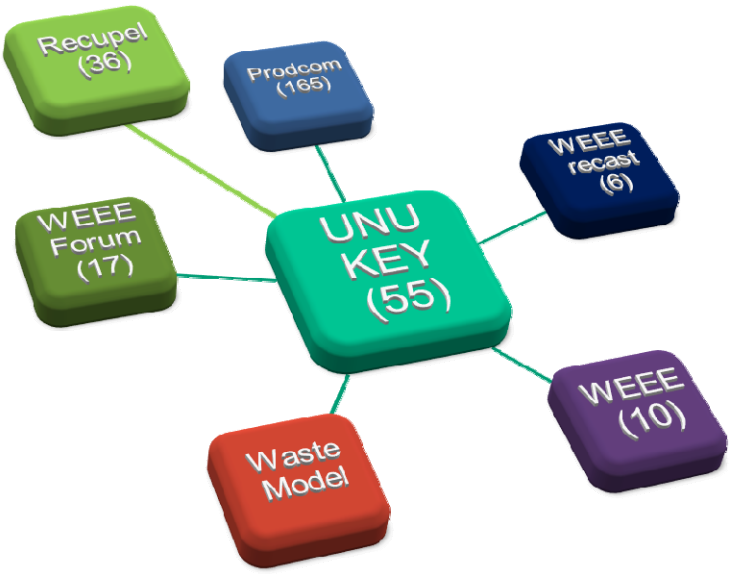

Figure 7: UNU-Keys, the key between different data sources

Finally, the UNU-keys are linked to all EEE related Prodcom (PCC) and the combined nomenclature (CN) codes as they are applied in international trade and production statistics and customs reports. The most important advantage is that all possible categories are now uniquely linked and international comparison of EEE and WEEE is possible.

3.1.3 Establishing the scope

This research comprises the following (W)EEE products:

A. Large household devices (LHA), including professional luminaires and other large professional iron dominated products, including central heating (central heating boilers, boilers and water heaters).

B. Cooling and freezing devices (C&F), including refrigerators, refrigerator-freezer combinations, deep freezers, and air conditioners and installations.

C. Small household devices (SHA), including small IT and CE (consumer electronics) products, tools, toys, and other small objects from the 10 old WEEE categories. This category includes products of which it is uncertain whether they fall within the scope of the revised EU Directive, such as consumer luminaires and small toys with light or sound functions.

D. Screens (SCREENS), including CRT and flat-panel TVs and Screens (FPD: Plasma, LCD and LED).

E. Lamps (LAMPS), with the exception of tungsten light bulbs and loose halogen light bulbs.

F. Professional equipment (PROF), including special professional (non-household) equipment, including cooling installations, automatic machines, hospital equipment, etc.

G. IT equipment (IT), including laptops and desktops incl. accessories, telephones, printers, and computer games.

This categorisation generally follows the collection categories that are recognized by Recupel. The decision was made to represent professional equipment and IT equipment (IT) in separate categories. This is important because they are also represented separately within the new EU Directive.

3.1.4 Comparison of the data sources

Different information sources are used to calculate the quantity of EEE that is historically placed on market. Table 2 shows an overview of each source with an indication of accuracy, reliability, historical coverage, completeness and accessibility.

Source	Description	Remarks	Accessibility	Used?
Recupel EEE report	Since 2001, more reliably since 2005, EEE reported in 36 categories.	In this period, coverage is limited, especially for products with a long lifespan. The quantities for household equipment are available in numbers and in kg, but the latter is based on weights of the return flows and not of new devices. The quantities of professional devices are considered reliable, also in terms of weight.	Only internally at Recupel and by the monitoring governments	Yes
Statistics industrial production (Prodcom)	Statistics Belgium (BELSTAT) gathers data about industrial production according to the provisions of the applicable EU Laws and thereby uses the prescribed techniques, definitions, and classifications. Data about the production of EEE are also included here. The data are available from 1993.	Data for some codes of certain products are confidential. The data concerns the value of the products, a complimentary unit that can vary per code (kg, piece or other measurement value). The classification of the products has been adjusted in the course of time.	Public	Yes
Trade statistics (Combined Nomenclature)	The National Bank gathers data monthly and quarterly on the value and scope of foreign trade in accordance with the provisions from the applicable EU Laws. These data also comprise information on EEE. Data are available from 1995.	The data concern the value of the goods and a complimentary unit that varies per code (kg, piece or other measurement value). Changes in the classification may arise, but are less frequent than in the case of the Prodcom codes.	Public	Yes
Federations of industry sectors	The most important federations from the industry can publish data about the market and sometimes about market penetration for specific products in their annual reports.	In general, these tabulations are available for the most representative products in a product category	Internally for members of the federations	Not available for Belgium
Experts market research	Questionnaires and analyses of market statistics are often	The questionnaires usually concern a limited number of products (less than	They are mostly available at a	Yes, IT (EITO) and

Source	Description	Remarks	Accessibility	Used?
	conducted by specialised organisations with the aim of evaluating the developments in specific markets and determining the market penetration of certain products.	several dozen).	price. Limited accessibility.	lamps (GfK)

Table 2: Summary of data sources

The registration of goods in the national statistics is the primary source for the validation of all Belgian sales data. This registration is extensive and comprises all EEE categories. This is because this registration is based on an EU Law and there are comparable registrations from other EU countries. Registration data kept by industrial sector federations and organisations for manufacturer responsibility are often incomplete.

For this project, the data from national statistics are used to verify all available sales data. The data about annual national production are registered by Statistics Belgium according to the EU nomenclature of the PRODCOM (EU's statistical classification of national production of commodities) as PRODCOM codes (PCC). The data on annual import and export volumes are registered by the National Bank according to the codes of the Combined Nomenclature (CN, based on the EU statistics). Most PCC codes are linked to one or more CN codes in the trade statistics.

By using the EU codes, all data in EU countries are registered in a comparable manner at the enterprise-level, as well as on the level of individual remittance. For publication, these data are aggregated to a quantity per country so that the data cannot be linked to individual companies.

The data per collection code are based on aggregate data from the national statistics.

Collection categories	Number of CN Codes	Number of PCC codes
LHA	18	10
C&F	19	9
SHA	202	96
SCREENS	19	8
LAMPS	14	9
PROF	22	12
IT	27	18
Total	**321**	**162**

Table 3: Number of product codes per collection category

3.1.5 Estimating WEEE

The UNU-model is an advanced version of so-called Input-Output Analysis methods (IOA). Whereas traditional IOA models only use two parameters, the advanced 'sales-stock-lifespan' model connects all three IOA pillars. First, the quality of the input data is verified and clearly described for all three of these pillars (right side of figure 8). Then, the most probable outcome is determined from the combination of the different data sources based on their quality, for example, based on the amount of underlying data points. Figure 8 illustrates the relation between these variables of the IOA and the different data. The quantity of products in households and companies is compared with the inflow of EEE (POM) and outflow of WEEE of a funnel. The level in the funnel represents the stock.

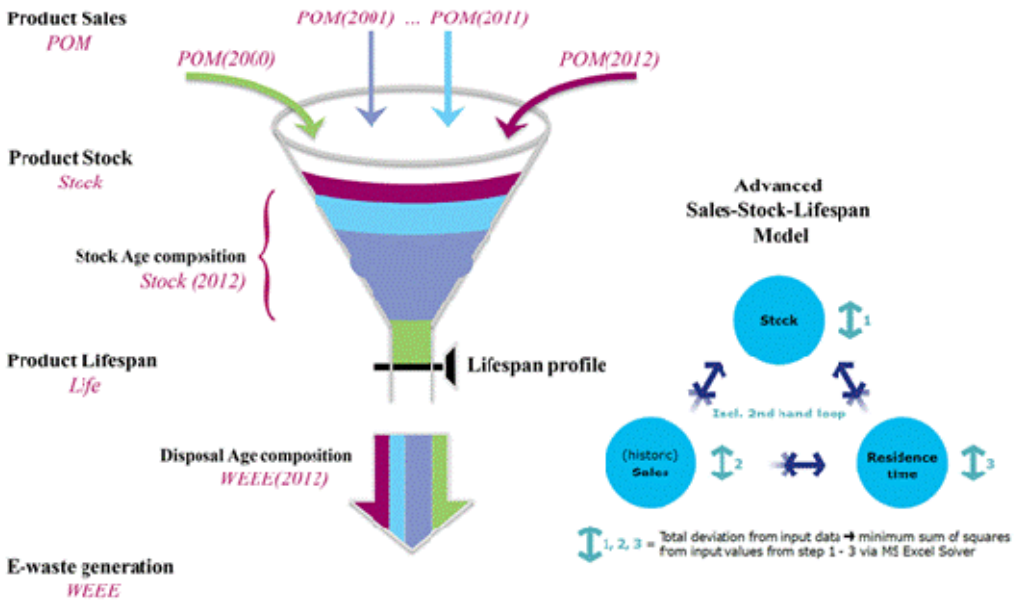

Figure 8: Structure of the UNU-model

Information can be extracted from each data point that represents a portion of the funnel:

- Historical sales
- Size of stock
- Age distribution of the stock
- Age distribution of the e-waste outflow

The relation between these data points must correspond with the law of mass preservation. Different IOA calculation algorithms are described by (Wang and Huisman, 2013). This allows for the reconstruction of historical EEE quantities and a prediction of the amount of WEEE that will be generated in the coming years. This approach seeks to determine the other variables with the highest data quality (such as consolidated or long-standing sales figures and the size of the outstanding stock of EEE from market research and the data with the most underlying data points in general), and other variables (with intrinsic higher uncertainty and less data points, such as the lifespan distribution over time) for each of the UNU-keys. By linking several data sources, structural errors or uncertainties in the data surface on their own. Different limitations and conditions, as well as knowledge of the market development for individual products, help to reconstruct the EEE and WEEE flows of the recent past. Examples of conditions are the saturation levels of devices such as having approximately one washing machine present per household, or from indirect data like the relation between the number of subscriptions and the stock of mobile phones. Additionally, there are numerous 'logical' conditions, such as the quantity of EEE, that must always be greater than WEEE generated, and the total mass balance present in the recycling market may not be greater than the predicted quantities. Due to the structural application of a weighing scheme for data quality from different sources for the same parameters and running data optimisation, consolidation and multi-variable analysis, the accuracy increases and the outcomes are better documented than traditional IOA methods that utilize fewer data sources. Finally, a careful documentation of data quality leads to an overview of the UNU-keys that have a little or a lot of room for improvement. This allows for targeted improvement of the quality of the entire data set and especially for the most relevant UNU-keys.

3.2. EEE Put on the Market

3.2.1 EEE data and data quality

The plausibility of the data from the national statistics is verified by comparing it to the sales data after modelling in the UNU-model for the quantity of WEEE generated. Sales data from reports by the European Information Technology Observatory (EITO) are used as a complimentary data source. Finally, the data from the possession study by Alpha Research for the year 2007 was used to calibrate the data from the other data

sources. The database and the model are processed via a standard procedure in order to find and eliminate errors and differences.

For the comparison of data from the national statistics with the data registered with Recupel and via the Individual Plans, the data from both sources are converted into quantities per UNU-key, a simple conversion because the classifications of the PCC and CN are more detailed than necessary for the model. Recupel's data and the Individual Plans are only available on a higher aggregate level and they are separated in order to derive data for the 55 UNU-keys. In order to make this division, the data from national statistics are aggregated further so that they coincide with the Recupel categories. After that, the weight share for these data per UNU-key within the Recupel categories was calculated, and these ratios were used to divide the original Recupel data into the UNU-keys. It then became possible to compare Recupel's data and the Individual Plans with the data from the national statistics in order to get an idea of the coverage and indications of possible free riders.

The resulting data quality is maintained precisely for the different data sources per UNU-key and expressed in a weighing scheme before and after applying the model. The highest reliability is found for washing machines, refrigerators, vacuums and TVs. The devices with the lowest data quality are heating equipment, air conditioners, remaining small household devices, sports equipment and professional surveillance & control equipment. On average, the data quality is slightly lower in the Belgian study than in the Italian study and significantly lower than in the Dutch study. This is primarily due to the lack of a recent and specific possession study at the household level in Belgium.

3.2.2 EEE Recupel plus Individual Plans vs. UNU-model

The outcomes of the evaluations of the amount of EEE placed on market are shown in Table 4. The amount of EEE placed on market from Recupel's registrations and the Individual Plans are compared with the outcomes of the UNU evaluations per Recupel category. Data from the Belgian statistics are used in combination with the Dutch average weights per product in order to achieve representative average weights per product: The weights from Recupel's registration are based on the data on the number of units, multiplied by the average weight per product in the return flow of household devices. For a significant number of categories, the weight in the return flow is not representative for the weights of the devices newly introduced to the market. This is due to newer products often being lighter than old products. Hence, the Dutch average weights of products placed on market are chosen for B2C equipment.

Recupel Cat.	Description	UNU-Keys	Recupel 2010 vs. 2011	Indv. Pl. 2010 vs. 2011	UNU 2010 vs. 2011	Deviation	Remarks
01.01	Fridge freezer – HH	0107-0112	3.12		3.23	- 0.11	Coincide fairly well
01.02	Large household appliances – HH	0102-0105,0114	**5.67**		**7.20**	- 1.53	Incl. 0106 and a portion of cat 2, weights deviate from Recupel.
01.03	Large household appliances ventilation and heating – HH	0106	0.37		0.45	- 0.08	Incl. A portion of cat 2, coincide well.
01.50	Fridge freezer – PROF	0113	0.53		0.67	- 0.14	Coincide fairly well
01.51	Large household appliances- PROF	0001,0101	0.77	0.16	1.32	- 0.39	Including central heating? More products in scope?
02.01	Small devices HH	0201-0203,0205	2.07		2.40	- 0.33	Coincide well. Some products are in 01xx Recupel codes.
02.02	Vacuums	0204	0.50		0.53	- 0.03	Coincide well.
02.50	Small devices – PROF	in 02.01				-	Included in 02.01
03.01	Monitors	0308-0309	0.56		0.42	0.14	Weights deviate from Recupel, supervise return flow CRT
03.02	Remaining IT – HH	0301-0306,0702	**4.63**		**2.23**	2.40	Weights deviate from Recupel.
03.50	IT – PROF	0307	0.45	0.18	0.80	- 0.17	Scope question: PROF vs. sell B2B?
04.01	TVs	0407-0408	**1.00**		**1.30**	- 0.30	Weights deviate from Recupel, return flow CRT, TVs
04.02	Remaining consumer electronics- HH	0401-0406	1.65		1.27	0.38	Weights deviate from Recupel, heavier products in return flow
04.50	Remaining consumer electronics – PROF	0703	0.09		0.09	- 0.00	Coincide well, in UNU under 0703 and 0704
05.01	Gas discharge lamps	0502-0505	0.33		0.25	0.08	Weights deviate from Recupel, weight per lamp too high at Recupel
05.02	Fixtures – HH	0501,0506	0.56		0.68	- 0.12	Uncertainty for halogen spots etc.
05.50	Fixtures – PROF	0507	0.75		0.73	0.01	Coincide well, uncertainty about scope.
06.01	Tools – HH	0601	1.17		0.83	0.34	Weights deviate from Recupel
06.50	Tools – PROF	0602	0.19		0.14	0.05	Weights deviate from Recupel
07.01	Toys – HH	0701	0.38		0.21	0.17	Gaming computers 0702 together with 0302, weights deviate from Recupel
07.02	Sports articles – HH	0703	0.39		0.13	0.26	Weights deviate from Recupel?
08.01	Medical – HH	0801	0.01		0.01	- 0.00	Coincide well

Recupel Cat.	Description	UNU-Keys	Recupel 2010 vs. 2011	Indv. Pl. 2010 vs. 2011	UNU 2010 vs. 2011	Deviation	Remarks
08.50	Medical – PROF	0802	0.16		0.39	- 0.22	Weights deviate from Recupel
08.51	Glucose measurement devices – PROF	in 0802	0.00			0.00	Included in 08.01
09.01-09.06	Surveillance HH	0901	0.19		0.23	- 0.04	Included in Recupel data?
09.50 – 09.53	Surveillance – PROF	0902	0.09		0.20	- 0.11	Scope, are installations included in the statistical data?
10.50	Automatic machines with cooling – PROF	1002	0.12	0.11	0.24	- 0.01	Coincide well
10.51	Remaining automatic machines - PROF	1001	0.06		0.13	- 0.07	Weights deviate from Recupel?
Total			**25.81**	**0.45**	**26.06**	**0.20**	

Table 4: Comparison of EEE placed on market in Recupel registrations and Individual Plans with the outcomes of the calculations from the UNU-model (quantities in kg/inh based on the average for 2010 and 2011)

For the total quantities, Recupel's data cover the total market, especially when looking at the number of units. By applying non-representative average weights, there are large deviations for some UNU-keys. By using better data about weights from the comparable study in the Netherlands, data that are more reliable could simply be derived for the amount for each UNU-key for EEE placed on market per inhabitant. For the future determination of the amount of EEE placed on market it is recommended that manufacturers report not only the number of units, but the weights per unit and the total amount in kilograms.

Based on data from the national statistics as well as the registrations of equipment placed on market by Recupel's participants and the Individual Plans, a time sequence is made of the amount of EEE placed on market per product category. These categories are made by aggregating the UNU-keys to a level that is comparable with the collection of WEEE categories. This is done in order to make a comparison between EEE and WEEE on the level of the collection categories later in the report. A time sequence is reconstructed that runs from 2000 to 2011. The total weight of devices is expressed in kilograms per inhabitant as well as in number of units, as shown in Figures 9 and 10. The tables with the background figures are included in Appendix B.

It is expected that, due to the higher number and shorter lifespans of devices placed on market, the amount of WEEE will increase very quickly. Indeed, this occurred up to 2006. However, the average weight per device has declined since 2003. This is especially the case for screens, as heavy CRTs were replaced by LCD screens between 2003 and 2008, and also for IT and small household devices, such as mp3 players. Additionally, the worldwide financial crisis at the end of 2008 led to a decline in sales. Together, these factors have contributed to a net stabilisation in the amount of EEE put on market of around 25 kg per inhabitant since 2007. For refrigerator-freezer combinations, the number of units has steadily increased, and the weight per unit has also increased, as people purchase more and larger refrigerators with double doors. For small household devices, including kitchen machines and consumer electronics, the increase in the number of units sold is very high. However, due to the lower weights per device (especially for consumer electronics) the increase in weight is limited. The same can be seen in IT equipment and in particular for screens.

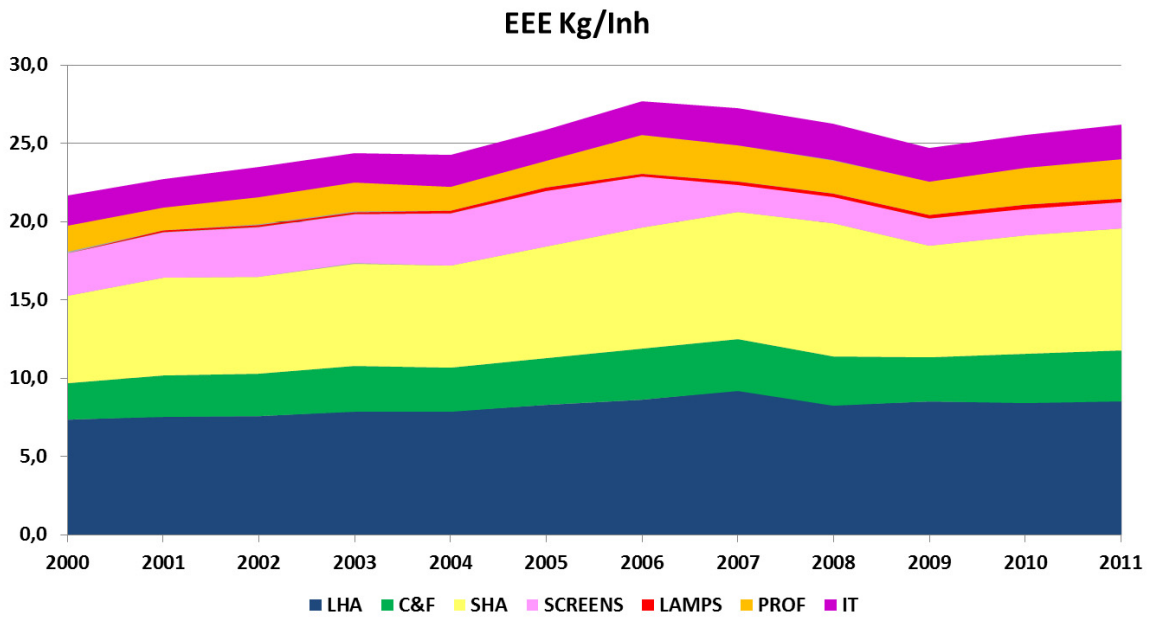

Figure 9: EEE 2000 – 2011 in Belgium in kg/Inh

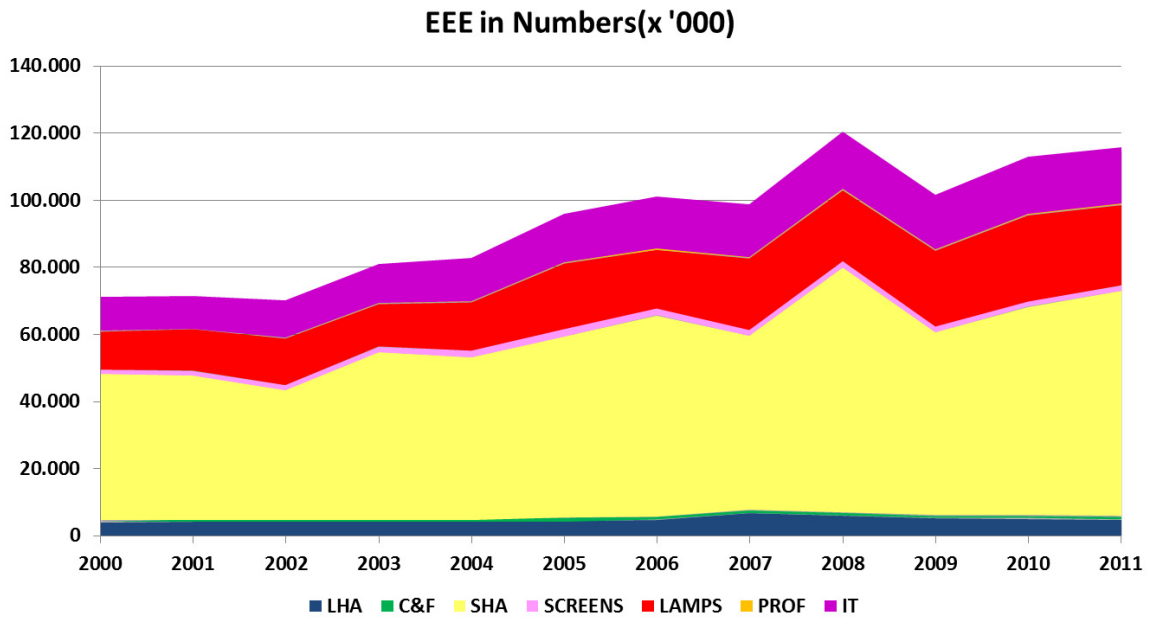

Figure 10: EEE 2000 – 2011 in Belgium in quantities x 1.000

With the UNU-model, a prediction is made for the development of the number of EEE for 2012 and 2015. This is shown in Table 5.

Collection category	EEE 2005	EEE 2010	EEE 2011	EEE 2012	EEE 2015
LHA	8.3	8.4	8.5	8.4	8.8
C&F	3.0	3.2	3.3	3.3	3.5
SHA (without IT)	7.1	7.5	7.8	7.2	7.6
IT	2.0	2.1	2.2	2.3	2.2
SCREENS	3.5	1.7	1.6	1.5	1.3
Monitors	*0.9*	*0.3*	*0.4*	*0.3*	*0.3*
TVs	*2.6*	*1.4*	*1.3*	*1.1*	*1.0*
LAMPS	0.20	0.24	0.22	0.23	0.22
PROF	1.7	2.4	2.5	2.0	2.1
Total	25.9	25.6	26.2	25.0	25.7

Table 5: Changes in the amount of EEE placed on market, with a projection to 2015 (kg/inh)

It is expected that the total weight of EEE per inhabitant will decline slightly in 2012 compared with 2011. After that, the quantity will increase again slowly. For IT and equipment with screens, the total weight of EEE per inhabitant is not likely to increase due to lighter devices introduced to the market.

3.3. Stock & lifespan

All EEE that is placed on market will eventually be discarded and become WEEE. The lifespans of different types of equipment are shown in Figure 11. For large household appliances and IT equipment, the profiles are based on Belgian data. For other devices, stock data are available from the possession study conducted by Alpha Research, but this dataset is not accurate enough to produce more detailed profiles of residence times. In such cases it is assumed that the parameters from the Netherlands are representative for Belgium. For a number of relevant products, the residence times shown for the devices in households and companies that are introduced to the market in 2005 are valid.

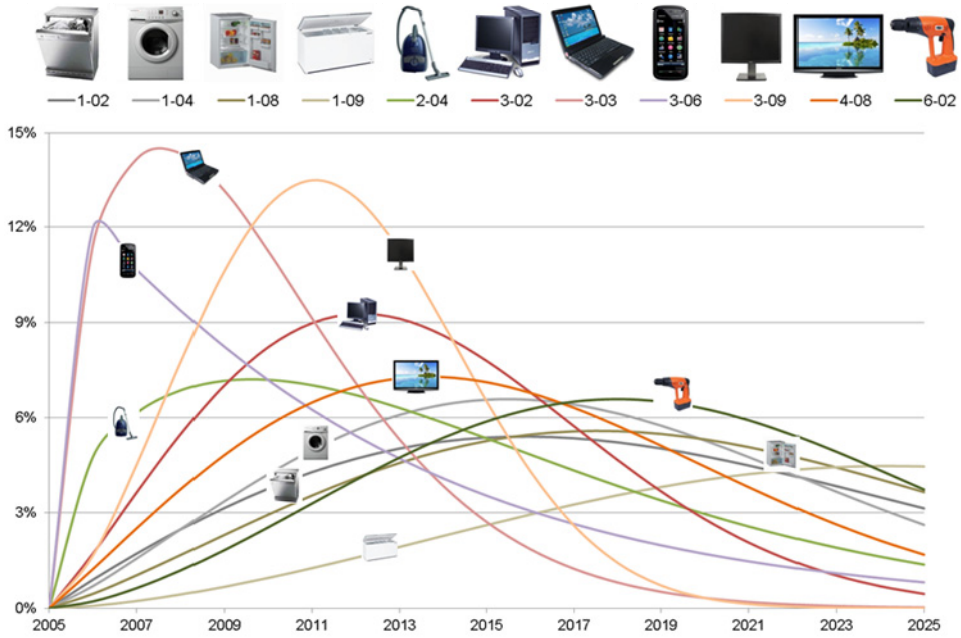

Figure 11: The predicted percentage of devices placed on market in 2005 becoming WEEE annually

The stock of equipment that is present in households is calculated based on the profiles of the lifespan and the quantities of EEE placed on market. The total combined stock of EEE in households and companies is calculated at 276 kg per inhabitant, or 653 kg per household (including all devices by companies). This is a total of approximately 750 million items, when also including lamps and luminaires (Table 6). In order to make better and more detailed calculations possible in the future, it is recommended that a detailed survey among consumers be conducted in order to gain more insight into the lifespans of the devices in the stock. Since the revised EU Directive assumes a new division in collection categories, it is also recommended the category SHA be split up into 'small domestic appliances' and 'IT' and that return flows be measured in these two categories.

Supply 2011* excl. Lamps and luminaires	LHA+CH	C&F	SHA	SCREENS	LAMPS	PROF	IT	Total
Pieces per household	0	0	55	0	47		14	**126**
Pieces per company	0	0	5	0	19	0,7	4,1	**36**
Total	**12**	**2,3**	**60**	**3,7**	**66**	**0,7**	**18**	**163**
Total in kg per inhabitant	94	44	77	26	1,29**	22	14	**276**

Table 6: Stock in households and companies in Belgium (including lamps).
* Deviations from Figure 12 due to applying the number of 'dual-use' products
** LAMPS is including luminaires, 1 luminaire with 2 lamps counts as 3 products, excluding tungsten and halogen light bulbs.
*** of which 0.24 kg are lamps excl. luminaires, excl. tungsten and halogen light bulbs.

Figure 12 shows how many devices there are and where within the house they are located in for an average Belgian household. Data on the average number of devices by room are available in Appendix C.

Figure 12: The average stock and device location in Belgian homes

3.4. Out of market: WEEE generated

Since the time between the purchase of EEE and disposal of WEEE for heavy appliances is often more than 10 to 15 years, the stabilisation arises in the WEEE generated flow that is discarded 10 years later on in the quantity of EEE that are visible since 2007. The quantity of WEEE generated continues to increase, but the growth is expected to decline in the coming five years. This results in an increase in the ratio between the quantity of EEE placed on market and WEEE generated.

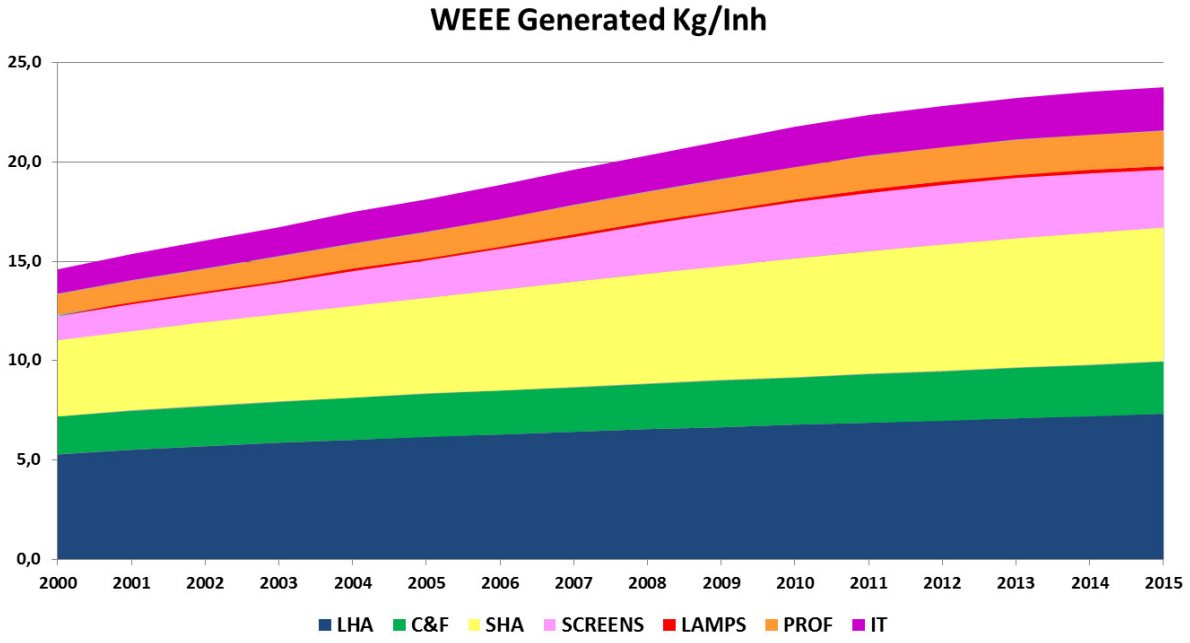

Figure 13: WEEE generated in Belgium, 2000 – 2015 (kg/inh)

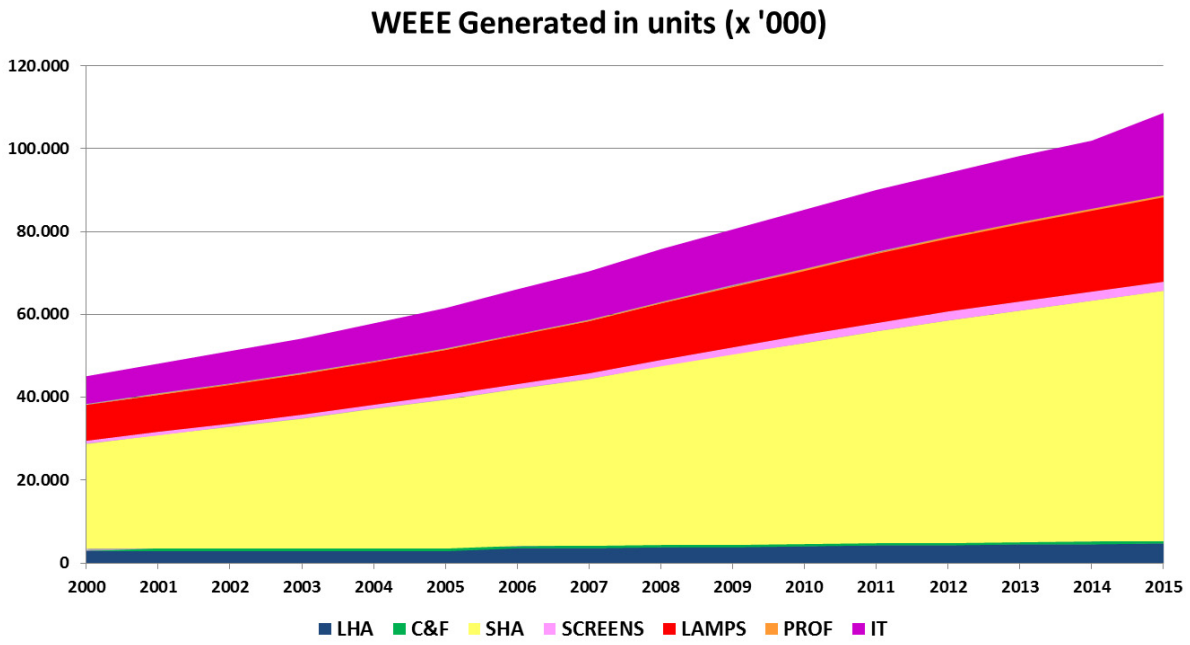

Figure 14: WEEE generated in Belgium, 2000 – 2015 Belgium (units x 1,000)

The quantities of WEEE generated from the UNU model fluctuate less than the quantities of EEE placed on market. The comparison of the quantities of EEE placed on market and the quantity of WEEE generated is shown in table 7.

Kg/Inh	LH	C&F	SHA	SCREENS	LAMPS	PROF	Total (kg/inh)	Total (kton)
EEE Put On Market	8,53	3,26	10,01	1,64	0,24	2,53	**26,2**	**287**
WEEE Generated	6,85	2,43	8,26	2,93	0,20	1,68	**22,4**	**245**
EEE/WEEE ratio	**80%**	**75%**	**83%**	**179%**	**83%**	**66%**	**85%**	**85%**

Table 7: Comparison of EEE and WEEE in 2011 for the collection categories (kg/inh and kton)

In the coming years, the quantities of EEE and WEEE will come closer together in absolute terms. For TVs and monitors, the quantity of WEEE is substantially higher than the quantity of EEE due to the replacement of heavier CRT screens/monitors with lighter flat panel screens.

Collection category	WEEE 2005	WEEE 2010	WEEE 2011	WEEE 2012	WEEE 2015
LHA	6.1	6.7	6.9	7.0	7.3
C&F	2.1	2.4	2.4	2.5	2.6
SHA (without IT)	4.9	6.0	6.2	6.4	6.8
IT	1.6	2.0	2.0	2.1	2.2
SCREENS	1.9	2.8	2.9	3.0	2.9
Monitors	*0.8*	*1.1*	*1.1*	*1.1*	*0.9*
TVs	*1.1*	*1.7*	*1.8*	*1.9*	*1.9*
LAMPS	0.12	0.16	0.17	0.17	0.19
PROF	1.3	1.6	1.7	1.7	1.8
Total	**18.1**	**21.7**	**22.3**	**22.8**	**23.7**

Table 8: Changes in the amount of WEEE generated, with a projection to 2015 (kg/inh)

In Table 8, the amounts of WEEE generated are summarised for 2005, 2010, 2011 and 2012, and a projection is made for 2015. The amount for 2011 includes used devices that are exported and do not become available as WEEE in Belgium. This amount is the starting point for the analysis of destinations of WEEE coming from Belgium, as discussed in the following chapter.

4. Collection of WEEE

Recupel organises the collection and responsible recycling of WEEE for its affiliated manufacturers and importers. The companies that conduct these activities for Recupel register the quantities of WEEE collected and recycled. This registration is the basis for the report that Recupel submits to governments who verify that the conditions in the Belgian legislation concerning the obligation to accept WEEE are fulfilled.

In addition to Recupel's data, there are also companies that fulfil the obligation to accept WEEE via the required registration of data in the Individual Plans on the collection and recycling of equipment they introduce to the market, which they report to the governments.

The quantities of WEEE in Recupel's reports and in the Individual Plans are called the **registered flows** in this report. All flows of WEEE that are discarded through other channels, collected and recycled, are called **complementary flows** in this report. An aim of the market research is to assess, to the extent possible, these complementary flows. The following points are reviewed:

- What is the scope of the different complementary flows?
- What kind of devices are they?
- Which actors are involved with their collection and why?
- How are they processed?

From the surveys and studies, it is possible to assess a portion of the complementary flows. Based on the information obtained, a realistic and reliable estimate can be made about the scope of these flows. In this report, this is referred to as the **documented flows.** Finally, there is still a portion of the WEEE that is not registered and cannot be documented in this study. The conclusions and recommendations address the possibilities of identifying these, by means of additional research.

The best measurement points for gathering the data in the collection and processing chain of possible complementary flows are identified in order to acquire more information. From this, it is assumed that there are two parameters that can account for the rise of the complementary flows of WEEE:

- There is WEEE that is not offered separately to collectors because it is difficult in practice, or it is financially unattractive. This WEEE is disposed of via so-called "mixed flows".
- For some types of devices, it is financially attractive to market them as so-called "mono flow", outside Recupel:
  - In Belgium: Some WEEE is delivered to Belgian actors outside the Recupel system due to the market value of the materials present.
  - Export: Some WEEE and used EEE is exported because it yields more profit than disposal via Recupel.

By means of conducting this market research, this chapter answers research questions 3 & 4:

3. **How much WEEE is being collected and how is it recycled?**
   While considerable data are collected by Recupel and the Individual Plans, it is suspected that WEEE collection and recycling also happens outside of these systems, thus rendering government data incomplete.
4. **Where and how large are the unregistered flows?**

4.1. Market structure & method of the market survey

4.1.1. Pyramid market structure

Because the value of WEEE is determined by the metals it contains, special attention is given to the metal recovery sector for gathering data on the complementary flows that arise from the high value of certain WEEE

categories. It is difficult to find the right measurement points here because the metal recovery sector has a pyramid market structure (Figure 15). Prior to the description of the market survey, a short description of the market structure is given.

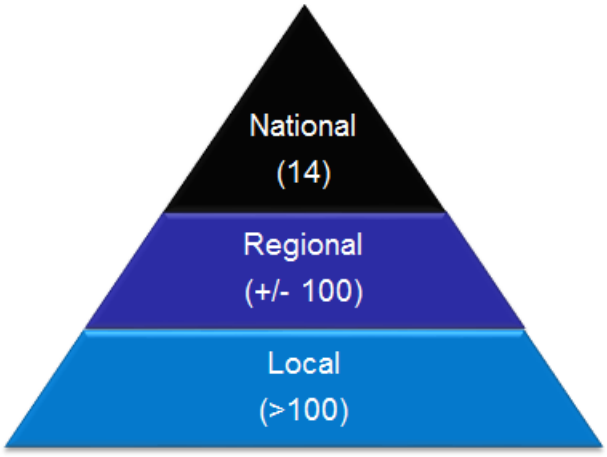

Figure 15: Market structure of the metal recovery sector

4.1.2. Local collectors

Metal-containing waste flows are collected by several hundred local collectors who usually cover a small geographic region. They make up the intricate collection network that ensures smaller metal-holding waste flows in Belgium are collected and available for processing. They collect all types of waste with a sufficiently high metal content to be financially worthwhile. This is the case not only for WEEE, but also for other waste flows such as household goods, construction site metals, metal waste from small metal processing companies etc. Many local collectors hold the required collection permits, but some of these companies also operate in the informal economy. They often do not have storage grounds or the required environmental permits. They sell the collected materials as soon as they have collected a significant quantity. This is usually approximately the load capacity of one vehicle for collection, owing to their lack of storage facilities. This load is generally sold to the following link in the pyramid, the regional scrap metal companies. The activities of these local collectors are only marginally represented within the current registration data, meaning that the total amount of WEEE they collect remains unknown. These companies are very difficult to approach. Thus, they are not specifically surveyed in this research.

4.1.3. Regional scrap metal companies

In Belgium there are approximately 100 regional scrap metal companies. They usually have a yard where collected materials can be stored, and they have the required environmental permits. They acquire metal-holding waste flows by collecting them and/or by buying them from larger disposers. Additionally, they buy the flows offered by local collectors. Individuals can also dispose of their metal waste at the yard of these companies, with or without financial compensation. At the yard, the metals are partially sorted and regrouped for selling. A number of companies process large scrap metal into smaller pieces for efficient transport. Most regional scrap metal companies deliver their scrap metal to the national scrap metal companies in Belgium which constitute the top of the pyramid. A significant number of these companies are daughter enterprises of the national scrap metal companies, or they have contracts with them. Some regional scrap metal companies specialise in the export of scrap metal. The quantities of WEEE collected and reported by these companies is currently limited. During an enforcement action by OVAM in 2012, all recognised collectors of WEEE were asked which quantities they collected in 2011. This included many of the regional scrap metal companies. The amount of WEEE collected and not reported to Recupel is a mere 3,700 tonnes. During the research, the aim was to achieve the best possible quantitative representation of the complementary flows at the regional scrap metal companies. Additionally, information was collected in order to gain insight into why certain flows of WEEE are complementary flows.

4.1.4. National processors

The national scrap metal companies appear at the top of the pyramid. These companies generally have shredder installations. In such an installation, scrap metal is cut into smaller pieces and sorted to acquire fractions usable as raw material in new production processes. In Belgium, 11 of those shredder installations are active. They receive the largest portion of their supply of materials from regional scrap metal companies, but they also receive a portion of their supply of materials delivered directly by disposers. The processed metals are sold as secondary raw material in the Belgian metal industry or exported. Additionally, there are three companies in Belgium fully specialised in the processing of WEEE. Adding these companies to the 11 others with shredder installations means that there are 14 national processors active in Belgium. The processors in the Recupel system belong to this group, and they report large quantities of WEEE.

Most significant measurement point: Belgian national processors

Considering that all collected WEEE that is not exported ends up at the national scrap metal companies, the data gathering is initially directed to these companies. These companies were all invited to participate in an interview to provide insight into the complementary flows that run through their companies. FFact approached 10 companies with shredder installations through mediation by the COBEREC. This resulted in successful data collection from 8 companies. The other 4 companies are organised in the EERA (European Electronics Recyclers Association), and they are surveyed in a similar manner through EERA.

The survey distinguishes between two types of flows:

- Mono flows of WEEE (pure WEEE flow)
- Mixed flows (WEEE in mixed scrap metal, pre-shredder material)

Figure 16: Mono flow WEEE

Figure 17: Mixed flow (pre-shredder material)

Mono flows of WEEE are scrap metal flows that (almost) exclusively contain WEEE products. The company's administration shows the quantities of batches, though it is usually not known to which category WEEE belongs. Determining the proportion of different categories of WEEE often has to be based on estimates made by the operators.

Mixed flows (pre-shredder material) can hold metals from all possible sources and these mostly have a limited percentage of WEEE. The companies do not register how much WEEE is found in such mixed flows, since they are usually not sorted. The material is brought directly to the shredder installation to process it further into different recyclable fractions to be used in the end-processing metal industry. The percentage of WEEE in the pre-shredder material and the share of different WEEE categories is determined by operator estimates.

In order to verify the research findings at the national scrap metal companies, other operators in the market were surveyed as well. The focus was mostly on the gathering of information in a random sample of the regional scrap metal companies. National scrap metal companies were surveyed about the activities of their affiliated regional scrap metal companies – in this case, approximately 20 regional scrap metal companies. Additionally, FFact, together with COBEREC, approached a selection of 25 independent scrap metal companies. The approach was aimed at the main large and mid-sized regional scrap metal companies and a few smaller companies. In the end, information was gathered from 16 of these independent scrap metal companies.

4.1.5. Remaining market parties

The market parties named above provided the most significant source of quantitative information about the processing of WEEE in Belgium for this research. However, there are other market parties that receive Belgian WEEE, as well. These companies are not crucial for deriving a clear representation of the mass balance of WEEE, but they do provide interesting information about how the market works and where flows are processed outside Recupel. This information helps to verify findings at the scrap metal companies. The following types of market actors were also interviewed:

- Container parks
- Distribution companies
- Waste collection companies
- Installation companies

4.1.6. Export

It is complicated to determine precise measurement points for exported flows. There are many actors involved who partially work illegally. Additionally, it is difficult to accurately determine how much of the exported flows outside the Recupel system, which is identified in the scrap metal trade, could be counted twice. In the survey, the market parties explicitly asked about exported flows, but double counting cannot be completely avoided.

Furthermore, there are conversations held with the Flemish environmental inspection and the Federal police about their experiences in relation to the export of (W)EEE in inspection and enforcement activities. The following is used from this:

- Information from the Dutch research on Belgian imports in the Netherlands
- Data about the export of scrap metal and of the export of WEEE from studies on the environmental inspection, trade statistics and remaining literature sources

Finally, a few hypotheses about export to France are tested at a few shredder companies there.

4.1.7. Residual waste

Information about the WEEE discarded in the residual waste is available from government-commissioned sorting analyses. Recupel in collaboration with BEBAT, has also conducted a sorting analysis on residual waste.

4.2. Recupel & Individual Plans

As stated above, the quantities of WEEE declared in Recupel's reports and Individual Plans are referred to in this report as **registered flows**. All WEEE flows that are disposed of, collected and processed via other channels are referred to as **complementary flows.**

In the following paragraphs, the different phases of the information gathering and analysis process are presented consecutively. The analysis uses Recupel's collection categories, as listed below:

- LHA: large household appliances
- C&F: Refrigerators and freezers
- SHA: Remaining equipment (including IT and luminaires)
- SCREENS: TVs and screens
- LAMPS: Lamps, excluding luminaires

Due to current WEEEE classification, it is not possible to analyse IT equipment as a complementary flow category separate from SHA. A separate category for professional equipment is analysed, though. In addition, smoke detectors are not analysed separately. This is an especially small flow about which no information is gathered in the complementary flows.

The majority of registered WEEE – more than 113 kton, or 10.3 kg/inhabitant, in 2011 – is processed via Recupel. By comparison, just over 1 kton of WEEE was processed via the Individual Plans. Thus, almost all

(>99%) registered flows are processed via Recupel. Table 9 gives an overview of the registered WEEE flows, by collection category. The table compares these with the quantities of EEE placed on market, as well as the quantities of WEEE generated, as determined by the UNU-model.

Kg/Inh	LHA	C&F	SHA	SCREENS	LAMPS	PROF	Total (kg/inh)	Total (kton)
EEE Put On Market	8,53	3,26	10,01	1,64	0,24	2,53	26,2	287
WEEE Generated	6,85	2,43	8,26	2,93	0,20	1,68	22,4	245
Registered	2,72	1,81	3,36	2,34	0,12	0,13	10,5	115
Not Registered	4,13	0,62	4,90	0,59	0,08	1,55	11,9	130
% Registered	40%	74%	41%	80%	60%	8%	47%	47%

Table 9: Registered WEEE flows in 2011, by collection category (kg/inh and kton).

In 2011, 47% of the WEEE generated, was registered as collected and treated by Recupel and the Individual Plans, collectively. According to the registered data, the WEEE categories with the highest collection and treatment percentages were C&F, SCREENS, and LAMPS. This is expected, given the fact they are also the flows where collection and recycling generally are not profitable. Proper recycling is thus made possible by Recupel's contribution. For the SCREENS flow, there is a peak in the return flow mainly due to heavier CRT TVs and Monitors being recently replaced by lighter, flat panel screens. These heavier CRT TVs and screens are responsible for 98% of the return flow of SCREENS in 2011.

Within the LHA and SHA flows, there are many devices where the scrap metal value of the device is higher than the collection and recycling contribution given by Recupel. The percentage registered via Recupel for these categories is considerably lower than for the other categories of consumer WEEE.

The category PROF is mainly covered via individual registrations. It is clear that the efforts to register professional WEEE via the Recupel charter for business and professional WEEE have not led to a high registration percentage for this flow.

4.3. Belgian Regional Scrap metal companies

A significant portion of the market research consisted of surveying various market parties. The survey of the regional scrap metal companies was the most extensive. The goal was to verify the data submitted by national processors and data from other sources through a quantitative survey. Additionally, this survey was meant to create insight into the reasons why certain actors offer WEEE outside Recupel.

Based on the data that is collected by the regional scrap metal companies, it appeared impossible to calculate a mass balance of the scrap metal processing pyramid's middle layer. There are two important reasons for this. First of all, it appears difficult to achieve an accurate assessment of the origin and the destinations of the scrap metal without generating double counts. Mutual deliveries between regional scrap metal companies are common, and these are difficult to estimate and therefore cannot be documented properly. Secondly, the research only concerned a random sample of the companies, and unfortunately, a large number of players did not wish to cooperate. Considering the difficulty of quantifying all flows and that the coverage of the random sample was smaller than planned, no mass balance for these companies was determined.

The research did yield a significant amount of data, which enables a reliability assessment of the remaining data used in this report. For example, it is confirmed by the regional scrap metal companies that the share of WEEE sold as mono flow outside the Recupel system is fairly limited. The companies report such flows with a scope of approximately 3,000 tonnes. That quantity is comparable to the OVAM findings during its enforcement action to report WEEE (see paragraph 4.1.3). Furthermore, the regional scrap metal companies confirmed the existence of a quantification of the export flows detailed in paragraph 4.5.

There was also a lot of information gathered about the mechanisms through which complementary flows arise and why they stay outside the Recupel system. Various regional scrap metal companies confirmed that they receive WEEE mixed in small quantities with mixed scrap metal. This is generally WEEE that has few, if any, hazardous substances or components. There is no economic motivation to sell such WEEE via Recupel. Due to the extra expenses incurred for recycling, it is more profitable to sell this WEEE outside Recupel.

The regional scrap metal companies more often see the trend in which their suppliers offer them pre-dismantled WEEE. Examples of this include washing machines where the condenser is already removed, or refrigerators that already have the cooling elements removed. In such cases, depollution was conducted by a vendor as opposed to a recognised processor. In these cases, it is unclear where the hazardous parts and substances end up.

Concerning the participation in the Recupel-charter for professional and business WEEE, a frequently-voiced concern among members is that the financial incentive to work with Recupel is limited. The system may not be very complicated, but it still requires extra efforts. The freedom to choose a destination is limited to processors recognised by Recupel, which is seen as an obstacle by some regional scrap metal companies. The administration burden of this system is also seen by members as heavy.

Many companies see participation in Recupel's system as a way of offering an extra service – a kind of quality guarantee – to their customers. By providing their customers with such a service, companies hope to gain access to their customers' other metal-holding waste flows. The reasons mentioned above illustrate why the categories LHA, SHA, and PROF have low registration rates with Recupel.

4.4. Belgian National Recyclers

Of the 14 national Belgian processors, 12 companies eventually participated in this study. These companies receive virtually no mono flows of WEEE that is processed outside of Recupel The volume of this flow amounts to approximately 1,000 tonnes, most of which is registered via Recupel.

The most significant complementary flow at these companies is the WEEE found in the pre-shredder material. Most companies found it difficult to estimate the quantity of WEEE found in this material because the flows are large and heterogeneous. The percentages found are shown in Table 10. The average percentage found for Belgium, 2%, is clearly lower than the percentage found in the Dutch study. In the Netherlands, a 3.5% minimum is assumed. Based on this information, it is assumed that the Belgian percentage is a conservative estimate of the actual quantity. In addition, regional differences are clearly represented in these figures.

Region	% WEEE in pre-shredder material	
	minimum	maximum
Flanders	1%	1.5%
Wallonia and Brussels	2%	4%
Belgium Total	2%	

Table 10: Percentage of WEEE in the pre-shredder material per region

Dividing the received volumes of WEEE into the different collection categories is reported to be difficult. These results suggest that there are very few lamps, televisions or screens in this flow. The volume of the C&F flow is also very limited. Table 11 (below) provides an estimate of the distribution, by product category, of WEEE fractions in pre-shredder material. This estimate is based on the data gathered in the Belgian study, as well as information and experiences from the Dutch study.

Collection category	Share
LHA	60%
C&F	5%
SHA	20%
SCREENS	0%
PROF	15%
Total	100%

Table 11: Distribution of WEEE, by product category, in pre-shredder material

Since not all companies in the sector participated in the market survey, COBEREC was consulted to estimate the total scope of the pre-shredder material market in Belgium. Including this estimate of pre-shredder material, the market survey covered more than 90% of complementary flows. For the remaining portion, best estimates are made and incorporated into the total estimation, shown in Table 12. The estimated total quantity of complementary WEEE flows in Belgium thus amounts to approximately 15,000 tonnes.

Kg/Inh	LHA	C&F	SHA	SCREENS	LAMPS	PROF	Total (kg/inh)	Total (kton)
EEE Put On Market	8,53	3,26	10,01	1,64	0,24	2,53	26,2	287
WEEE Generated	6,85	2,43	8,26	2,93	0,20	1,68	22,4	245
Registered	2,72	1,81	3,36	2,34	0,12	0,13	10,5	115
Not Registered	4,13	0,62	4,90	0,59	0,08	1,55	11,9	130
Schredders & EERA	0,83	0,08	0,29	0,00	0,00	0,21	1,4	15
% Registered or documented	52%	78%	44%	80%	60%	20%	53%	53%

Table 12: Documented complementary flows treated by national Belgian processors, kg/inh and kton (2011)

Especially for the flows with the lowest grade of registration, these are specifically found with substantial amounts present in the pre-shredder material. For these categories, the amount that is not documented decreases. In total, 53% of the flow of WEEE generated in Belgium is now represented.

4.5. Export of WEEE

Three types of export of WEEE are studied:

- Export of WEEE in pre-shredder material to neighbouring countries
- Export of WEEE as mono flow to the Netherlands
- Export of (W)EEE to countries outside Europe

4.5.1. Export of WEEE in pre-shredder material to neighbouring countries

There is a lot of scrap metal trade between Belgium and its neighbouring countries. The shredder capacity in North-Western Europe is greater than the supply of pre-shredder material. That leads to considerable competition on the market for collecting this material, especially in the border regions. The Dutch study explores the scope of the export flow from Belgium to the Netherlands and the share of WEEE. The Netherlands receives approximately 150,000 tonnes of this material from Belgium, with a reported WEEE content of a least 3.5%. The companies from which this material originates are not usually known, though a large share of these exports is thought to be sent by regional Belgian scrap metal companies. Additional material is supplied by local scrap metal companies from Belgium. This was confirmed in conversations with the Belgian national processors and the regional scrap metal companies. From the market survey, it also became clear that there is a significant amount of export to France and, to a lesser extent, Germany. Surveys of companies from this region confirmed this assessment.

National export statistics are used to estimate the amount of WEEE in pre-shredder material exported to France and Germany. These national export statistics include data about the scrap metal export. For the Netherlands, the figures reflected the findings from the study of Dutch processors. Hence, it is assumed that those export figures also give a reliable representation of the export to Germany and France. There is no data about the

share of WEEE in the fractions exported to those countries. Consequently, based on the percentage of WEEE in the pre-shredder material in the Wallonia and Brussels regions, 2.5% of WEEE in pre-shredder material is assumed. For the distribution of the collection categories, the same split is applied for the material that is processed in Belgium.

There are some discrepancies between the quantities that Belgium reports in the trade statistics as exports to the surrounding countries and the quantities those countries report as imports from Belgium. Therefore, the export calculations show a range of 11.9 to 16.8 kton. The overview uses the average of 14.4 kton. The export to France is 6.5 kton, to the Netherlands it is more than 5.2 kton, and to Germany it is approximately 2.7 kton.

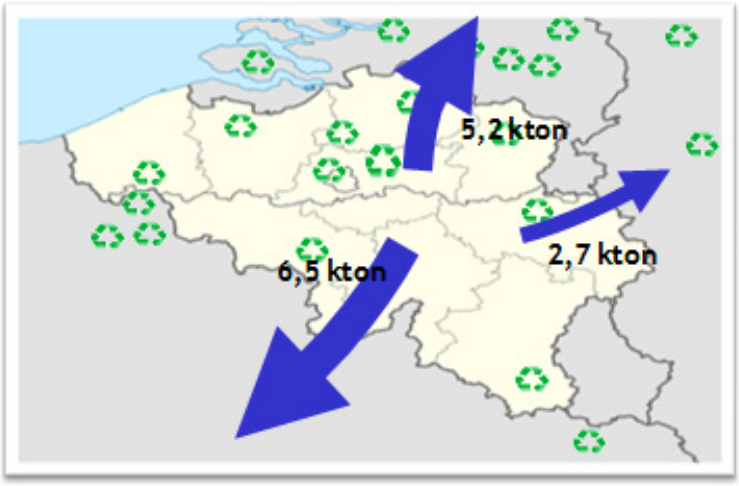

Figure 18: Export of WEEE in pre-shredder material to Belgium's neighbouring countries in 2011

4.5.2. Export of WEEE as mono flow to the Netherlands

The study in the Netherlands determined that approximately 5 kton of WEEE are exported as mono flow from Belgium. In terms of collection categories, the composition of this exported WEEE is comparable to composition of the pre-shredder material. In the course of this research, several Belgian companies acknowledged the existence of such exports, but indicated that they were not involved and that there is no double counting. However, local players not included in the survey do engage in commercial exports. Furthermore, no data are available on exports to France and Germany, though it is highly probable that such exports occur.

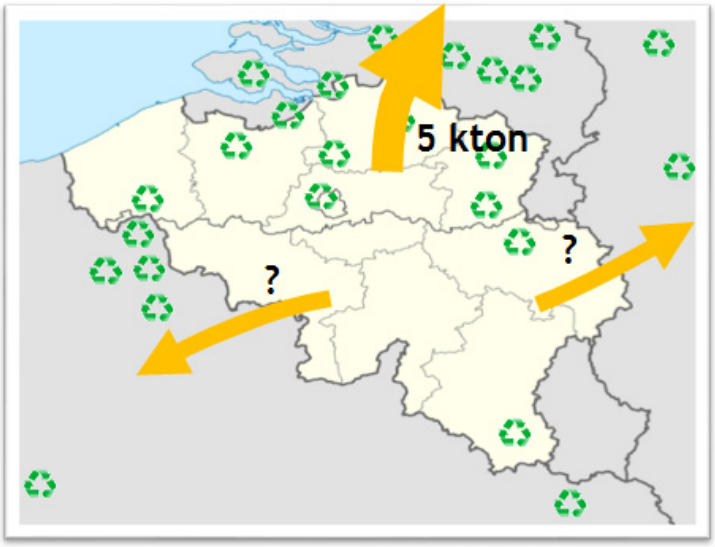

Figure 19: Export of WEEE in mono flows to the Netherlands in 2011

4.5.3. Export of (W)EEE to countries outside of Europe

The Flemish environmental inspection agency conducted research on the export of (W)EEE to countries outside Europe. This research included data from enforcement projects and an analysis of customs data about exports from the port in Antwerp.

Inspections in the port regularly find containers with heterogeneous contents. The containers, often filled with assorted household goods, including (W)EEE are typically destined West Africa and the Democratic Republic of Congo. There are a few exporters shipping such containers on a regular basis, but in the majority of the cases, exporters ship only one or a few containers. It is unclear whether these containers comprise commercial exports or exports by private individuals. It is difficult to verify because these exporters usually do not reside permanently in Belgium.

Figure 20: A container with mixed household goods for export to Africa

Analysis of the customs data indicates that a few thousand such containers per year are exported, totalling approximately 3,000 tonnes. The contents of these containers include EEE, roughly 1,000 tonnes of which no longer functions, and thus must be classified as WEEE.

In general, these exports often include refrigerators, TVs, screens and IT equipment. Large household appliances are less commonly exported. In Belgium, however, the composition of this exported (W)EEE is unknown. Based on data from the Dutch study and data about material that arrives in Africa, it is assumed that the composition of the material is approximately as follows:

Collection category	Share
LHA	15%
C&F	45%
SHA	10%
SCREENS	30%
Total	100%

Table 13: Composition, by category, of WEEE exported to Africa among mixed household goods

Antwerp is a main port for the export of second-hand vehicles from Europe. Approximately 500,000 of these vehicles pass through the port at Antwerp annually. During inspections, it appeared that these vehicles are regularly loaded with 'additional cargo' that contains (W)EEE. The environmental inspection conducted a baseline measurement of the share of vehicles with such additional cargo. They estimate that 10% of the vehicles have additional cargo including WEEE. Most of the exported vehicles originate in Germany, France and the Netherlands, and are exported in via Antwerp. Approximately 40,000 cars originate from Belgium. Second-hand delivery vans and trucks are also exported from Antwerp.

A conservative estimate by FFact is that a car with additional (W)EEE cargo will contain an average of approximately 150 kg of (W)EEE. For a delivery van, this is estimated to be one tonne of (W)EEE, and for a truck, it is five tonnes of (W)EEE. Based on these assumptions, the total export of Belgian (W)EEE contained in the

vehicles exported from Antwerp is approximately 1,200 tonnes per year. Approximately 400 tonnes of which can be classified as WEEE.

Possible overland exports of (W)EEE to Eastern Europe were also discussed with the different enforcement agencies. In the Netherlands, at checkpoints at the border crossings with Germany, it was indicated that significant flows of exported (W)EEE pass through there. The Belgian enforcement agencies rarely perform these checks at border crossings with Germany. The Federal police regularly conduct traffic checks in Belgium, including checks on the transport of (W)EEE. The police data, however, do not form a conclusive basis for an estimate about possible exports to Eastern Europe. Although it is remarkable that such exports of Belgian (W)EEE take place, it appears nearly impossible at this point to quantify them.

Figure 21: Export of WEEE outside Europe in 2011

4.5.4. Summary of the documented export flows

In summary, it can be determined that with the documentation of the aforementioned export flows, a portion of the complementary flows are also represented. As a result, 63% of the WEEE generated in Belgium is now documented.

Kg/Inh	LHA	C&F	SHA	SCREENS	LAMPS	PROF	Total (kg/inh)	Total (kton)
EEE Put On Market	8,53	3,26	10,01	1,64	0,24	2,53	26,2	287
WEEE Generated	6,85	2,43	8,26	2,93	0,20	1,68	22,4	245
Registered	2,72	1,81	3,36	2,34	0,12	0,13	10,5	115
Not Registered	4,13	0,62	4,90	0,59	0,08	1,55	11,9	130
Schredders & EERA	0,83	0,08	0,29	0,00	0,00	0,21	1,4	15
Export Scrap Metal Companies	0,79	0,07	0,26	0,00	0,00	0,20	1,3	14
Export EEE	0,22	0,14	0,14	0,03	0,00	0,05	0,6	6
Export WEEE	0,10	0,06	0,06	0,01	0,00	0,02	0,3	3
% Registered or documented	68%	89%	50%	81%	60%	36%	63%	63%

Table 14: Documented complementary flows and exports via national processors in 2011 (kg/inh and kton)

4.6. WEEE in residual waste

In households as well as in companies, WEEE is sometimes discarded through the residual waste system. This is incinerated and is therefore impossible to recycle.

4.6.1. Household residual waste

The regional governments conducted research about the composition of household residual waste. The Flemish study concerning the year 2006 arrived at 0.72% WEEE in the residual waste by weight. Studies in Wallonia and Brussels concerning 2009/2010 arrive at 0.42% and 0.20% WEEE in the residual waste, respectively. Based on this data, it can be assumed that the average quantity of WEEE in the household residual waste in Belgium is approximately 0.75 kg/inh, with a regional distribution of 0.6 kg/inh in Brussels to 0.9 kg/inh in Flanders.

When studying the data for urban areas within the municipalities, it is apparent that the percentage of WEEE household residual waste in urban areas is often a slightly lower than in rural areas. In urban areas, paid bags for the collection of residual waste are used more often than collection in containers. The percentage of WEEE in the residual waste is probably higher there, because it is easier to dispose of WEEE in a container.

The percentages found in Belgium are in line with the data found in studies in the Netherlands and in Germany. The percentages for the areas where residual waste has to be paid according to weight or volume (DIFTAR) are in the same magnitude as in Belgium. In Belgium, DIFTAR is applied much more broadly than in the Netherlands and Germany. In these countries, the percentage of WEEE in residual waste in the non-DIFTAR municipalities is significantly higher than in Belgium.

Recupel's research in 2011 revealed that small devices from the category SHA and lamps comprise the vast majority of WEEE in household residual waste.

4.6.2. Commercial residual waste

Relatively limited research has been published on the composition of commercial residual waste in Belgium. In a 2006 study, OVAM determined that the share of WEEE in commercial residual waste is approximately 1.6%. This is high in comparison with research from abroad. More extensive research in the Netherlands, which covers more companies and sectors, arrived at 0.6% WEEE in commercial residual waste. Because the Flemish research is dated, draws on a small random sample, and is not in line with comparable studies abroad, this research will not assume 1.6% WEEE content in commercial residual waste. Rather, this study uses the more conservative estimate of 0.6% found in the Netherlands study.

The types of devices that companies discard in the residual waste are essentially the same types of devices as in the households. The larger, purely professional devices do not end up in the residual waste. The complete quantity of WEEE in residual waste from companies is therefore assigned to the category SHA.

4.6.3. Summary of the documented residual waste

The total amount of WEEE in residual waste of households and companies in Belgium is estimated at 17 kton. Adding this result to the earlier results, 70% of the quantity of WEEE that is to be removed according to the UNU-model is registered or documented.

Kg/Inh	LHA	C&F	SHA	SCREENS	LAMPS	PROF	Total (kg/inh)	Total (kton)
EEE Put On Market	8,53	3,26	10,01	1,64	0,24	2,53	26,2	287
WEEE Generated	6,85	2,43	8,26	2,93	0,20	1,68	22,4	245
Registered	2,72	1,81	3,36	2,34	0,12	0,13	10,5	115
Not Registered	**4,13**	**0,62**	**4,90**	**0,59**	**0,08**	**1,55**	**11,9**	**130**
Schredders & EERA	0,83	0,08	0,29	0,00	0,00	0,21	1,4	15
Export Scrap Metal Companies	0,79	0,07	0,26	0,00	0,00	0,20	1,3	14
Export EEE	0,22	0,14	0,14	0,03	0,00	0,05	0,6	6
Export WEEE	0,10	0,06	0,06	0,01	0,00	0,02	0,3	3
WEEE in residual waste	0,00	0,00	1,53	0,00	0,01	0,00	1,5	17
Documented	**1,94**	**0,35**	**2,28**	**0,04**	**0,01**	**0,48**	**5,1**	**55**
% Registered or documented	**68%**	**89%**	**68%**	**81%**	**65%**	**36%**	**70%**	**70%**

Table 15: Documented complementary flows via national processors, export and residual waste (2011; kg/inh and kton)

4.7. Remaining market parties

Next to the extensive market survey conducted with the parties described above, a small-scale survey was also administered with other selected market parties. These surveys were conducted to verify information derived from other market parties.

At a few Flemish **container parks,** conversations were held. Requests to hold a meeting with Walloon container parks was denied. The request for a conversation with a Brussels container park remained unanswered. The managers of the Flemish container parks indicate that it is difficult to prevent WEEE from ending up in the containers for mixed scrap metal or household refuse. They claim that WEEE ends up in household waste as result of ignorance or oversight on the part of the consumer. For example, for some devices, such as lawnmowers, users may not regard the device as WEEE and thus do not dispose of it as such. .

Interviews with **waste collection companies**, conducted via FEBEM, generally confirmed the findings from the scrap metal companies about the reasons for working (or not working) with Recupel. It was also confirmed that construction and demolition waste are not significant sources of complementary WEEE flows.

Interviews with **distribution companies** indicate that there is a significant amount of dissatisfaction about the current Recupel system. This is mostly due to the high fees and the relative inflexibility of the logistics system, as well as storage considerations. A trend of retailers offering WEEE outside of Recupel appears to be on the rise.

Finally, interviews were conducted with **installation companies**, which install larger installations (i.e. CH and air-conditioning) for companies and often take back the old installations. This equipment is partially dismantled by the installation companies themselves in order to sell the parts in separate material flows and via the scrap metal sector, making this material difficult to recognise as WEEE.

5. The WEEE mass balance

The quantity of WEEE generated in 2011 was approximately 85% of the quantity placed on market that year. Of the WEEE generated, approximately 47% is registered via Recupel and the Individual Plans. While this research has documented an additional 23% of WEEE generated in Belgium, approximately 30% remains undocumented. In comparison, in the Dutch study around 19% remained undocumented. In Italy, by contrast, 37% of household equipment, alone, remains undocumented.

Kg/Inh	LHA	C&F	SHA (incl IT)	SCREENS	LAMPS	PROF	Total (kg/inh)	Total (kton)	
EEE Put On Market	8,53	3,26	10,01	1,64	0,24	2,53	26,2	287	
WEEE Generated	6,85	2,43	8,26	2,93	0,20	1,68	22,4	245	
Registered	2,72	1,81	3,36	2,34	0,12	0,13	10,5	115	
Not Registered	4,13	0,62	4,90	0,59	0,08	1,55	11,9	130	47%
Schredders & EERA	0,83	0,08	0,29	0,00	0,00	0,21	1,4	15	
Export Scrap Metal Companies	0,79	0,07	0,26	0,00	0,00	0,20	1,3	14	
Export EEE	0,22	0,14	0,14	0,03	0,00	0,05	0,6	6	
Export WEEE	0,10	0,06	0,06	0,01	0,00	0,02	0,3	3	
WEEE in residual waste	0,00	0,00	1,53	0,00	0,01	0,00	1,5	17	
Documented	1,94	0,35	2,28	0,04	0,01	0,48	5,1	55	23%
Not documented	2,19	0,27	2,62	0,55	0,07	1,07	6,8	75	30%
% Not documented	32%	11%	32%	19%	35%	64%	30%	30%	

Table 16: Mass balance of (W)EEE in Belgium in 2011

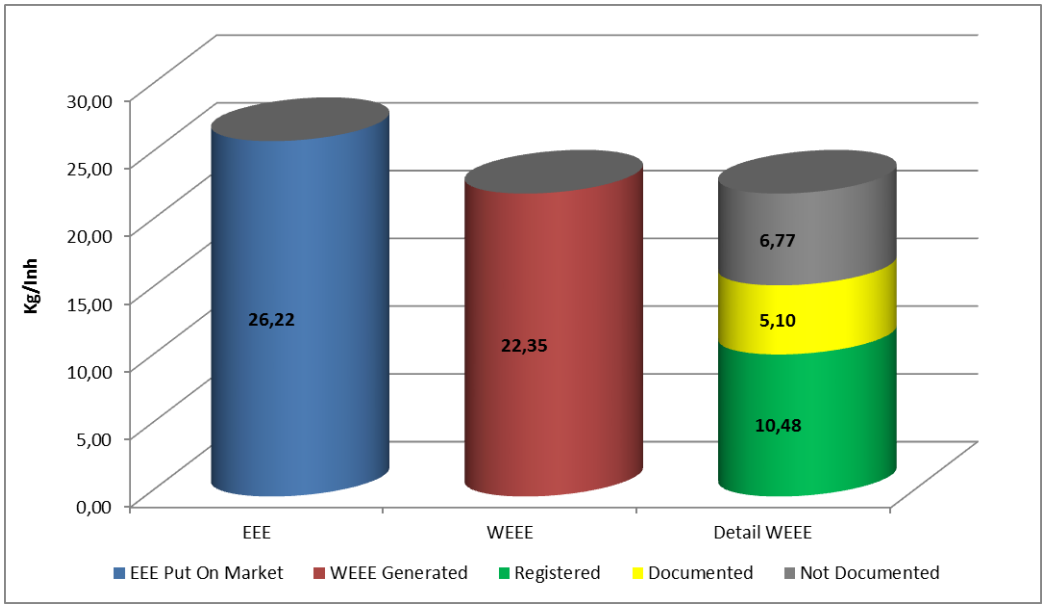

Figure 22a: Mass balance of (W)EEE in Belgium in 2011

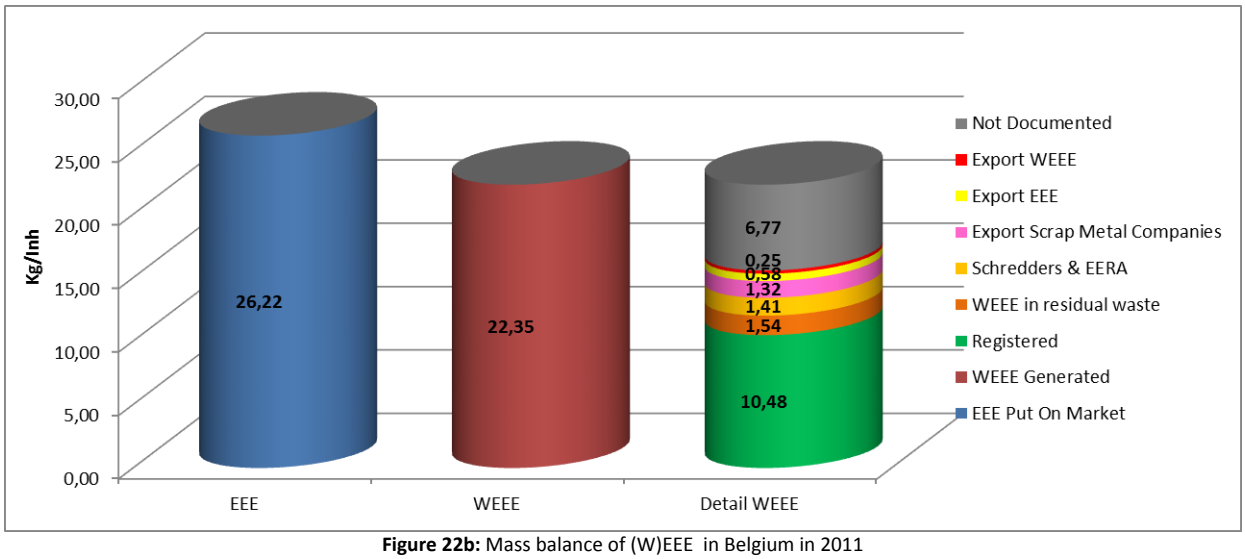

Figure 22b: Mass balance of (W)EEE in Belgium in 2011

During the research, a number of reasons were given as to why it is impossible at this time to represent the missing 30% of WEEE generated in Belgium:

- The calculation of the quantity of WEEE generated is based on average weights from the Netherlands and can thus deviate from the actual quantities in Belgium.
- The quantity of WEEE in pre-shredder material in Belgium is lower than in the Netherlands, and this estimate must be seen as very conservative. The quantity of 15.1 kton that is included in the research is a conservative estimate. It is a minimum of 13.7 kton, but if the share of WEEE is comparable with the 3.5% that was found in the Netherlands, it could be 26 kton.
- The quantity of WEEE in export flows of pre-shredder material that is exported to France and Germany is also a conservative estimate. 14.3 kton are included as export, but it could also be 21 kton.
- The research on the export of (W)EEE is based on a limited number of sources. There is probably complimentary export from mono flows of WEEE to France, Germany, and the export of used EEE (with partial WEEE) to Eastern Europe and the export of EEE for reuse, originating from companies.
- For the quantity of WEEE found in commercial residual waste, a conservative estimate is chosen based on the percentage from the Netherlands because the data from the Belgian study is too limited.
- Complimentary studies of these points could considerably improve estimates on the amount of WEEE generated in Belgium.

6. Conclusions and recommendations

6.1. EEE placed on market

In 2011, the amount of EEE placed on market in Belgium was 26.2 kg per inhabitant.

Based on Recupel's registered data and the Individual Plans, combined with national statistics data, the UNU-model provides a robust calculation for the total amount of EEE placed on market in 2011 and earlier. The model offers an added value here because these amounts cannot be directly calculated based solely on Recupel's submissions and the Individual Plans. This is because:

- data on free riders are missing;
- Recupel does not have the weights of newly sold devices;
- The grouping of devices in the categories that Recupel uses is not ideal for making such a calculation.

The comparison of the calculations of the total quantity of devices placed on market based on registered sales (25.8 kg per inhabitant) with the total quantity of devices based on the sales and production statistics (26.2 kg per inhabitant) shows that these two data sources are quite comparable. Therefore, it appears that the number of free riders, companies that do not register their sales so as to avoid fulfilling their obligations of manufacturer's responsibility, is small. However, there is a level of uncertainty in this conclusion because there are significant differences between product categories. For some categories, the calculation based on available statistics results in a higher amount of EEE placed on market than the data available by Recupel, and for other categories exactly the opposite is true. This could be because the calculations from the model use data from average weights from the Netherlands. Another possible cause is the difference in scope between the two calculations. It is thus important to review these findings again in the future when better data are available of the weights of new devices sold in Belgium.

6.2. EEE Stock

Currently, a stock of 750 million electrical and electronic devices currently exists in Belgian households and companies. The combined weight of this stock amounts to approximately 276 kg per inhabitant.

This stock is made up of devices that are in use as well as devices that are no longer used, but not yet discarded. This forms the stock that will eventually be removed as WEEE. The data about the market input and stock levels in the model could improve by conducting new possession studies.

6.3. WEEE generated

In 2011, the amount of WEEE generated in Belgium was 22.4 kg per resident.

The estimation of the amount of WEEE generated via the model is a sufficiently robust calculation, but the estimation was based on a limited set of Belgian data. The quality of the calculation of the amount of WEEE generated can thus still be improved.

The accuracy of this calculation of the WEEE generated is still uncertain, but it is expected to be within a 5% uncertainty margin and is very comparable to the Dutch amounts. The lack of good data about the lifespan profiles of the current stock of devices in households presents a particular challenge in formulating precise calculations. Additionally, there is no possession study of commercial equipment.

6.4. The WEEE mass balance

In 2011, the amount of WEEE generated in Belgium was 85% of the amount of EEE placed on market. Registered flows cover 47% of the WEEE generated in 2011. In the study, complementary flows are documented so that a total of 70% of the WEEE generated is represented. There are still possibilities of gaining better insight into the missing 30% by conducting a number of complimentary studies.

6.5. Recommendations

6.5.1. Improve the estimation of the amount of EEE that is placed on market

- Start to register the average weights of new devices

For professional devices, data is already available because at the time of registration with Recupel, the weights as well as the number of devices are requested. For household devices, it would be useful to start such a registration program.

- Redistribution of device categories

The categories must be adjusted within the framework of the changes to the EU WEEE Directive. One possibility is to use the distribution in UNU-Keys as a basis for future registration and to include the IT category separately.

6.5.2. Improve the estimation of the amount of WEEE generated

- Conduct a renewed possession study of households

It is especially important to gather more accurate information about the number of products per household over time (stock development) and complimentary information about the lifespan profiles and the disposal channels of a larger group of devices from the category SHA.

- Conduct a possession study of companies

The stock, lifespan profiles and disposal channels of devices used by companies must be assessed.

6.5.3. Improve insight into undocumented flows

- Sampling of the pre-shredder material

The share of WEEE in pre-shredder material is not accurately represented at this moment. A conservative estimate is made here in this study. Sorting samples of this material can offer more a more accurate estimation of the amount of WEEE present.

- Further analysis of refurbishing and export of devices for reuse

Screens and professional devices in particular are frequently traded for reuse, a phenomenon that is still insufficiently represented in estimations.

- Research on export by ground towards Eastern Europe, export of mono flows towards France and Germany, and a broader study of customs data.

There are indications that there is more export than is currently documented. The sources used in the research do not allow for quantitative statements to be made about the volume of this flow. Complimentary studies can help to provide more insight into this export flow.

- Research on commercial residual waste

The currently available research is outdated and is insufficiently extensive to make reliable statements about the amount of WEEE that is disposed of along with commercial residual waste.

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Appendix A: 55 UNU-keys

UNU Key	Primary Collection Category	Full name	Abbreviation	# of Subkeys	# of Product types	WEEE Forum KF/ UNU WEEE Review (17)	Wecycle 2013 # keys	Median Lifespan Equipement sold in 2005
0001	F PROF LHA	0001 PROF Central Heat (HH installed central heating on gas)	0001 PROF Central Heating	4	8	1A LHHA	1	12,7
0101	F PROF LHA	0101 PROF Heating & Ventilation (excl. cooling eq.)	0101 PROF Heating & Vent.	3	18	1A LHHA	3	14,6
0102	A LHA	0102 LHA Dishwashing (dishwashers)	0102 LHA Dishwashing	1	1	1A LHHA	1	10,5
0103	A LHA	0103 LHA Kitchen (large furnaces, ovens, cooking equipm.)	0103 LHA Kitchen	3	6	1A LHHA	1	15,6
0104	A LHA	0104 LHA Washing (washing machines&combined dryers)	0104 LHA Washing Machines	2	2	1A LHHA	1	10,3
0105	A LHA	0105 LHA Drying (wash dryers, centrifuges)	0105 LHA Wash Dryers	2	2	1A LHHA	1	14,3
0106	A LHA	0106 LHA Room (large HH room heating & ventilation, hoods)	0106 LHA Heating & Vent.	3	19	1A LHHA	1	11,2
0107	A LHA	0107 LHA Sun (sunbeds & tanning equipment)	0107 LHA Sunbeds	1	3	1A LHHA	1	8,8
0108	B C&F	0108 C&F Fridge (fridges for food, wine, ice, etc.)	0108 C&F Fridges	3	3	1B C&F	1	14,0
0109	B C&F	0109 C&F Freezer (freezers for food, ice, etc.)	0109 C&F Freezers	1	1	1B C&F	1	17,4
0110	B C&F	0110 C&F Combi (combi fridge- reezers, food, wine, ice, etc.)	0110 C&F Combi-fridges	1	1	1B C&F	1	17,1
0111	B C&F	0111 C&F Aircon (HH installed airconditioners)	0111 C&F HH Aircon	3	13	1B C&F	1	12,8
0112	B C&F	0112 C&F Other (dehumidifiers, heat pump dryers, etc.)	0112 C&F Other Cooling	2	3	1B C&F	1	11,7
0113	F PROF C&F	0113 PROF C&F (Prof. aircons, cooling displays, etc)	0113 PROF C&F	5	15	1B C&F	3	17,8
0114	C SHA	0114 SHA Microwaves ((combined) microwaves, excl. grills)	0114 SHA Microwaves	2	2	1C SLHA	1	9,4
0201	C SHA	0201 SHA Other (small ventilators, irons, clocks, adapters, etc.)	0201 SHA Other	8	26	2 SHA	3	6,2
0202	C SHA	0202 SHA Food (kitchen, food processing, frying pans, etc.)	0202 SHA Food	6	56	2 SHA	3	9,5
0203	C SHA	0203 SHA Hot water (coffee, tea, hot water, etc.)	0203 SHA Hot water	4	15	2 SHA	1	6,5
0204	C SHA	0204 SHA Vacuum cleaners (excl. professional ones)	0204 SHA Vac.Cleaners	2	4	2 SHA	1	8,0
0205	C SHA	0205 SHA Personal Care (tooth brushes, hair, razors, etc.)	0205 SHA Personal Care	8	28	2 SHA	1	8,1
0301	G IT	0301 IT Small (other small IT, incl components & acces.)	0301 IT Small IT & acces.	9	19	3A IT	2	4,4
0302	G IT	0302 IT Desktop PCs (excl. monitor, accessoires)	0302 IT Desktop PC's	1	1	3A IT	1	7,2
0303	G IT	0303 IT Laptop PCs (laptops, notebooks, netbooks, tablets)	0303 IT Laptop PC's	4	4	3A IT	2	5,3
0304	G IT	0304 IT Printers (printing & imaging, scanners, MFS, faxes)	0304 IT Printers	7	10	3A IT	1	8,3
0305	G IT	0305 IT Phones (telephones & equipment, DECT phones)	0305 IT Telecom	3	7	3A IT	1	5,5
0306	G IT	0306 IT Mobile phones (mobile phones, smartphones, pagers)	0306 IT Mobile phones	3	3	3A IT	1	5,0
0307	F PROF IT	0307 PROF IT (large IT, servers, routers, data storage, copiers)	0307 PROF IT	6	8	3A IT	1	6,1
0308	D Screens CRT	0308 SCREENS CRT monitors (cathode ray tube mon.)	0308 SCREENS CRT Mon.	1	1	3B IT CRT	1	11,0
0309	D Screens LCD	0309 SCREENS Flat Display Panel Monitors (LCD, LED monitors)	0309 SCREENS LCD Mon.	3	4	3C IT FDP	1	7,4
0401	C SHA	0401 SHA CE (other, headphones, adapters, remote controls)	0401 SHA Small CE & acces.	5	5	4A CE	0	8,1
0402	C SHA	0402 SHA Portable Audio/ Video (MP3, e-readers, car nav., etc)	0402 SHA Portable AV	7	13	4A CE	1	5,1
0403	C SHA	0403 SHA Radio & Hifi (audio sets, components, etc.)	0403 SHA Radio & Hifi	5	17	4A CE	1	13,1
0404	C SHA	0404 SHA Video (VCR,DVD(R), Blue Ray, Decoders, etc.)	0404 SHA Video	6	15	4A CE	0	8,4
0405	C SHA	0405 SHA Speakers	0405 SHA Speakers	2	3	4A CE	0	8,5
0406	C SHA	0406 SHA Cameras (camcorders, foto&dig. still cameras)	0406 SHA Cameras	2	4	4A CE	0	6,3
0407	D Screens CRT	0407 SCREENS CRT TVs	0407 SCREENS CRT TVs	1	1	4B CRT	1	11,1
0408	D Screens LCD	0408 SCREENS Flat Display Panel TVs (LCD, LED, PDP)	0408 SCREENS LCD TVs	3	9	4C FDP	1	10,0
0501	C SHA	0501 SHA Lamps (pocket, christmas, halogen, ex. LED & incand.)	0501 SHA Other Lamps	3	3	5B Lum	0	6,8
0502	E Lamps	0502 LAMPS CFL (compact fluorescent, retro & non-retro)	0502 LAMPS CFL	2	2	5A Lamps	2	6,6
0503	E Lamps	0503 LAMPS TL (straight tube fluorescent lamps)	0503 LAMPS TL	2	2	5A Lamps	1	11,7
0504	E Lamps PROF	0504 LAMPS Special (Hg, high & low pres. Na, other prof. lamps)	0504 LAMPS PROF Special	4	4	5A Lamps	1	5,5
0505	E Lamps	0505 LAMPS LED (incl. retrofit lamps, HH LED luminaires)	0505 LAMPS LED	2	2	5A Lamps	2	-
0506	C SHA	0506 SHA Luminaires (incl HH incandescant fittings)	0506 SHA Luminaires	2	11	5B Lum	1	14,6
0507	A LHA	0507 PROF Luminaires (all lum. offices, public space, industry)	0507 PROF Luminaires	2	2	5B Lum	4	-
0601	C SHA	0601 SHA Tools (all HH saws, drills, cleaning, garden, etc.)	0601 SHA Tools	9	83	6 Tools	1	9,3
0602	F PROF Tools	0602 PROF Tools (Professional tools, excl. dual use)	0602 PROF Tools	7	36	6 Tools	1	13,8
0701	C SHA	0701 SHA Toys (small toys, vehicles, small music)	0701 SHA Toys	3	3	7 Toys	2	3,6
0702	G IT	0702 SHA Game Consoles (video games and consoles)	0702 IT Game Consoles	4	4	7 Toys	1	3,5
0703	C SHA	0703 LHA Toys (exercising, large music instr.)	0703 LHA Toys	3	17	7 Toys	2	10,0
0801	C SHA	0801 SHA Medical (small HH thermom., blood pressure meters)	0801 SHA Medical	1	52	8 Medical	0	11,4
0802	F PROF Med	0802 PROF medical (hospital, dentist, diagnostics, etc.)	0802 PROF Medical	1	47	8 Medical	3	11,7
0901	C SHA	0901 SHA Monitoring (alarm, heat, smoke, security, ex. screens)	0901 SHA Monitoring	2	28	9 M&C	1	4,7
0902	F PROF Mon	0902 PROF Monitoring (Prof. M&C, garage, diagnostic, etc.)	0902 PROF Monitoring	1	7	9 M&C	1	9,6
1001	F PROF LHA	1001 PROF Dispensers (non-cooled vending, coffee, tickets, etc.)	1001 PROF Disp. non-cooled	1	4	10 Disp	2	8,5
1002	F PROF C&F	1002 PROF Dispensers (cooled vending, bottles, candy, etc.)	1002 PROF Disp. cooled	1	3	10 Disp	3	8,5
				182	660	17	71	

Appendix B: EEE put on market, WEEE generated

Quantity of EEE placed on market per collection category 2000 – 2011 (kg/inh)

Kg/Inh	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LHA	7,4	7,5	7,6	7,9	7,9	8,3	8,6	9,2	8,3	8,5	8,4	8,5
C&F	2,3	2,7	2,7	2,9	2,8	3,0	3,3	3,3	3,2	2,9	3,2	3,3
SHA	5,6	6,2	6,2	6,6	6,5	7,1	7,7	8,1	8,5	7,1	7,5	7,8
SCREENS	2,7	2,9	3,1	3,1	3,3	3,5	3,2	1,7	1,7	1,7	1,7	1,6
LAMPS	0,1	0,1	0,2	0,1	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
PROF	1,7	1,5	1,8	1,9	1,6	1,7	2,5	2,3	2,1	2,2	2,4	2,5
IT	1,9	1,8	1,9	1,9	2,1	2,0	2,2	2,3	2,4	2,2	2,1	2,2
TOTAL	21,7	22,7	23,5	24,4	24,3	25,9	27,7	27,2	26,3	24,7	25,6	26,2

Quantity of EEE placed on market per collection category 2000 – 2011 (thousands of units)

Units (x '000)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LHA	4.016	4.139	4.154	4.220	4.344	4.485	4.672	6.800	5.952	5.201	5.113	4.834
C&F	553	640	647	697	678	715	757	755	743	666	726	767
SHA	43.586	42.909	38.490	49.703	48.113	54.157	60.183	52.094	73.251	54.742	62.369	67.267
SCREENS	1.282	1.360	1.500	1.641	1.953	2.235	2.177	1.659	1.774	1.695	1.593	1.704
LAMPS	11.365	12.443	13.929	12.720	14.485	19.587	17.303	21.317	21.259	22.605	25.692	24.083
PROF	281	227	305	325	227	249	456	400	343	401	430	458
IT	10.076	9.817	11.137	11.711	13.041	14.464	15.447	15.856	17.126	16.225	17.103	16.804
TOTAL	71.160	71.535	70.162	81.017	82.840	95.892	100.995	98.881	120.448	101.535	113.025	115.917

Quantity of WEEE generated per collection category 2000 – 2015 (kg/inh)

Kg/Inh	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
LHA	5,3	5,5	5,7	5,8	6,0	6,1	6,3	6,4	6,5	6,6	6,7	6,9	7,0	7,1	7,2	7,3
C&F	1,9	2,0	2,0	2,1	2,1	2,2	2,2	2,2	2,3	2,3	2,4	2,4	2,5	2,5	2,6	2,6
SHA	3,9	4,1	4,3	4,5	4,7	4,9	5,1	5,3	5,6	5,8	6,0	6,2	6,4	6,6	6,7	6,8
SCREENS	1,2	1,3	1,4	1,6	1,7	1,9	2,1	2,3	2,5	2,6	2,8	2,9	3,0	3,0	3,0	2,9
LAMPS	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,2	0,2	0,2	0,2	0,2	0,2
PROF	1,0	1,1	1,1	1,2	1,3	1,3	1,4	1,5	1,5	1,6	1,6	1,7	1,7	1,7	1,8	1,8
IT	1,2	1,3	1,4	1,5	1,6	1,6	1,7	1,8	1,8	1,9	2,0	2,0	2,1	2,1	2,2	2,2
TOTAL	14,6	15,3	16,0	16,7	17,4	18,1	18,8	19,6	20,3	21,0	21,7	22,3	22,8	23,2	23,5	23,7

Quantity of WEEE generated per collection category 2000 – 2015 (thousands of units)

Units (x '000)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
LHA	2.872	2.986	3.097	3.203	3.306	3.404	3.503	3.611	3.737	3.871	4.000	4.128	4.252	4.373	4.494	4.617
C&F	506	521	536	549	562	574	587	599	612	624	636	648	660	672	685	697
SHA	25.365	27.303	29.174	31.022	33.255	35.335	37.833	40.060	43.163	45.837	48.392	51.091	53.507	55.761	57.991	60.251
SCREENS	695	754	818	886	962	1.054	1.172	1.323	1.501	1.694	1.881	2.041	2.159	2.228	2.247	2.227
LAMPS	8.653	8.987	9.426	9.866	10.340	11.050	11.827	12.722	13.670	14.632	15.683	16.740	17.782	18.788	19.733	20.604
PROF	150	160	174	190	201	210	230	247	259	275	292	308	319	325	330	333
IT	6.770	7.248	7.810	8.404	9.054	9.852	10.753	11.658	12.684	13.532	14.329	14.962	15.558	16.090	16.551	19.943
TOTAL	45.011	47.959	51.035	54.120	57.680	61.479	65.905	70.220	75.626	80.465	85.213	89.918	94.237	98.237	102.031	108.672

Appendix C: Stock of EEE by an average Belgian household in number of pieces

EEE	Attic	Office & Hobby Room	Bedroom	Children's Room	Bathroom	Living Room	Kitchen	Storage space	Garden / Garage	Totaal
Devices	1,0	16,0	1,9	6,3	7,2	18,7	13,6	7,7	6,6	**79,0**
Lamps and fixtures	7	5	4	5	3	9	6	5,0	3,1	**47,1**
Total	**8**	**21**	**6**	**11**	**10**	**28**	**20**	**13**	**10**	**126**

Attic: 8 pieces EEE
1 CH inst./boiler
0.03 tanning beds
2 other lamps
1 energy saving lamp
2 fluorescent lamps
2 fixtures

Children's Room: 11 pieces EEE
5.2 electronic toys
0.5 game consoles
0.7 smoke detectors
2 other lamps
1 energy saving lamp
2 fixtures

Bedroom: 6 pieces EEE
0.9 TVs
1 other lamp
1 energy saving lamp
2 fixtures
1 smoke detector

Bathroom: 10 pieces EEE
5.9 shaving equipment, electric toothbrush, hair dryer, etc.
1 other lamp
1 energy saving lamp
1 fixture
1.3 thermometers/ blood pressure meters

Garden: 10 pieces EEE
6.6 drills, lawnmowers, saws, hedge cutters,
pressure washers, etc.
2.2 other lamps
0.9 fixtures

Office & Hobby Room	22 pieces EEE
6,0 mouse, keyboards, etc	0,7 LCD Monitors
0.8 desktops	1,1 cameras
0.8 laptops/tablets	3,5 mobile phones
1.1 printers	2 Other lamps
1.4 telephonesets	1 energy saving lamp
0,4 CRT Monitors	2 fixtures

Living Room	28 pieces EEE
0.07 Airconditioning	1.9 DVD/VCRs
5 small devices	2.3 speakerssets
(clock's, adapters, batterychargers, etc)	0.9 LCD TV's
2.2 remote controls, headsets	4 other lamps
2.2 radio/mp3	2 energy saving lamps
4.1 audio/HiFi sets/parts	3 fixtures

Kitchen	20 pieces EEE
0.6 dishwasher	6.8 Kitchen appliances
0.8 ovens	(Blenders, mixers, frying pan,...)
1.1 ventilationsystems	2 coffee machine/ waterboiler
1.4 refridgerators	2 Other lamps
0.1 iceblenders	2 energy saving lamps
1.0 microwave ovens	2 fixtures

Storage	13 stuks EEA
1.0 Washing machine	1.2 energy saving lamps
0.6 Dryer	2.8 fluorescent lamps
0.6 Freezer	1 fixture
3.9 iron, scale, etc	
1.6 vacuumcleaners	