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Circular economy indicators for consumer goods

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Veerle Vermeyen
Luc Alaerts
Karel Van Acker
Sustainability Assessment of Material Life Cycles, KU Leuven
Kasteelpark Arenberg 44, 3001 Leuven, Belgium

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Contact information:

Luc Alaerts
manager Policy Research Center
luc@vlaanderen-circulair.be
+32 16 324 969

Karel Van Acker
promoter Policy Research Center
karel.vanacker@kuleuven.be
+32 16 321 271

Summary

This report is part of the ongoing research at the Policy Research Centre for Circular Economy to create a framework for a monitor to guide the transition to a circular economy in Flanders. This report presents a set of indicators for the system of consumer goods, revealing how this system performs in relation to the principles of the circular economy.

In general little evidence was found that the system of consumer goods is circular or evolving towards it. The study revealed that large amounts of raw material input are needed to fulfil the need for consumer goods. While it is positive that reuse of consumer goods in Flanders seems to be increasing, the reuse centres signal that continued growth is hindered by the decreasing quality of the inflow in products. This while goods which could potentially be reused are ending up in municipal solid waste. Consumer goods could be further kept from becoming waste by increasing repair, however at the moment this strategy is only marginally implemented and documented. The total amount of municipal solid waste collected decreased compared to 2013, but has stagnated in recent years. The data also shows that there is still room for improving the selective collection of recyclable materials that now end up in residual or bulky waste.

As the consumer goods system is a grouping of very diverse goods, it proved impractical to find general indicators expressing the circularity of the consumer goods system as a whole. This created the necessity to further disaggregate the system of consumer goods, creating three distinct sub-categories, specifically for ‘textiles’, ‘electronic and electric equipment’ and ‘furniture’. This way specific opportunities and problems could be highlighted for each of these large impact categories. About electronic and electric equipment the most is known, due to the data available for the EPR obligations. Electronic and electric equipment waste is successfully kept out of the residual waste fraction and about 50% gets collected through official channels, where almost 80% is recycled. However, the stock of electronic and electric equipment in households is still increasing and there is a significant amount of electronic and electric equipment present in households which remains underused. While for textiles data is limited, there are few signals that textiles are transitioning towards a more circular system. About half of discarded textiles end up in residual waste and information on what happens to the selectively collected fraction is scarce. Furniture has so far seemed to stay under the radar of policymakers, resulting in very little information. Its significant material and carbon footprint however reveal that this product group should not be overlooked.

It can be noted that each of these three product groups were identified as priority product groups in the new circular economy action plan of the European Commission and thus are likely to receive increasing attention in the coming years. By continuing the current research Flanders has a chance of getting out in front of this. This report is a first step in putting together data to create a circular economy monitor for consumer goods. However, if this monitor is to further grow, it will be key to add further data to fill the remaining data gaps, for some of which new specific studies will need to be conducted. Also the industry should be further included to ensure their role in the transition to a circular economy is sufficiently highlighted. A key issue hindering the data availability on consumer goods is that they are not evident to track within the economy, as there is very little administration involved with these goods after purchase.

Samenvatting

Dit rapport is onderdeel van het lopende onderzoek door het Steunpunt Circulaire Economie om een kader te creëren voor een monitor die de overgang naar een circulaire economie in Vlaanderen weergeeft. In dit rapport wordt een reeks indicatoren voor het systeem van consumptiegoederen voorgesteld die aangeven hoe dit systeem functioneert in relatie tot de principes van de circulaire economie.

In het algemeen is er weinig bewijs gevonden dat het systeem van consumptiegoederen circulair is of in die richting evolueert. Uit het onderzoek is gebleken dat er grote hoeveelheden grondstoffen nodig zijn om in de behoefte aan consumptiegoederen te voorzien. Hoewel het positief is dat het hergebruik van consumptiegoederen in Vlaanderen toeneemt, geven de erkende kringloopcentra aan dat hun verdere groei belemmerd is door de afnemende kwaliteit van de instroom van goederen voor hergebruik. Dit terwijl goederen die mogelijk kunnen worden hergebruikt in het huishoudelijk afval terechtkomen. De levensduur van consumptiegoederen zou verlengd kunnen worden door reparatie, maar deze strategie wordt momenteel slechts beperkt uitgevoerd en gedocumenteerd. De totale hoeveelheid ingezameld huishoudelijk afval daalde ten opzichte van 2013, deze trend stagneerde de laatste jaren echter. Verder blijkt dat de selectieve inzameling van recycleerbare materialen nog beter kan.

Aangezien het systeem van consumptiegoederen een groepering van zeer diverse goederen is, bleek het onpraktisch om algemene indicatoren te vinden die de circulariteit van dit systeem uitdrukken. Omwille hiervan, werd het systeem van consumptiegoederen verder opgesplitst, waarbij drie afzonderlijke subcategorieën werden gecreëerd, namelijk "textiel", "elektronische en elektrische apparatuur" en "meubilair". Zo konden de specifieke mogelijkheden en problemen voor elk van deze invloedrijke categorieën worden belicht. Over elektronische en elektrische apparatuur is het meeste bekend. Het afval van elektronische en elektrische apparatuur wordt met succes uit het restafval gehouden en ongeveer 50% wordt via de officiële kanalen ingezameld, waarna bijna 80% wordt gerecycleerd. De voorraad elektronische en elektrische apparatuur in huishoudens neemt echter nog steeds toe en een aanzienlijke hoeveelheid blijft onderbenut. Hoewel de gegevens voor textiel beperkt zijn, zijn er weinig signalen dat het overgaat naar een meer circulair systeem. Ongeveer de helft van het afgedankte textiel komt bij het restafval terecht en informatie over wat er met de selectief ingezamelde fractie gebeurt is schaars. Meubilair lijkt tot nu toe onder de radar van de beleidsmakers te zijn gebleven, met als gevolg zeer weinig informatie. De aanzienlijke materiaal- en koolstofvoetafdruk van meubilair toont echter dat deze productgroep niet over het hoofd mag worden gezien.

De drie belichte productgroepen werden in het nieuwe actieplan voor de circulaire economie van de Europese Commissie als prioritaire productgroepen geïdentificeerd en zullen dus in de komende jaren wellicht meer aandacht krijgen. Door het huidige onderzoek verder te zetten kan Vlaanderen hierop vooruit lopen. Dit rapport is een eerste stap in het samenzetten van de nodige gegevens om een monitor voor consumptiegoederen te creëren. Om deze monitor verder te ontwikkelen is het van groot belang dat er meer gegevens aan worden toegevoegd om de resterende gaten op te vullen, hiervoor zullen ook enkele nieuwe studies moeten worden uitgevoerd. De sector zelf moet verder betrokken worden om ervoor te zorgen dat hun rol bij

de overgang naar een circulaire economie voldoende wordt benadrukt. De beschikbaarheid van gegevens over consumptiegoederen wordt belemmerd doordat deze niet makkelijk te traceren zijn binnen de economie, aangezien er na aankoop zeer weinig administratie bij te pas komt.

List of Abbreviations

CE	Circular Economy
CF	Carbon Footprint
COICOP	Classification of Individual Consumption by Purpose
CSG	Consumer Goods
EEE	Electronic and Electric equipment
EPR	Extended Producer Responsibility
MF	Material Footprint
MSW	Municipal Solid Waste
NBV	Netwerk Bewust Verbruiken
OOM	Out-Of-Market
POM	Put-On-Market
PRO	Producer Responsibility Organization
PSS	Product-Service Systems
R&S	Repair&Share
WEEE	Waste from Electronic and Electric Equipment

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Circular economy indicators for consumer goods

1 Introduction

The region of Flanders has put forth the ambition to have a circular economy by 2050 (Vlaamse Regering, 2016). To help achieve this, the Policy Research Centre for Circular Economy was given the task to create a monitor for the circular economy in Flanders by 2021. The aim of this monitor is to provide indicators to help guide the transition to a circular economy and give feedback to policy makers. This study is part of this ongoing research line.

The research line started in 2017 with the development of a conceptual framework to underpin the monitor. The key idea in the resulting framework are so-called '**systems to fulfil societal needs**' (Alaerts et al., 2019a, 2019b), which overlap with the major consumption domains of households, i.e.: mobility, housing, nutrition and consumer goods[1]. As is shown in figure 1, these four consumption domains together represent about 90% of the material and carbon footprint of households in Flanders (Raes, Pelt, et al., 2020; Vercalsteren et al., 2017). The reasoning behind this framework is that the economy is a system which fulfils needs through offering products and services. A transition to a circular economy will involve major modifications in those products and services. By creating a better understanding of this, the associated material requirements and impacts, as well as the potential progress towards a more circular economy can be monitored.

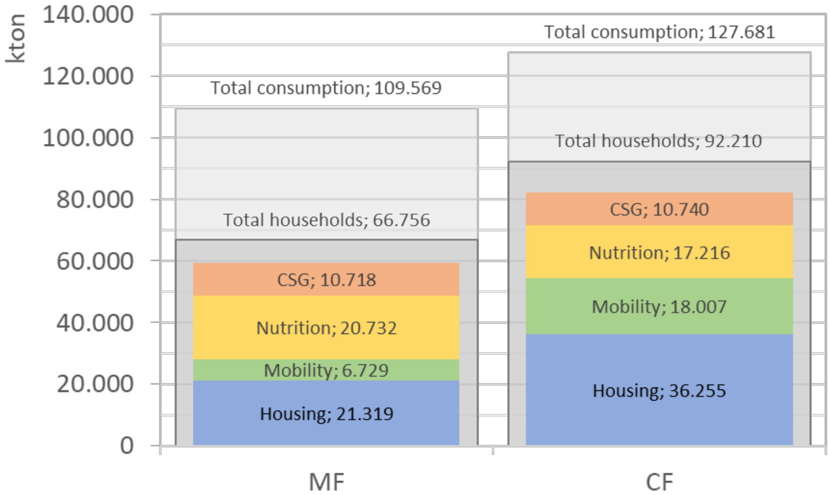

Figure 1 – Material- and carbon footprint of consumption in kton, Flanders, 2010
(Christis et al., 2019; Vercalsteren et al., 2017)

[1] The first three domains (mobility, housing and nutrition) are each individually established final demand categories in COICOP (1999), while the last domain (consumer goods) was added to encompass the remaining large categories, the list of consumption categories included in this domain are given in appendix A1.

It should be noted that while the fulfilment of societal needs lays at the basis of this monitor, it is not the aim of the monitor to make a judgement on the societal need, but to show how the societal need can be fulfilled in a more circular way. The aim is to create for each system a monitor which reveals its underlying processes. Thus, while the material and carbon footprint of consumption where used as a guide to determine which systems to include in the CE monitor for Flanders, the monitor itself takes a lifecycle perspective, including all lifecycle phases from extraction and design to End-Of-Life. This way a bridge is forged between production and consumption. Through a range of indicators, from the society-wide level of macro indicators to micro level product indicators, the monitor aims to display the material consumption and associated impacts of these systems (Figure 2). This combination of indicators should then offer more direct feedback at different levels to policymakers. Both goods and services are included so that the effects of circular economy business models, where owning a product (e.g. car) can become a service (e.g. carsharing), are also taken into account.

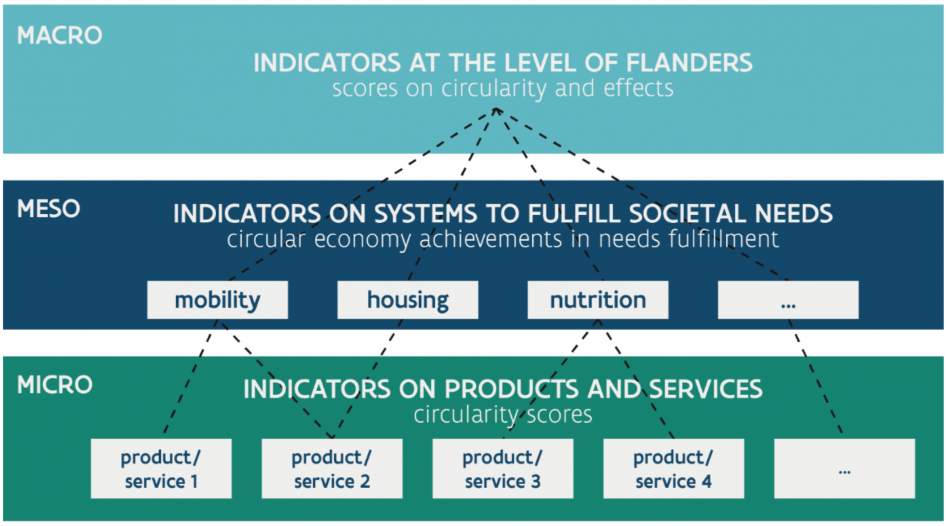

Figure 2 – Overview of the monitor for circular economy
(Alaerts et al., 2019a)

This study implements the developed framework for the **system of consumer goods**. This system encompasses a set of typical household goods which are used in our daily lives but fall outside of the three main domains (mobility, housing, nutrition). This includes a whole range of products from clothing, to electric appliances, books or other household items. This report aims to put together data in such a way as to answer the question: 'How circular is the need for consumer goods currently fulfilled in Flanders and how is this evolving?'. Ideally, this is assessed from two sides: the role of the consumption of consumer goods in Flanders and the role of the production of consumer goods in Flanders. The focus of this study is on consumption by households. Thus, those aspects like consumption outside of households and production should be further addressed in future studies. This study further looks at the data availability and governance for the consumer goods system. Throughout this report the available data is discussed, as is the data gap between what is available and what ideally would be.

Previous work already applied the framework to the system of mobility, resulting in a set of indicators that show the current state of this system with regard to a transition towards circular economy (Alaerts et al., 2020). This study helped to make the theoretical framework more tangible and provided practical insights into the challenges and bottlenecks of applying the developed concept.

2 Materials and methods

This section discusses the framework of the monitor and how it was applied to this particular system. This is followed by an overview of the data gathering process, with a brief description of the different actors from whom data was used.

2.1 Framework of the monitor

This study is a first attempt at creating a monitor to track whether the need system of consumer goods in Flanders is becoming more circular. In order to better understand such a monitor, we will first explain the terms circular economy, consumer goods and life cycle perspective.

In general, the key idea of **circular economy** (CE) is to keep products and materials functional as long as possible at the highest possible application level, while minimizing total material-related environmental impacts (Alaerts et al., 2019b). This can then be roughly translated into two high-level objectives:

- to minimize our material footprint, with the aim that our global consumption of materials should be minimized – as such respecting the planetary boundaries (Alaerts et al. 2019b).
- to minimize our carbon footprint, with respect to reducing the environmental impact our consumption has, most notably the CO2-eq emissions given the context of climate change.

This study looks at what this means for **consumer goods** (CSG), which include a whole range of typical household products. The full list of included consumption categories for this system, according to COICOP[2] 1999, is given in appendix A1, as is the material and carbon footprint of each category. Within the consumption categories included, three main product groups emerge: textiles, electronic and electrical equipment (EEE), and furniture, which together represent respectively 54% and 53% of the material and carbon footprint of CSG (Christis et al., 2019; Vercalsteren et al., 2017). Therefore, throughout the monitor there is a special focus on these three product groups.

Lastly, it is important to note that this study looks at the circularity of the CSG system from a **lifecycle perspective**, meaning that not only the use phase of the CSG is taken into account but also all preceding and subsequent steps. To create a truly circular system for CSG in Flanders it is necessary to also look at these steps, whether they occur in Flanders or abroad. Especially for CSG, which are often produced overseas, at high environmental costs. The focus of the developed framework to look at CE through systems to fulfil societal needs allows for this by looking at the material requirements and impacts of the products and services associated with a certain system. By taking this perspective it becomes possible to look at both the role of consumption, as that of production in Flanders.

Thus, based on the definitions above, a circular fulfilment of the need for CSG in essence comes down to minimizing the material and carbon footprint of CSG throughout their lifecycle. This then lays at the basis of the CE monitor for the CSG system.

[2] COICOP stands for 'Classification of Individual Consumption According to Purpose' and is the UN reference classification.

2.2 Data sources

At the basis of this report lays an extensive data collection process. In a first step the key stakeholders within the need system for the CSG where identified. A practical starting point for data collection was OVAM, the Flemish waste agency, due to their involvement in the handling and monitoring of CSG waste. A number of meetings with OVAM revealed which data they gather and which additional stakeholders they believed it would be interesting to contact. All stakeholder interactions where preceded and accompanied by online research to identify which data was available and gain an understanding of what may be obtained. Through an iterative process of exchanges good contacts where established with the different stakeholders, deepening our understanding of the numbers and revealing additional data.

The following organizations provided data which was analysed for the monitor:

- **BeWeee**: As it is not mandatory for a company to join Recupel, this non-profit organization was created in 2018 to further complete the amounts of WEEE being reported. Companies choosing not to join Recupel are asked to report their numbers to BeWeee. Thus, BeWeee was contacted to supplement the numbers received from Recupel.
- **Circular Economy Policy Research Centre**: Another research line with in the CE Policy Research Centre provided data on the stock of second-hand goods in households and the amount of reuse in Flanders, their full findings are available in Delanoeije & Bachus (2020). This research allowed for widening the scope of the reuse in Flanders beyond just the official reuse centres, monitored by OVAM.
- **Netwerk Bewust Verbruiken (NBV):** is a non-profit which aims to promote a simple and sustainable lifestyle. NBV brings together more than 40 consumer-, environmental- and development organizations working toward this. The NBV spin-off **Repair&Share (R&S)** specifically aims to improve the quality, repairability and lifespan of products. They do this through supporting projects and companies that contribute to the lifetime extension and the sharing of products, as well as making the concept of repairing and sharing more accessible to the general public. In this context they were able to provide initial insights into the repair and share efforts ongoing in Flanders.
- **OVAM - The Flemish Waste Agency**: As the government agency responsible for waste collection and treatment in Flanders, OVAM played a central role in providing data. OVAM provided their data on municipal solid waste, providing detail into the amount of waste, the types of waste and the treatment of waste. Additionally, OVAM shared all the available data on reuse in Flanders through the official reuse centres, known as the 'De Kringwinkel'.
- **Recupel**: This non-profit is the extended producer responsibility (EPR) organization for waste from electronic and electric equipment (WEEE) in Belgium. As such, they possess key data and insights regarding the amounts and types of electronics put on and taken out of the market. Recupel provided detailed yearly reports (2010-2019) on the amounts of electronic and electric equipment brought on the market by their members and the amounts collected and processed through the official channels they preside over. Furthermore, they shared the insights of their two-yearly consumer survey on the amounts and types of electronics present in households.

- **MIRA (VMM)**: This unit, within the Flanders Environment Agency (VMM), is responsible for the State of the Environment Report (SOER) in Flanders. MIRA provided the data on the material and carbon footprints of the Flemish consumption.

Additional stakeholders that were contacted for the study were: VVSG, HERW!N, Fost Plus and Bebat. These exchanges led to further insights but did not result in specific data. Notably no significant stakeholders concerning clothing or furniture were found that were willing to share specific data regarding these products. Unlike with EEE, no separate non-profit seems to exist to track these products. While companies and sector organizations probably hold interesting data, the perceived protectionist nature of these organizations towards their commercial position and intellectual property creates significant bottlenecks. Some of these bottlenecks may be overcome given more time and a significant effort, which was not possible in the time frame of the current project.

3 Results

The first section of this part discusses what data is required for a CE monitor for the CSG system. The next section covers the available data, providing detail into their origin and quality. The final section pulls together the collected data into a general overview, which is a first version of the CE monitor for the CSG system.

3.1 Data needs

Currently in Flanders there is no clear official policy framework or targets outlining at what point the transition to a CE would be considered successful or against which indicators success will be measured. Thus, to be able to answer the question posed in this report ‘how circular is the CSG system in Flanders and how is this evolving’ there is a need to define what would be considered as a circular CSG need system. Section 2.1 already started to answer this by stating that a circular fulfilment of the CSG need system in essence comes down to minimizing the material and carbon footprint of CSG throughout their lifecycle.

One way this can be achieved is through **smarter product use and manufacturing.** A direct path to achieve this is by increasing the efficiency of product manufacturing. Yet there is also a large potential gain to be had by reducing the number of products needed to fulfil the need for CSG. To decrease the amount of products in circulation, while still meeting the societal need, an increase in the efficiency and the intensity of use for CSG is required. CE business models are often brought forward as a way to achieve this by offering the use of the product (‘the functionality’) instead of the product itself, for example by sharing washing machines within an apartment building. This then provides a strong incentive to producers to design their products for longevity, repairability and recyclability, as they retain ownership over the product. Better product design, so called ‘eco-design’, will play an important role in the transition towards a CE, as the choices a producer makes in the initial design phase strongly influence the final footprint of that product (European Commission, 2020). Hence, it is interesting to know how many products are required to fulfil the need for CSG, how efficiently they are produced, and how intensely these products are utilised. Materials or products entering/in/leaving the market should thus be tracked.

The amount of materials required to fulfil the need for CSG can further be lowered by **keeping products functional as long as possible at their highest possible application leve**l. Simply put, it should be avoided that CSG become waste before reaching the end of their technical life. Extending the lifetime of products (or their parts) reduces the needed input and output. In its most extreme form, this means that producers should not destroy unsold stocks of products but should instead find a purpose for these products, for example donating them to charities. Further, consumers should be encouraged to consider the possibility of reuse and repair for their CSG before discarding them. For example, clothing that is no longer worn could be swapped with others or donated. This can however only be achieved if products are designed in such a way that repair is accessible and products are designed for longevity so that reuse is viable, placing the responsibility with both consumers and producers. Thus, knowing the evolution in the amount of reuse, the amount of repair and their average lifetime will all provide interesting insights into the circularity of the CSG system.

Only when the product has reached the end of its lifespan should it be discarded to be collected as waste[3]. At this point, **the aim should be to find the most useful application for the collected materials, which can be achieved through recycling.** Recycling lowers the amount of raw primary resources needed by replacing virgin input with recycled content. Materials can be recycled through different processes, for example: fibre from clothing could be recycled to make clothing again or the fibre could be used as filling for furniture. Ideally, the materials are recycled in such a way that there is minimal quality loss in the recycling process. Here again, producers hold a crucial role during the design phase, determining which recycling options are available. Recycling is facilitated by products that can be easily taken apart into their different material fractions. Yet this can conflict with desirable product properties, for example the use of composites. However, materials naturally deteriorate during use making it, even with design for recycling in mind, impossible to recycle them indefinitely to the same application. Recycling requires energy input to reverse the natural process of increasing entropy. At some point the required energy to counteract this process renders a certain recycling process undesirable. Here cascading principles[4] can provide insights into which recycling process should be considered. For example: large pieces of virgin wood should be used as a whole (e.g. in furniture), while smaller pieces of non-contaminated residual or waste wood can be shredded to pulp and pressed into particular boards. In a next step, the wood fibres could go towards chemical recycling in a bio-refinery, where for instance the cellulose can be extracted to use in the paper and pulp industry. When no more gains are to be had from recycling, materials should go towards incineration with energy recovery. The use of residual or waste streams increases the value extracted from the material. Thus, mapping the various material input and output flows of recycling processes can reveal opportunities to increase material efficiency.

To achieve all of the above, a very diverse and extensive set of data would be required. The next section makes a first attempt to fill this data need.

3.2 Available data

This section presents the most suitable data found for CE monitoring regarding the CSG system. This selection is non-exhaustive, in the sense that not all data encountered will be explicitly dealt with in a high level of detail. Rather, the focus will be on the major insights and decisions along the process of collecting and evaluating data for use in terms of monitoring CE. Where possible, the data is discussed for the three main CSG product groups: textiles, EEE and furniture (see section 2.1).

A. Material and carbon footprint

The material footprint (MF) shows the global primary material use needed to fulfil the final demand of Flemish households within a year, while the carbon footprint (CF) shows the total CO_2-eq emissions associated with this. They do this by aggregating all upstream steps from the beginning of a production chain until the end of its use phase. This is particularly relevant in CE monitoring, because a lot of the material use and carbon emissions occur upstream outside of Flanders. Both footprints thus provide insights into which consumption domains or product

[3] Some exceptions exist, for example with old electrics replacement combined with high quality recycling may be preferred due to the significant improvements in energy efficiency in recent years.

[4] Cascading is defined as the sequential use of one unit of a resource in multiple material applications with its use for energy generation as a final step (Sirkin & Houten, 1994).

groups are most responsible for global material use and carbon emissions. In first instance the MF and CF are used as macro-indicators. However, the underlying data allow a disaggregation to the level of the consumption domains and even product groups for 2010 (Christis et al., 2019; Vercalsteren et al., 2017).

Thus, the MF and CF are ideal indicators to tie the different consumption systems to the wider economy in Flanders. Household consumption counts for respectively 61% and 72% of the MF and CF (Figure 1). The consumption of CSG accounts for respectively 10% and 8% of the MF and CF of Flanders. The data allows to go into further detail on the MF and CF of CSG. The full list of consumption categories within CSG and their MF and CF is given in appendix A1, revealing three key product groups: textiles, EEE and furniture (Figure 3). Together these three categories represent respectively 54% and 53% of the MF and CF of CSG. Especially the MF and CF of textiles is notably large. The CF of EEE is slightly bigger than its MF, which can be explained through emissions in the use phase.

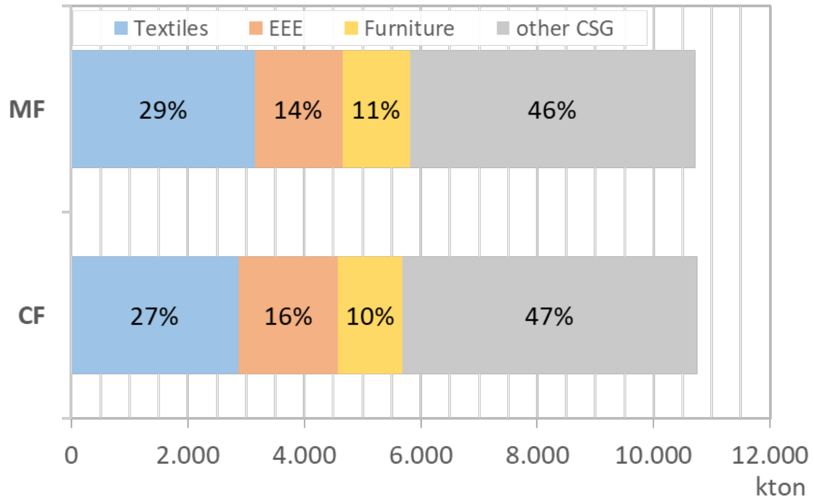

Figure 3 – Material- and carbon footprint of CSG for households in kton, Flanders, 2010
(data source: Christis et al., 2019; Vercalsteren et al., 2017*)*

The MF and CF provide interesting insights into the CSG system, however both indicators are not regularly updated due to the substantial effort required for assembling the underlying dataset and then processing the data into indicators (Alaerts et al., 2019b). However, due to the macro nature of this indicator any changes or evolutions in the economy would anyway first have to have grown sufficiently large before being reflected in the MF or CF. Thus, the data for 2010 is likely to still be fairly relevant today. Thus, while they may be based on raw approximations, these indicators provide an interesting baseline to guide the research by revealing how the different consumption domains are related to each other.

B. CSG brought on market

The amount of new articles Put-On-Market (POM), both in weight or in pieces, is an interesting indicator because it shows the new input required to fulfil the consumers need. This new input can be caused by a growing stock or by the replacement of (broken) pieces. Due to the variety in CSG products it is not convenient to take them all together, instead a general indicator was sought for each of the three main product groups: EEE, textiles and furniture. However, even this proved difficult, with data regarding the amounts of CSG POM being very limited.

Mostly, financial data on consumption (according to COICOP) is available, through the two-yearly household budget survey conducted by the federal government. This data is however not ideal in the context of this study, as financial data does not reveal the amounts of products POM. As shown later on in this section for furniture, it would be possible to use the financial data as a basis to estimate the amounts POM. This exercise is however very tedious and requires a lot of market insight to lead to an accurate estimate, due to this conducting this exercise is not in the scope of this study. Fortunately, for EEE direct data on the amounts POM was available, which is discussed in the section below.

Amount of EEE POM

As part of the European directive (2012/19/EU) on waste electrical and electronic equipment (WEEE), companies have to report the amount of EEE they bring on the market (number of pieces). In Belgium companies can choose to report individually to the regional government, OVAM in Flanders[5], or via the producer responsibility organization (PRO) for WEEE, Recupel. The two figures below show the aggregated data of household EEE POM in Flanders by companies reporting to Recupel in number of pieces and in weight (Figure 4). When it comes to EEE POM, the reporting to Recupel covers the entire Belgian market. The total for Belgium is then divided over the different regions based on population. The numbers above are thus believed to provide reliable estimates for Flanders. The reported weight POM is based on a conversion with unit weights from the reported number of pieces. It should be noted that the unit weights were recalculated in 2017.

The total number of pieces EEE POM for households has been going up strongly since 2013, while the total weight POM knows a slighter increase since 2017 (orange lines in figure 4). The strong rise in pieces EEE POM is largely due to a number of new, lightweight, EEE categories added to the reporting scope[6]. If these new categories are excluded from the numbers the increasing trend becomes less pronounced (grey line in figure 4). The difference between the orange and grey line shows that the strongest growth in EEE is in the newly added categories. Today new types EEE continuously enter the market, showing the importance of continuing to extend the monitoring scope to ensure all EEE is reported. In the right figure there is a trend break between 2016 and 2017 caused by the above-mentioned recalculation of the conversion factors, causing the decrease in the weight POM. The aggregated numbers shown below are given at the level of the 10 different EEE reporting categories in appendix A2.

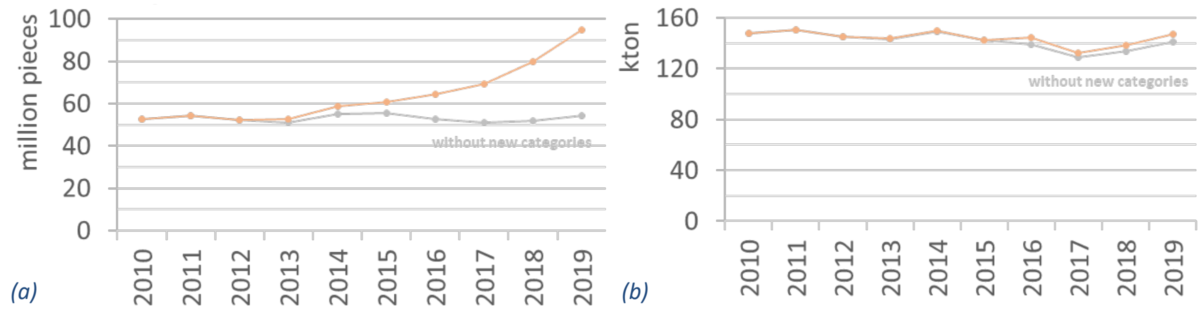

Figure 4 – EEE POM for households reported to Recupel (a) in million pieces and (b) in kton, Flanders, 2010-2019 (data source: Recupel *– yearly reports 2010-2019)*

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[5] Since 2018 companies can also report individually to BeWeee.

[6] Categories added to scope → in 2013: 'LED lights'; in 2016: 'Cartridges/toners' and 'Cables, Socket blocks, Electricity adapters, Battery chargers'; in 2018: 'Small electrical installation material'

Amount of Furniture POM

OVAM organized a study in 2019 on possible schemes to increase the reuse of furniture in Flanders (OVAM, 2019). As part of this effort, a market study was conducted, in which, amongst others, an estimate of the amount of furniture POM was made. OVAM estimated that 2,8 million pieces are POM, representing 76 kton. This number is based on the average financial expenditure on furniture from the household budget survey, 700 euro per year. While only an initial and rough estimate, it is included here to show the order of magnitude.

C. CSG in Stock

In CE monitoring it is interesting to know the stocks of materials in circulation. As the economy grows, materials tend to build up in societies. The stocks of CSG could be a possible indicator to express how the need for CSG is fulfilled in Flanders. Furthermore, if it is known how intensely and efficiently these goods are used, strategies can be developed to fulfil this need with less materials. For example, if a certain product is often idle, sharing this product will allow to fulfil the same societal need with less products. CE business models try to play into this by offering consumers the function of the product through renting services instead of simply selling the product. Further, where possible product lifetimes in stock should be extended through repair or reuse. However, little is known about the stocks of CSG or their use, with EEE once more forming the exception.

Stock of EEE

Every two years Recupel holds a survey, conducted by GFK, among consumers to estimate the amount of EEE present in households (Recupel, 2019a). After the first survey in 2013, a number of extra EEE categories were added in 2015, largely explaining the increase between 2013 and 2015 (Figure 5). Because of this, the trend is discussed between 2015 and 2019. The full list of EEE included in the survey is given in appendix A3 by category. In 2019 there were approximately 240 million pieces of EEE present in households in Flanders, an increase of 8% or 18 million pieces compared to 2015. On average Flemish households possessed respectively 82 and 85 pieces of EEE in 2015 and 2019. 'White goods' is the largest category of products, while 'ICT' and 'others' display the largest growth over the last four years. The only category which shows a decrease are 'brown goods'. At this time, it is not possible to convert these numbers to weights, as no conversion factors for the EEE categories of this survey have been estimated.

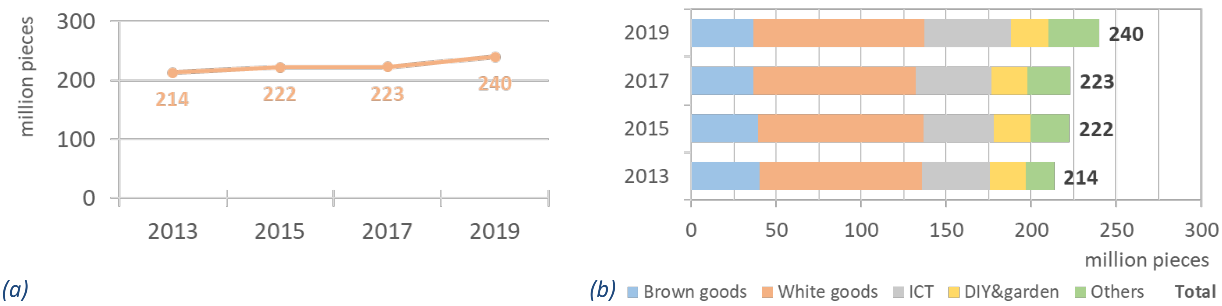

Figure 5 – Amount of EEE present in households (a) in million pieces and (b) by type of EEE, Flanders, 2013-2019 (data source: Recupel, conducted by GFK – bezitsmeting – n= 1.692)

The survey then further inquires whether or not these EEE are still functioning and whether they have been used in the last year. This reveals that in 2019 13% or 32 million pieces of EEE in Flemish households remained unused, of which most (82%) are still functioning. There is a slight decrease in the number of unused EEE compared to 2015, when there were 34 million unused pieces. In 2019 white goods are most likely to be in use and least likely to remain within the household once defect (Figure 6). Going into further detail, projectors are most often functional but unused, while CRT PC monitors are most often stored despite of being defect. Appendix A4 gives the use status for each sub-category.

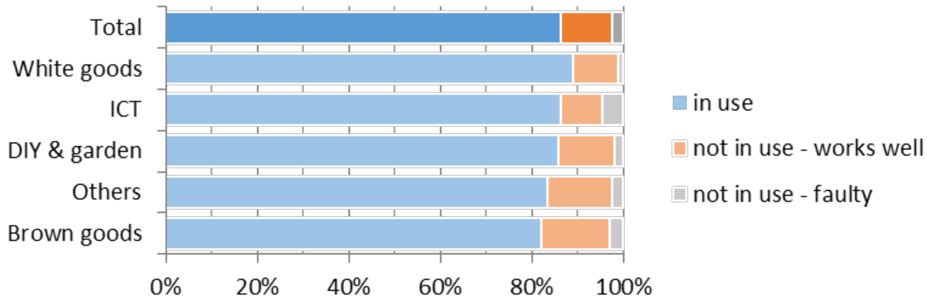

Figure 6 – Use status of EEE in households by type in %, Flanders, 2019
(data source: Recupel, conducted by GFK – bezitsmeting – n= 1.692)

It should be noted that these numbers cannot be compared with the yearly reporting of companies on the amounts of EEE they bring on market or WEEE taken out (resp. discussed in section B and E), due to differences in product categories and scope.

CE business models for CSG

As stated, some CE business models focus on offering consumers the function of the product through selling access to the product instead of directly selling the product. This provides incentives to improve product design and potentially increases intensity of use. Real-world implementations of this kind of CE business models in Flanders are however still scarce, only recent and at small-scale. Because of this reliable data is not yet available. Thus instead two examples are given to demonstrate the concept.

Firstly, **libraries to borrow CSG** are gaining traction in Flanders. This strategy falls under the wider concept of the 'sharing economy', where goods and services are shared between consumers, either for free or for a fee. In recent years the sharing economy has been strongly enabled by the rise of online platforms. Like in a traditional library, these places offer a whole range of products to borrow in exchange for a membership fee. The idea being that this way use-intensity is increased and unnecessary new purchases are avoided. Two particular groups of CSG that show great potential for this concept are DIY tools and baby gear. Both concern easily transportable goods, which are only needed for a short time and for a specific purpose.

- In a **tool library** a whole array of practical tools can be borrowed. This way tools that often lay dormant in households are actively shared. The offered goods are usually DIY and garden tools, figure 6 already revealed that for this category 12% of goods in households was not used in the last year while still being fully functional. Further, considering a product as used if it was utilised only once in the last year sets a rather low bar. It is thus within reason that a significant fraction of 'in use' products are actually severely underused and thus prime candidates to increase use efficiency through sharing them. In November 2020, there were 6 cities in Flanders with a tool library[7].

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[7] An overview of the tool libraries in Flanders is available at:
https://repairshare.be/repair/gereedschapsbibliotheken/

- Similarly in **baby libraries**, new parents can borrow some of the many goods required for their new-born, returning them once they no longer have a need for them. This avoids the purchase of products which are often only needed for a very short time. There are currently 13 baby libraries in Flanders[8].

Secondly, CE business models for CSG could also focus on '**product-service systems**' (PSS), where the producer offers the performance or result of a CSG instead of the product or service itself (BSI, 2017). An example of this is the ongoing pilot project 'papillon' by Samenlevingsopbouw West-Vlaanderen vzw and Bosch. In this project large, energy intensive EEE are rented to households for a period of 10 years. By staying the owner of the product it becomes in the producers best interest to design their products for longevity, repairability and recyclability. This project has the added dimension of renting the appliances specifically to low-income households, providing them with access to otherwise unaffordable products that increase their quality of life and potentially help reduce their energy bill. The project started in 2018 with about 70 households and 130 appliances, in 2021 the project will be expanded with an additional 550 appliances. Now that the project is up-and-running attention should go to collecting the necessary data to assess the actual environmental and social effects of the project. Further, while PSS business models seem promising, it should be noted that when Recupel ask households in Belgium in 2019 about their interest in leasing EEE 62% indicated no interest at all. For those that were willing to consider leasing, there was the most interest in garden appliances with 26%, while for washing machines only 6% indicated a potential interest.

CE initiatives, like described above, should be mapped and investigated to evaluate how they can best contribute towards creating a more circular and sustainable society. This is especially necessary to avoid unintended adverse effects, like rebound or income effects (Cooper & Gutowski, 2015)

Repair of CSG

Aside from the stock of functional goods, there are also the faulty products. Figure 6 indicates that some households hoard faulty EEE in their attics and garages, but faulty products are also often discarded straight away. In the context of CE monitoring it would be interesting to know how many faulty products are in stock and how many faulty products are repaired or could be. There are currently significant barriers to repair, like the lack of spare parts, parts fixed with glue, lack of qualified repairers, lack of technical information and the financial expense of repair (Repair & Share, 2020). Yet, there is a growing awareness that CSG are breaking down and being discarded too quickly. The most notable effort to address the lack of repair within Europe is the 'right to repair' campaign. This campaign's aim is to make repair more appealing, systematic and cost-efficient (European Parliament, 2020). While not much is currently known about repair in Flanders, the data that could be found is presented below.

An initial clue on the stock of faulty products can be found in a survey on repair commissioned by Netwerk Bewust Verbruiken (NBV) and conducted by iVOX in 2018. In one of the questions respondents were asked to indicate the number of faulty products in their household. The survey had 1000 respondents and was representative for Flanders for gender, age and schooling. Among respondents there was a stock of 1.817 pieces of faulty CSG, which becomes after extrapolation based on the number of households in Flanders 12 million pieces. As table

[8] According to: https://babytheek.wordpress.com/, checked on 17/11/2020

1 shows, more than half of this is clothing. The estimate for EEE in the table is in line with that of Recupel, who estimated there to be respectively 4,3 and 5,7 million pieces of faulty EEE in households in 2017 and 2019.

Table 1 - Extrapolation of stock of faulty CSG, in million pieces, Flanders, 2018

	Furniture	EEE*	clothing	All CSG
Faulty stock	1,32	4,17	6,29	11,78

**Includes also some non-electric tools*

(Source: own extrapolation based on survey results from NBV, conducted by iVOX - n=1.000)

Knowing that there is a significant stock of faulty products it would be interesting to know what attempt is made to repair CSG. The two-yearly household budget survey could provide insight on this. However, for Flanders this information is grouped with other expenditures, like on cleaning or hiring of CSG, as shown in figure 7. For Belgium in 2018 there is for 'clothing' and for 'photographic and cinematographic equipment and optical instruments' a further division possible. For 'cleaning, repair, tailoring and hire of clothing' about 75% of expenditure goes to cleaning, 18% goes to repair, 4% to tailoring and 3% to hiring. For 'repair of photographic and cinematographic equipment and optical instruments', 73% goes toward repair of PC's and tablet computers and 27% to repair of photographic and cinematographic equipment.

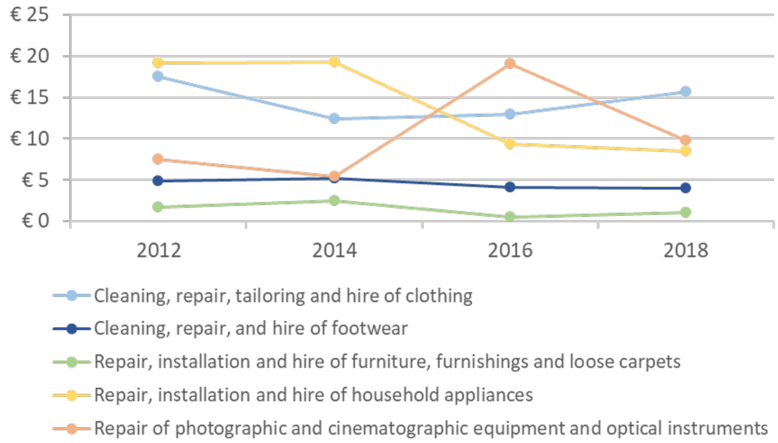

Figure 7 – Expenditure per person per year in euro, 2012-2018, Flanders (source: statbel)

However, the numbers above only show the repair which occurs through the formal economy. Yet, repair is also possible through other channels. Some initial insight into the distribution of repair channels can be gained for EEE from Recupel's two-yearly survey on EEE in households. In 2019 this survey posed additional questions inquiring after the repair behaviour of respondents in the last year, to which 4 out of 5 responded they had not engaged in any repair of EEE. For those that did engage in repair, it was most often effected by the owner themselves (23%) or by an acquaintance (23%). The distribution amongst repair channels for EEE is shown in the figure below. This shows that a significant fraction of repair seems to occur within the informal economy, meaning it does not appear in financial reporting.

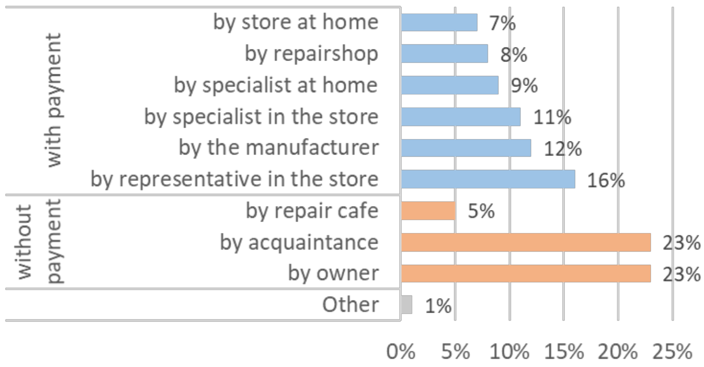

Figure 8 - Repair channels for EEE, multiple options were possible, 2019, Belgium (data source: Recupel, conducted by GFK – bezitsmeting – n= 1.000)

The 'repair cafes' are an example of an informal channel through which repair is affected. These events are local initiatives where volunteers repair goods brought in by citizens from the neighbourhood for free. NBV is currently in the process of mapping these initiatives. In a first approximation they estimate that in 2019 there were 176 groups organizing repair café's, organizing together 716 individual repair events, where on average 45 people were present and 35 pieces where offered for repair. Small electronics and textiles are most often seen in repair cafes. It is unclear how many pieces were successfully repaired. However this indicates that only a fraction of the suspected stock shown in table 1 is being offered for repair through this channel, only about 0,2%.

To start filling in the data gap on repair and to provide further insight into repair as a strategy for the CE in Flanders the policy research centre for CE will conduct a study specifically on this strategy in 2021. This study will develop a typology of repair channels, map repair in Flanders, discuss the potential environmental impacts and provide policy recommendations.

Stock of second-hand CSG

In the context of a study to map the amount of reuse in Flanders by Delanoeije & Bachus (2020), respondents were asked to indicate if they had second-hand goods at home and if so, which fraction of the goods in their household were second-hand goods. From this study percentages for furniture, EEE and textiles are available. As shown in table 2, furniture is the product group for which at least one second-hand item is most often present in households, with 52% of respondents indicating to possess second-hand furniture. This product group is also present in the largest fraction, with on average 18% of furniture in households with second-hand furniture being second-hand. However, without knowing the amounts which these fractions represent it is impossible to calculate the total stock, or vice versa. Second-hand goods find their way into households through reuse, this crucial CE strategy is further discussed in the next section.

Table 2 - Second-hand CSG in households, Flanders, 2018

	Furniture	EEE	Textile	All CSG
% with second-hand goods present	52%	38%	49%	
% of goods that are second-hand	18%	10%	15%	19%

(Source: Delanoeije & Bachus (2020) – n= 1.000)

D. Reuse of CSG

The European Commission defines reuse as “any operation by which products or components that are not waste are used again for the same purpose for which they were conceived” (Europees Parlement, 2008). Reuse is an important strategy within the CE to prevent products from becoming waste before the end of their technical lifespan has been reached. This section pulls together and discusses the available data, with a singular focus on reuse within Flanders.

When looking into reuse in Flanders the social reuse network, 'De Kringwinkel', is an evident starting point. De Kringwinkel is an umbrella name for 131 governmentally accredited and subsidized[9] reuse centres operating throughout Flanders. Partly from store stock management, partly due to reporting obligations related to the government subsidies they receive, an interesting time series of data about reuse through their stores exists that can serve as a starting point to say something about reuse in Flanders. In 2019 De Kringwinkel collected 88 kton of materials and brought 36 kton of materials back in circulation. This demonstrates that there is a significant gap between the amount of goods offered for reuse and what is effectively acquired again. The two figures below give a timeseries of the amount of reuse through De Kringwinkel. Figure 9(a) shows that while both the amount of goods collected, as the amount of goods sold is rising, the relative fraction of goods sold is decreasing. According to the reuse centres this has several reasons, like a decrease in the quality of the goods collected, leading to strategic choices being made on which products to resell in stores and a shortage in workforce to adequately prepare all collected materials for reuse. Figure 9(b) shows that reuse per capita is still increasing. However, it can be noted that as primary consumption is likely still increasing, as shown for EEE in section 3.2.B, it is not surprising that reuse is also still increasing, as more goods are available for potential reuse.

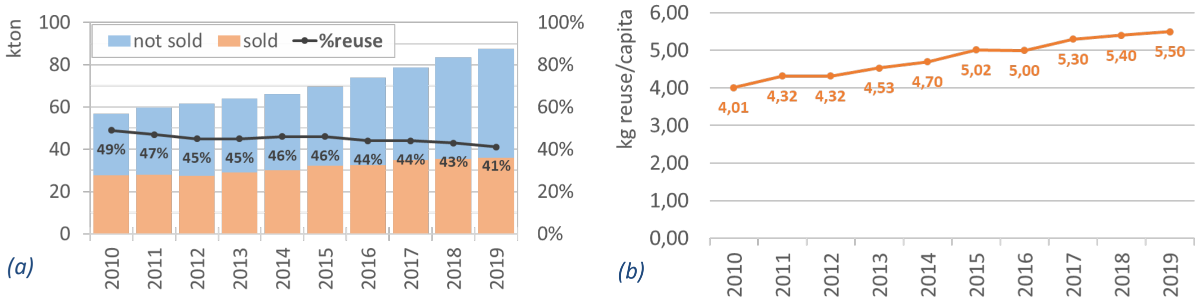

Figure 9 –Reuse (a) in kton and (b) per capita, Flanders, 2010-2019 (data source: OVAM)

The data from De Kringwinkel can be disaggregated to each of the three main CSG product categories: textiles, EEE and furniture. The three graphs in figure 10 below show that there are large differences between the categories in the fraction that can be reused. This is in line with expectations: furniture is often a less technical and very durable product, while EEE is easily damaged and some guarantees about functional lifetime need to be given when resold. For textiles also only a small fraction of what is collected is sold again[10]. The figures below show that especially for textiles there has been a strong decrease in the fraction the re-use centres are able to bring back in circulation.

[9] The stores receive subsidies for the social employment they offer.

[10] The unsold fraction of textiles is sold to private companies to be exported for reuse abroad or recycling, this is further discussed in section 3.2E

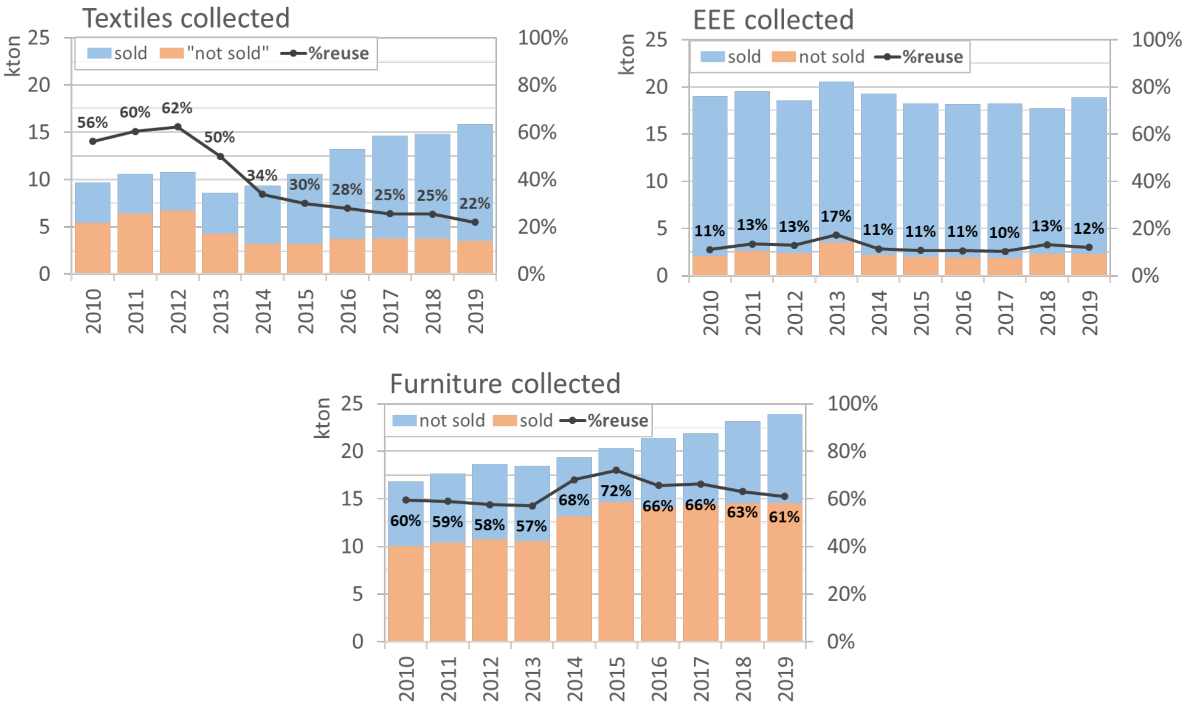

Figure 10 – EEE, furniture and textiles collected by 'De Kringwinkel' in kton, Flanders, 2010-2018 (data source: OVAM)

However, De Kringwinkel is far from the only channel through which reuse occurs in Flanders, especially the increasing use of informal online platforms raise the suspicion that the above numbers are far from complete. To get insight into the actual amount of reuse in Flanders the Circular Economy Policy Research Centre did a study to map this for 2018 (Delanoeije & Bachus, 2020). Through a survey combined with available empirical data from the reuse network the fraction represented by De Kringwinkel was determined, resulting in the figure below. This shows that only 15% of reuse happens through this channel. The amount of reuse through the different channels was obtained separately for each of our product groups. Reuse through De Kringwinkel is 15% for furniture, 16% for textiles and 11% for EEE. The division of the channels for each product group is given in appendix A5.

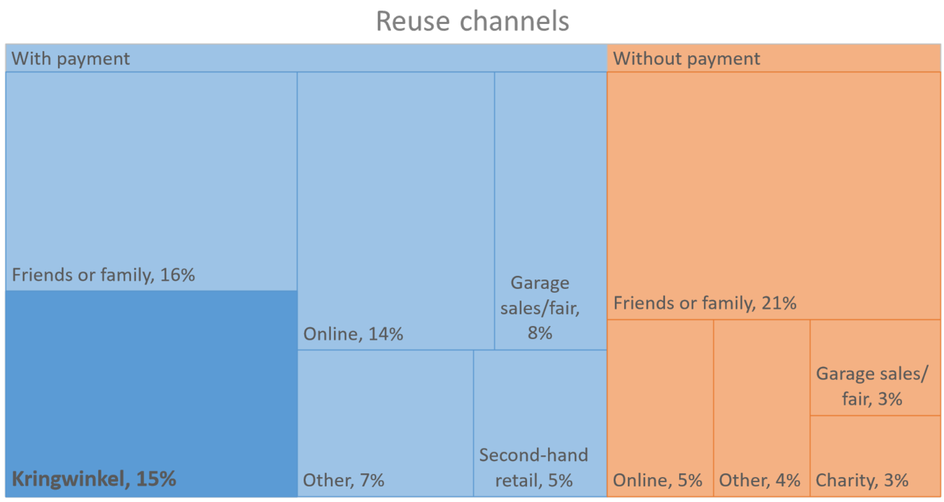

Figure 11 – Mapping of reuse channels, Flanders, 2018
(Delanoeije & Bachus, 2020)

Based on the estimated fraction of the reuse through De Kringwinkel it is possible to extrapolate to an estimate for the total amount of reuse. Figure 12 gives for 2018 the reuse through De Kringwinkel and the extrapolated total reuse estimate for each of the main categories and for all CSG in Flanders. If it is assumed that the share of De Kringwinkel for each of the product categories is the same in 2019 as in 2018, then the total reuse in Flanders for 2019 is 224 kton instead of the 36 kton reported by De Kringwinkel.

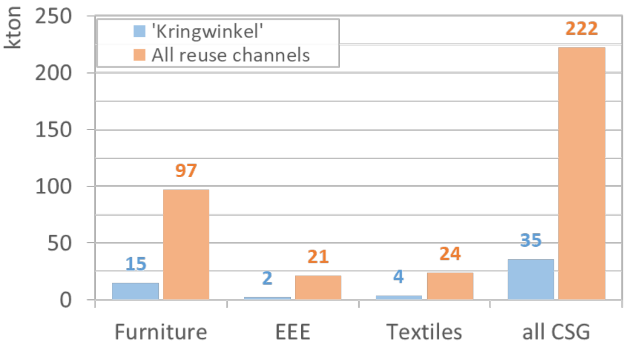

Figure 12 – Estimated reuse in kton, Flanders, 2018
(Delanoeije & Bachus, 2020)

Within the context of the CE it should be kept in mind that increased reuse may not always lead to the expected environmental benefits. It is often assumed that the purchase of a second-hand product replaces the purchase of a new product. However recent research nuances this assumption. It is increasingly becoming clear that the purchase of a second-hand good only partly offsets the purchase of a new good (Castellani et al., 2015; Delanoeije & Bachus, 2020). The extent to which a second-hand product replaces the purchase of a new product is expressed in the 'replacement rate' (Castellani et al., 2015). The survey mapping reuse in Flanders gauged the replacement rate for the product goods in their scope. On average they found a replacement rate of 28%, meaning that for about every four second-hand products purchased the purchase of one new product is avoided (Delanoeije & Bachus, 2020). The results for each of our product groups are given in the table below (Table 3).

Table 3 - Replacement rate per product category, Flanders, 2018

	Furniture	EEE	Textile	All CSG
Replacement rate	29%	21%	32%	28%

Source: Delanoeije & Bachus (2020)

The lower than expected environmental gains of reuse can be further explained through the 'rebound effect'. This occurs when the price decrease for reused products leads to additional consumption (direct rebound) or when the money saved is spent on other goods (indirect rebound) (Cooper & Gutowski, 2015). Thus estimating the potential gains from reuse can be tricky, since the specific assumptions made about the replacement rate and rebound effects play into the result. However, irrespective of the replacement ratio or rebound, reuse still prevents goods from entering the waste stream.

E. CSG leaving the market

This last section looks at what happens to CSG when they lose their function and become waste. In a CE, the aim at this final product stage becomes to use the materials for high value purposes. To achieve this, materials should be recycled as much as possible, avoiding the destruction of valuable materials. Only those materials that cannot be recycled should go towards incineration and this with energy recovery. Landfilling should be an option of last resort.

In Flanders municipal solid waste (MSW) is collected either selectively or non-selectively. A full overview of the amount of MSW collected per fraction between 2013 and 2019 is given in appendix A6. There are 17 different fractions of household waste which are collected separately with the aim to guaranty optimal waste treatment. Large waste fractions like ‘organic waste’ or ‘construction & demolition waste’ produced by households are not within the scope of this report and are thus excluded in the numbers discussed below. The non-selectively collected waste, a.k.a. the unsorted fraction, is currently not recycled and thus goes towards incineration. The collection of unsorted waste is through four distinct channels: residual waste, bulky waste, municipal waste[11] and waste from machinal street sweeping. The last two fractions are notably smaller in size than the first two, each of the four representing respectively 79%, 16%, 4% and 1% of unsorted waste. However, the two smallest fractions should not be overlooked, because they are most likely to leak into the environment, posing an environmental hazard.

The amount of MSW collected, is followed up by OVAM (Raes et al., 2020). Between 2013 and 2019 a slight decrease can be noted in the total amount of MSW, from 2.139 kton to 2.092 kton (Figure 13), this was achieved despite a rising population in Flanders[12]. In the last two years the decreasing trend however seems to have stagnated or even reversed. Below, figure 13(a) shows the amount of MSW collected. About half of this is being collected separately, which is a crucial step to enable recycling. It is thus positive to note that this fraction is showing a slight upward trend. Figure 13(b) shows an approximation of waste treatment, here it is important to note that the amount reported as recycled is actually the amount entering the recycling process, ‘the amount offered for treatment’. There is not much information available about the actual output of the recycling process.

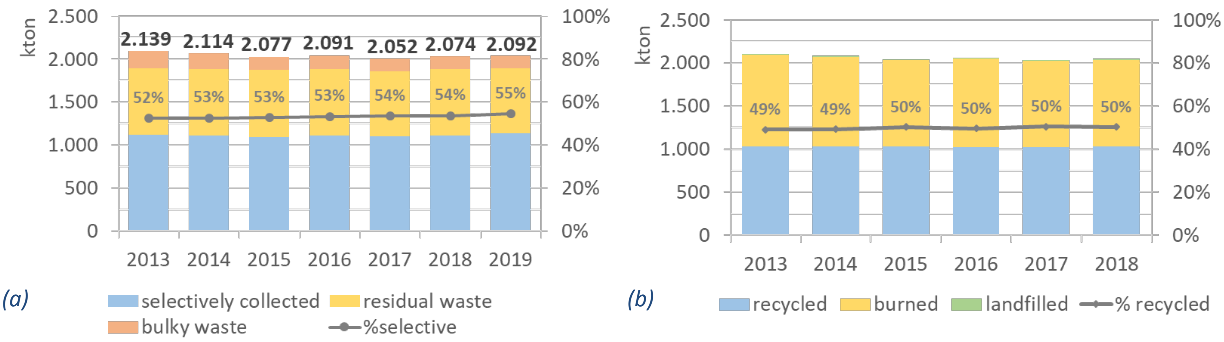

Figure 13 –Evolution of solid municipal waste (a) collected and (b) treated in kton, Flanders, 2013-2018 (excl. organic and construction & demolition waste) (data source: OVAM (Raes et al., 2020)*)*

Figure 13 clearly shows that the collection of sorted waste is an important prerequisite for recycling. It is thus interesting to know how well the current waste collection system achieves this and where the largest margins for improvement are. In 2013/2014 OVAM did a study to sort the content of the residual waste collected from households (De Groof, 2015). This study

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[11] This term encompasses: garbage from street bins, manual street sweeping and the clean-up of illegal dumping.

[12] It should be noted that OVAM measures the amount of MSW collected by the municipalities, this includes the amount of similar industrial waste collected by municipalities. Similar industrial waste is waste comparable to that of households in composition and amount. However similar industrial waste can also be collected by private actors, when this is the case it is not included. Thus, the decrease could also be (in part) due to a shift to private waste collection.

reveals that 45% can already be separately collected via the existing collection channels, while an additional 11% can already be separately collected in some parts of Flanders (mixed plastics) (Figure 14(a)). This means that if the current system of separate collection worked optimally in 2014 an additional 349 kton of materials could have gone towards recycling. The study from 2013 was the fourth time OVAM sorted residual household waste, with previous studies being held in 1995, 2000 and 2006. If the results from 2006 are compared to those of 2013, it is revealed that for each fraction which can be separately collected, the amount of 'textiles', 'plastic bottles and flasks' and 'beverage cartons' has gone up (Figure 14(b)). In absolute terms the amount of textiles went up most, from 4,4 kg per citizen per year to 7,7 kg.

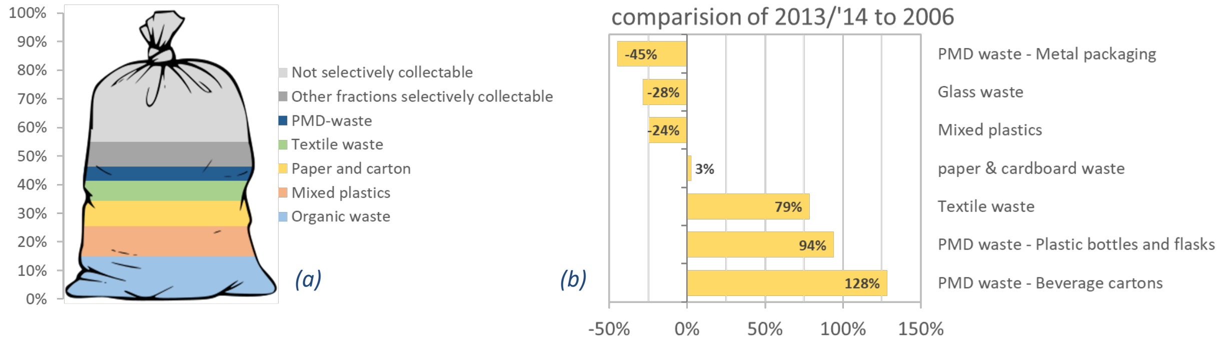

Figure 14 – (a) Content and (b) evolution of residual household waste, Flanders, 2013/2014 (data source: OVAM (De Groof, 2015))

Bulky waste is waste which originates in households, for which there is no separate collection channel and which can, due to its size or weight, not be discarded with residual waste. About the composition of bulky residual waste from households not much is known, this fraction was last sorted by OVAM back in 2011 and the results were not representative for Flanders (De Groof, 2012). However, it can be noted that this study did reveal that furniture makes up a significant fraction of this waste stream. The sample in the study found furniture to be easily the largest fraction found in residual waste, representing more than 40%. Furthermore, it was estimated that about 90% of this furniture was still suitable for reuse. Even though these estimates should be treated with caution, it still shows that it is very likely that there is a significant potential in Flanders to better sort and reuse furniture. WEEE was found to be only 1,6% of bulky waste.

About the remaining fractions: garbage from street bins, manual street sweeping, the clean-up of illegal dumping and waste from machinal street sweeping, information is also limited. Estimates were made by OVAM about the size out-of-home waste in 2015, 2017 and 2019 (Figure 15) (Schnitzler & Vanstockem, 2020). Further information about the composition of these fractions is scarce.

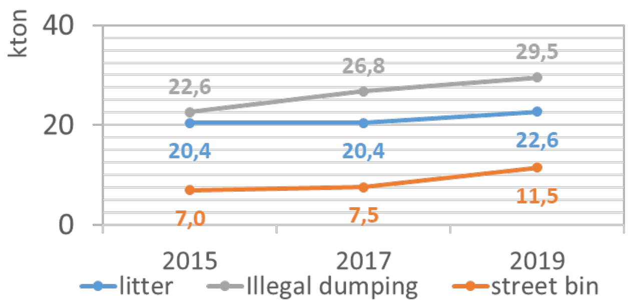

Figure 15 – Estimates for out-of-home waste in kton, Flanders, 2015-2017 (data source: OVAM)

The following two sections go into more detail on the end-of-life (EOL) treatment of EEE and textiles.

EOL treatment of EEE

As part of the extended producer responsibility (EPR) for EEE, producers are given the responsibility for ensuring proper EOL of their products. Through the EPR they have to report on the EEE waste fraction collected and recycled. Every year, Recupel reports the amounts of WEEE that is collected and processed by either them or their official partners. In 2019, they processed in total 68 kton WEEE. About 80% of the materials that enter the process get recycled, while another 10% is burned with energy recovery. There seems to be a slight decrease in the percentage recycled, coming from 82% in 2010 to 78% in 2019 (Figure 16). This could be due to the increasingly complex composition of EEE. Ferro and non-ferro materials are most effectively recycled. With 31.8 kton in 2019, ferro is also the biggest material fraction found in WEEE.

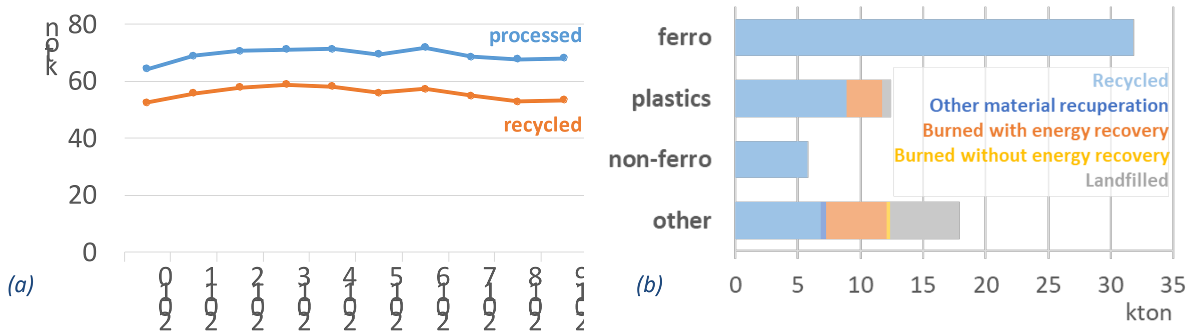

Figure 16 – (a) Evolution in the amount of WEEE processed and (b) treatment per materials stream for 2019, Flanders (Other material recuperation: wastes that do meet the criteria for recycled under the WEEE directive of 2012) (data source: Recupel – yearly reports 2010-2019)

Furthermore, it is interesting to look at the ratio of EEE taken out-of-market (OOM) to POM. The EU, as part of its WEEE directive, requires in this respect the following: "the minimum collection rate to be achieved annually shall be 65 % of the average weight of EEE placed on the market in the three preceding years in the Member State concerned, or alternatively 85 % of WEEE generated on the territory of that Member State." The target had to be achieved by member states in 2019. Belgium opted for the first calculation methode. Based on the available data from Recupel this ratio can be calculated specifically for household EEE in Flanders, as is shown below in Figure 17.

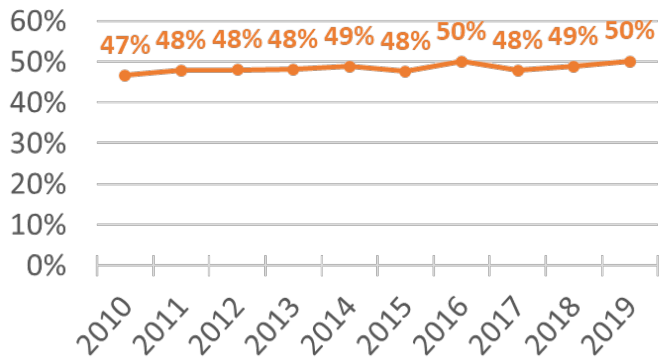

Figure 17 – Ratio OOM/POM for household EEE based on the numbers reported to Recupel, Flanders, 2010-2019 (source: own calculations based on Recupel – yearly reports)

Thus with 50% in 2019, Flanders seems to fall short of the intended target. However the amount OOM only includes the number available to Recupel, while not all (W)EEE taken OOM is reported to them. To identify where the remained 50% of (W)EEE is located Recupel put together a mass balance in 2016. 30% proved to be currently unfindable, but for the remaining 20 % they found the following: at least 9% ends-up as scrap, 6,5% is exported as used EEE, 2,81% is exported as WEEE and 1,5% ends up in residual household waste (Recupel, 2018). To further locate WEEE, there are at the national level efforts ongoing to extend the reporting of OOM WEEE in Belgium through the non-profit BeWeee. Via this way already an additional 12 kton of WEEE from households was reported for Belgium in 2019. At the moment it is difficult to make an approximation on how much of this should be allocated to Flanders, but any increase in the total amount of OOM for Flanders will naturally further increase the percentage of the ratio.

It can be noted that the ratio OOM/POM varies significantly between the different EEE product groups reported. As figure 18 shows, consumer equipment is most efficiently collected again through the official channels of Recupel, while other products do not yet seem to find their way to these channels.

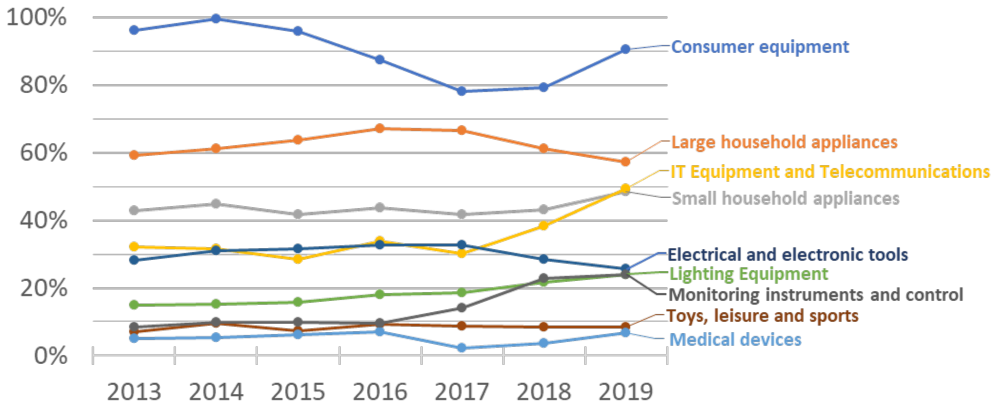

Figure 18 - Ratio OOM/POM for household EEE per product category, Flanders, 2013-2019 (source: own calculations based on Recupel – yearly reports)

EOL treatment of textiles

In Flanders textiles collected through textile bins are considered a waste material and thus fall under reporting obligations to OVAM. Because of this, a time series of the amount of selectively collected textiles is available. Figure 19 shows this series, revealing a slightly increasing trend.

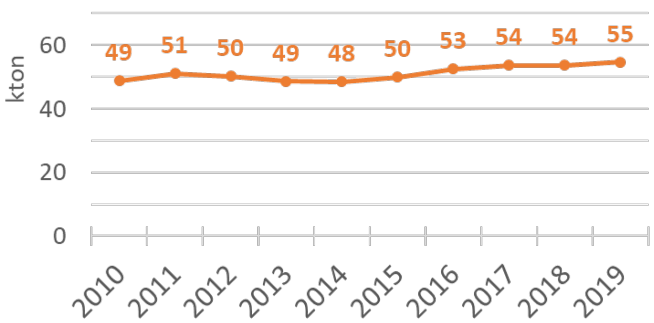

Figure 19 – Timeseries of selective textile collection in kton, Flanders, 2010-2019 (data source: OVAM (Vervaet et al., 2018)*)*

However, not all of the collected textiles are still suitable for reuse. After collection, the textiles are sorted based on quality, determining what will happen to them: reuse or recycling. As such, only some pieces are returned back into circulation. Furthermore, a significant fraction of both reusable and recyclable textiles is exported out of Flanders. Figure 20 below gives an approximation of where textiles end up after being discarded by a consumer in 2019. This figure is a compilation from different data sources, for which can be noted:

- The amount of textiles in residual solid waste is based on the results of a study done by OVAM in 2013/2014 (De Groof, 2015). By sorting the residual waste put out by households in Flanders they found that on average 7,7 kg of textiles per citizen per year were discarded in this way and thus incinerated. This average is used to estimate the amount of discarded textiles in 2018.
- Private actors within the sector of sorting selectively collected textiles use the following percentages for reuse, recycling and incineration: resp. 55%, 35% and 10% of the collected amount (Vlaams Parlement, 2020).

Figure 20 clearly shows that, when accounting for both the textiles selectively collected and those discarded in residual waste, almost half of discarded textiles go straight towards incineration. This is largely due to the fraction of textiles in residual waste. Of what exactly happens to the selectively collected textiles little detailed data is available. Only for the fraction resold by De Kringwinkel is it possible to say that it goes towards reuse in Flanders. The fraction which De Kringwinkel is not able to sell gets passed on to private traders and thus could be either reused, recycled or incinerated inside or outside of Flanders. The same goes for the stream directly collected by private actors, where the divisions used in the figure, as stated above, are merely based on industry accepted fractions. Unfortunately, there is also no information available on how much of the fraction collected by private actors stays inside Flanders.

While reuse is considered a high CE strategy, exporting textiles for reuse comes at the risk of poor EOL treatment after reuse. The additional emissions from transport combined with the potential landfilling of clothing could easily offset the beneficial effect of extending the lifetime of the garment.

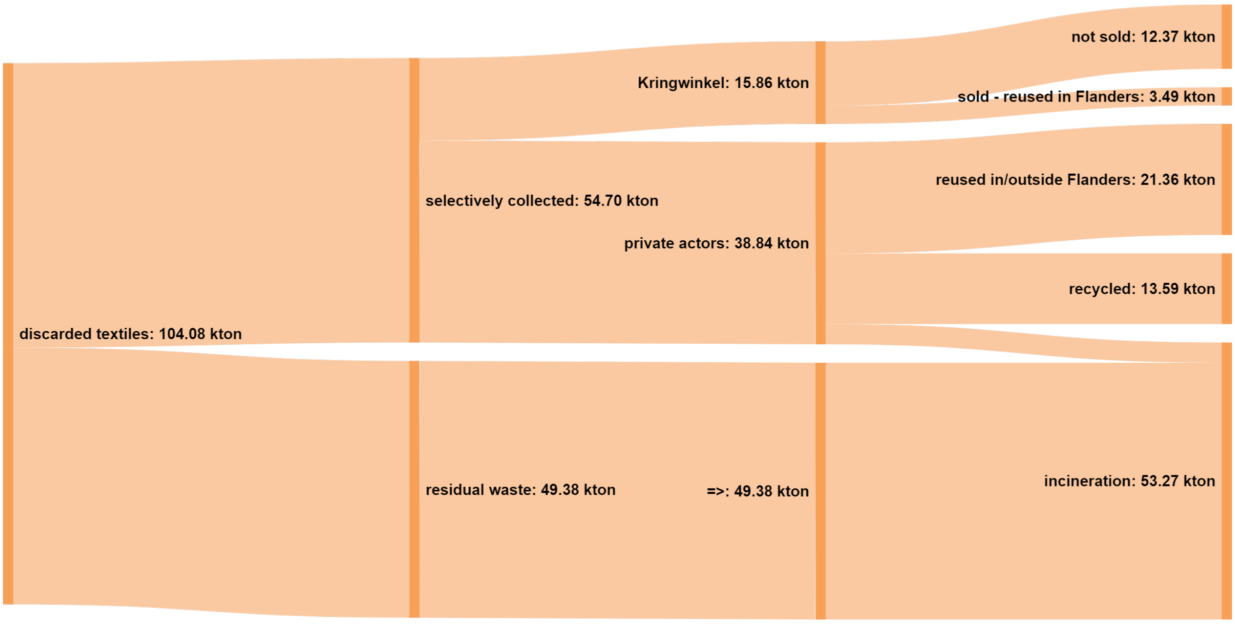

Figure 20 – Flow of EOL textile in kton, Flanders, 2019
(data source: various sources - OVAM)

3.3 A CE monitor for consumer goods

In the previous section, the available data for monitoring the circularity of the CSG system was discussed in detail. The figure below puts this data together to give a general overview of the material flows of CSG in Flanders. This figure is a compilation from different sources and years, and is thus only meant to give a general impression of CE in the CSG system and how the different numbers relate to each other. There where no numbers are given, no data was found, indicating data gaps to be filled. Ideally, in the coming years,this figure could be completely compiled for multiple years, to see which trends emerge.

For now, the MF is given for 2010, the most recent year for which it is available (Christis et al., 2019; Vercalsteren et al., 2017). The POM is given for 2018, for EEE Recupel data is used, for furniture an estimate made by OVAM. The stock of EEE is from Recupel for 2019. The reuse figures are for 2018 from Delanoeije & Bachus (2020). The data on MSW and OOM combines data from OVAM for 2018, except for the amount of textiles in residual waste, which is based upon an average from 2013/2014. The recycling rate of EEE is from Recupel for 2018, while the percentages for textiles are based upon the numbers in Figure 20.

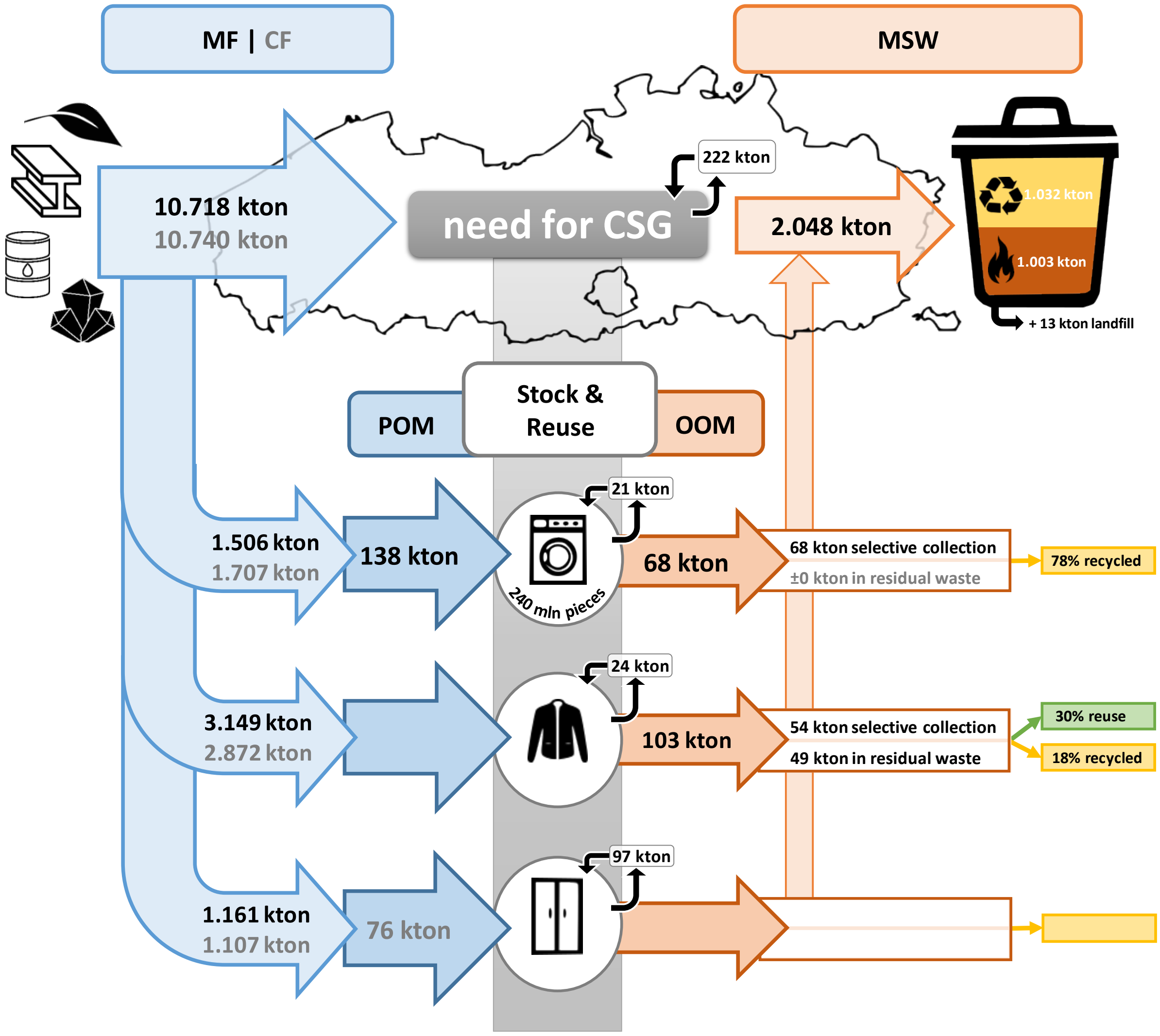

Figure 21 – CE monitor for consumer goods

While only meant to give a rough approximation, putting the different indicators next to each other does reveal a number of noteworthy things.

Firstly, figure 21 makes clear that while EEE, textiles and furniture together represent more than half of the MF and CF needed to fulfil the need for CSG, they are not the main contributors to MSW. While for furniture the amount in MSW is unknown, textiles and EEE together only represent 0,08% of MSW. A further look into the data reveals that packaging emerges as the largest single contributor to household waste, estimated to represent 30%. Here it is important to note that packaging is not a separate category in the MF and CF. Both footprints are calculated in such a way that any materials used for packaging the product are included in the final footprint of that product, thus the packaging for CSG fall within the footprint of the product. This is not the case for the numbers shown for POM and OOM, where packaging is reported separately. Some of the packaging in household waste thus does originate from the consumption of CSG. However initial data collected on packaging revealed that the largest share (+70%) of packaging POM is related to food and beverages (Fost Plus, 2019). Houshold packaging waste then actually falls under another consumption system, that of 'food'. However, also industrial packaging has to be considered, which is likely to be even more spread across systems. Because of this, the Policy Research Centre is currently assessing how best to further handle the monitoring of packaging.

Secondly, it can be noted that textiles are the CSG product group with both the largest MF and the largest OOM waste, of which little gets recycled. Almost half of discarded textiles end up in residual waste and are thus incinerated, while for the selectively collected textiles the final EOL treatment is unknown (Figure 20). Further, while the amount of textiles donated to the reuse centre ('De Kringwinkel') has been steadily increasing since 2013, while the amount resold by the centres has remained stable, resulting in a decrease in the % of collected weight being brought back into use in Flanders to 22% in 2019 (Figure 10). With 24 kton of reuse in 2018 there is however a significant market for reuse in Flanders. Figure 20 further indicates that 30% of OOM textiles go towards reuse, it is however unclear where this reuse occurs. All of this indicates that, within CSG, textiles are a category with a large margin for improvement with regard to becoming circular. This then makes addressing gaps in the monitoring data for textiles concerning the amount POM, in stock and EOL treatment especially important.

Thirdly, the most complete picture emerges for EEE. The available data can be mainly attributed to the existence of an EPR for WEEE, demonstrating the role such schemes can play in data collection. Figure 21 shows that this product group seems to perform significantly better compared to the other two when it comes to separate collection and recycling. The number of pieces of EEE POM and in stock both show a slightly increasing trend, indicating that the stock in EEE is still growing (Figure 4 and Figure 5). This while there is quite some potential to use the existing stock more efficiently, with 13% of EEE in stock currently laying unused (Figure 6). This unused stock could be reactivated through reuse, EEE however prove a difficult product group for this, with only 13% of goods collected by De Kringwinkel being brought into circulation again (Figure 10). Alternatively, there are also opportunities to increase the utilisation of EEE through the sharing economy. Those goods not suitable for reuse should go towards material recuperation. The separate collection of EEE functions well, with only negligible amounts of EEE ending up in residual waste. However, at the moment, only about 50% of EEE POM is collected again through the official collection channels of Recupel (Figure 19), about the remaining half little is known of where it ends up. The recycling process monitored by Recupel, while preforming well, seems to have plateaued at about 80% of materials recycled (Figure 16).

4 Discussion and Conclusion

4.1 Progress towards CE

Given the data discussed throughout, this report an attempt is made to answer the central question of this study: ‘To what extent is the CSG system circular and how is this evolving?’. There being little administration involved with CSG however makes tracking these products throughout their lifecycle difficult. Clear conclusions at this time are difficult due to data gaps (figure 22) and the heterogeneity of products within the system of CSG.

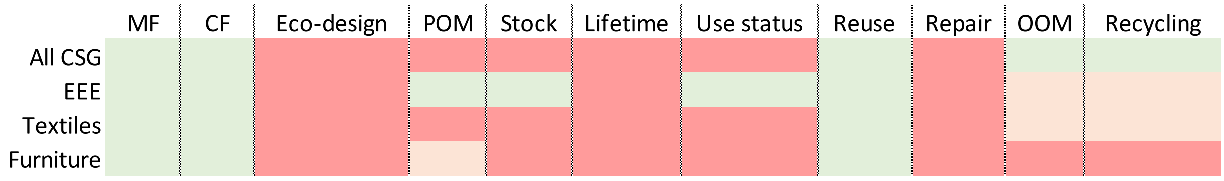

Figure 22 - Overview of data landscape
Green: indicator exists - Orange: rough estimate or incomplete indicator – Red: no data available

In general, little evidence was found that the current system of CSG is circular or evolving towards it. Starting from the input side, the study revealed that large amounts of raw material input are needed to fulfil the need for CSG, in particular for three categories: textiles, EEE and furniture. General data on CSG POM, their stocks, their use intensity or their lifetime is currently missing. While it is positive that reuse of CSG in Flanders seems to be increasing, the reuse centres signal that continued growth is hindered by the decreasing quality of the inflow in products. This while some products which could potentially be reused are ending up in MSW. The potential rebound effects associated with reuse further complicate conclusions on reuse contributing to a CE. CSG could be further kept from becoming waste by increasing repair, however at the moment this CE strategy is only marginally used and documented. The same goes for CE business models, like product sharing and PSS, which are only just starting to find their footing. The total amount of municipal solid waste collected decreased compared to 2013, but has stagnated in recent years. The data also shows that there is still room for improving the selective collection of recyclable materials that now end up in residual or bulky waste. More information is required on the output of recycling processes to assess if secondary materials are optimally used, in line with the principle of a recycling cascade, where one unit of a resource is sequentially used in multiple material applications with its use for energy generation as a final step (Sirkin & Houten, 1994).

The diversity of products within CSG makes it difficult to evaluate the transition of this system towards a CE as a whole. For example, textiles and some EEE have short lifespans, while (large) EEE have medium long lifetimes and well-made furniture is able to last generations. The CE strategies for short-lived products will differ from long-lived products. Further, some CSG can easily be transferred between individuals, making them ideal to integrate in the sharing economy, while for others CSG this is impractical and thus other CE models should be considered to elongate lifetimes and use intensity. For the stock of most CSG - like furniture, textiles or books - it is clear that they should be kept in use for as long as possible, this however does not apply to all CSG. Mainly for large, energy intensive, EEE at some point poor environmental performance may make replacing and recycling the more circular strategy. To address this trade-off, more information is required on the energy performance of the stock of large EEE.

EEE is currently the product group about which most specific insight is available, revealing to some extent the circularity of this system. For example, it is positive that WEEE is successfully kept out of residual waste and that the collected fraction is for almost 80% recycled. However at the moment only about 50% of POM is collected as WEEE again through the official channels. What happens to the remaining 50% is mostly unknown. Data are available mainly due to data collection by Recupel in the context of the EPR obligations. Here it can be noted that this EPR has so far been focused on ensuring proper collection and EOL treatment of WEEE. This focus is reflected in the available data. With other CE strategies in mind, like reuse and repair, it should be considered how the EPR can be further extended to stimulate the transition towards circularity. Recupel's two-yearly survey on the stock of EEE in households and their use already provides some initial interesting insights towards this. The data reveals that the stock of EEE in households is still increasing and that there is a significant amount of EEE present in households which remains unused (13%). It should be considered how the unused or underused stock of EEE can be activated, be it through encouraging sharing and reuse, be it through collection and recycling for those products which are not suitable anymore for further use.

While data is limited, there are few signals that textiles are transitioning towards a more circular and sustainable system. Global trends like fast fashion seem to have led to a decrease in price, accompanied with a decrease in product quality. This is reflected in the decreasing reuse percentage for clothing and increasing amounts of discarded textiles. About half of discarded textiles still end up in residual waste and detailed information on what happens to the selectively collected fraction is few and far between. **Whereas furniture has so far seemed to manage to stay under the radar of policymakers.** This has resulted in very little information regarding this product group. Its significant MF and CF however reveal that this system should not be overlooked when planning the transition towards a CE. It is further suspected that still reusable or repairable furniture is currently a major contributor to bulky waste in Flanders.

With the ambition of the Flemish government to achieve a CE by 2050 in mind, it seems that significant action is still required for the system of CSG. Further, EEE, textiles and furniture are all identified as priority product groups in the new CE action plan of the European Commission and thus are likely to be the focus of compulsory or voluntary initiatives in the coming years. In this context it may be beneficial to create a clear policy document outlining which actions will be taken and when. For this inspiration could be drawn from the anti-waste law in France, in which the deployment of a wide set of initiatives targeting both producers and consumers, like a ban on destroying unsold goods or a repair score on products, are clearly outlined. To make sure these initiatives target the right processes the current data gaps will need to be filled.

Lastly, the way in which indicators are presented matters. One important matter to consider is whether to show trends in absolute terms or relative to another indicator, for example per capita or per GDP. In this report, indicators are expressed primarily in absolute terms for the following reason: the earth's resources are finite and thus per capita improvements are not sufficient to stay within the planetary boundaries. However, where deemed relevant, the absolute number is supplemented with relative figures. Further, due to the CE emphasis on optimizing material flows, the indicators in this report often focus on the amount of materials involved. However the trend of an indicator may vary based on the unit being used. For example if products are becoming lighter it may happen that the total weight brought on market remains stable, while the amount of pieces is going up, as seen in the EEE data in section 3.2.B. Because both an increase in the total amount of materials in the system, as in the total number of pieces, are undesirable in the transition to the CE, both were discussed where possible.

4.2 Fulfillment of societal needs as a basis for monitoring

This report is a second implementation of the conceptual framework of the fulfilment of societal needs developed by Alaerts et al. (2019a), which aims to provide policy makers with more direct feedback by combining information from the macro to the micro level. While the CSG system is very different from the first case, the mobility system, it did prove workable and insightful to apply the framework in a similar way.

The main limitation with regard to the CSG system is that it proved impractical to find one general indicator expressing the need fulfilment in the CSG system as a kind of denominator to set against the amount of products in the system. Unlike with the mobility system, where this could be logically expressed as the amount of passenger kilometres travelled in Flanders, with the passenger car having clearly emerged as the main product within this system. This is however not really surprising, due to the nature of the CSG system being a grouping of very diverse products (see appendix A1). This created the necessity to further disaggregate the meso level, creating three distinct sub-categories in the meso layer, specifically for textiles, EEE and furniture. This way specific opportunities and problems could be highlighted for each of these large impact categories of CSG.

It should be highlighted that while the framework as it stands was designed to provide guidance towards policy makers based on the footprint of a certain consumption system, it is equally valuable for industry. Various crucial decisions determining the final footprint of a product are made by producers, with little to no say from consumers, like the repairability or the recyclability of a product. It is to those shortfalls' policymakers will look to ensure the transition to the CE. Thus, while it may not explicitly stand out in the current version of the monitor it is still intended to also provide feedback to the industry. To those companies looking to gain a head start in the transition to a CE, the monitor can already highlight where potential opportunities are, for example by decreasing the raw primary input of products by using recycled content or through offering their product as a service. These efforts will then get reflected in the monitor through the input data they provide.

Further, the monitor for the CSG system currently contains little in the way of micro indicators. Product level data is required for micro indicators, which is typically located with producers and thus harder to obtain. With mobility this was to some extent possible due to the official administration involved with the goods in this system. For example: the age of a car at EOL is documented. Similarly, it would be very interesting to know (the evolution of) the average lifetime of select products within the CSG system, as would the energy performance of large electronics. Life cycle-based indicators for products representative for the CSG system in Flanders could highlight where hotspots are, as would allow for comparison between types of products. In time a basket of products representative of the CSG system could be formed, in line with the European efforts on this (Castellani et al., 2019).

Lastly, it had to be considered how to handle packaging due to its role in different systems, specifically the CSG and the food system. However, solving this in essence comes down to a technical decision and some pragmatism in what logically belongs together. Realizing that not all aspects will clearly fit under one single need system and the important role of packaging in food, the CE policy centre currently plans to include packaging in that system or alternatively create a separate monitor for packaging waste.

4.3 Data availability and governance

This study pulls together data found on CSG in Flanders with the purpose of monitoring the transition of this consumption system towards a CE. Because data gathering specifically for the purpose of CE monitoring is still in a start-up phase in Flanders, this monitor is mostly set up with data that happened to already be available for a different purpose. It was thus not collected with CE monitoring specifically in mind. Therefore it is not unexpected that far from all desirable data was readily available, as is reflected in figure 22. Further, some of the data encountered is based upon certain assumptions, extrapolations or approximations. Interpretations should thus be made with a degree of caution and sufficient understanding of the underlying methodologies. However, by putting together data from different sources and reframing it within the context of CE monitoring it was possible to give a first overview of what is known about the circularity of the CSG system in Flanders.

For CSG in general, most detailed data is currently available on the waste stage, which is in line with the current strong focus on recycling as a CE strategy (Potting et al., 2018)**.** The available data on municipal solid waste and further insights on the composition of residual household waste offer valuable information for CE monitoring. It reveals the fractions contributing most to waste, which ones are managed well and where improvements are possible. OVAM is currently in the process of replicating the residual waste analysis and additional analysis on sorting both bulky and out-of-home waste are ongoing. These studies will provide much needed further information on where policy should focus to improve selective collection and recycling. For example, (still reusable) furniture is likely to be a large share of bulky waste. However, recycling is a strategy at the bottom of the CE hierarchy (Potting et al., 2018). **To guide the economy in Flanders towards a CE more attention will need to be given to higher CE strategies like increasing use intensity, reuse and repair.** To monitor these strategies novel indicators for measuring progress need to be developed (Potting et al., 2018). New studies like the one done by the CE policy research centre on reuse in Flanders (Delanoeije & Bachus, 2020) clearly demonstrate that valuable insights can be gained from expanding the current data gathering practices. Further research should address the remaining knowledge gaps, for example on the potential of repair as a CE strategy. Especially considering the current developments at the level of the European Union, chiefly the launch of the new CE action plan, in which EEE, textiles and furniture are identified as priority product groups (European Commission, 2020). To start addressing this need, the Circular Economy Policy Research Centre currently plans a study on repair as a circular economy strategy. This study will develop a typology of repair channels, map repair in Flanders, discuss the potential environmental impacts and provide policy recommendations.

To ensure the future maintenance and development of the CE monitor, it is important to consider how data collection should be managed, how updating and expanding could happen and how the accessibility of data could be improved. It will be important to consider a data governance that enables bringing together and manage data from different stakeholders in a safe and collaborative way. During the data collection process it became clear that quite some data regarding the CSG system is present at OVAM, with most stakeholders contacted for this study reporting in some extent to them (e.g. Recupel, De Kringwinkel). At OVAM, efforts are ongoing with regard to structuring this data and making it available in the context of CE monitoring.

A key issue hindering the data availability on CSG is that they are not evident to track within the economy. This is mainly because there is very little administration involved with these products after purchase. This is very different from the system of mobility, where the main good, a person car, is individually tracked throughout its lifecycle. In contrast, CSG once acquired by the consumer disappear within the stock and can at most be tracked as general product groups. **If the CE monitor is to further grow, additional data will need to be added, for some of which new specific studies will need to be conducted to fill in the current gaps.** This should especially be addressed for large impact product groups like textiles and furniture, for which at the moment virtually no data is readily available.

Another issue is that there are currently few incentives for companies to contribute to setting up data gathering systems in the context of CE monitoring. Company data could provide valuable insights into the impact of innovative product design (eco-design) and production processes. On top of this, the gap between what actors possess and what they are willing to share outside of their organization is perceived to pose an additional bottleneck. It may be that interesting data on CSG already exists, however it takes considerable time and effort to build the trust required with the different actors to gain access to this information and aggregate it together. With respect to this, the EPR for WEEE seems to provide an efficient pathway to facilitate data gathering and sharing. Here, an independent neutral actor, Recupel, aggregates the company data into general numbers which can be made available to interested parties. They provide a buffer between (sensitive) company data and governmental regulations. Further, the obligations regarding the management of WEEE have already initiated the industry to start to think about how to integrate into the CE. It could thus be interesting to introduce similar EPR obligations for the two other main CSG categories, textiles and furniture. Yet, it should be noted that setting-up and implementing EPR regulations is not evident. It requires significant resources and cooperation. If EPR regulations were to be extended to new product groups careful consideration should be given on how the associated administrative burden can be limited. Further, it is advisable to implement EPR at the largest territorial entity possible, in order to profit from scale effects. To judge whether or not additional EPR schemes for certain CSG are feasible is not within the scope of this research. Merely the observation is made that such schemes offer interesting opportunities when it comes to data gathering for CE monitoring and to simulate CE strategies within industries, thus that CE principles should be kept in mind when implementing them. In this, care should be taken that the focus is not just on simulating better EOL management of products - like through separate collection and recycling targets - but that stimulants towards circularity are included throughout the products lifecycle, for example by including eco-design for products POM through targets on reuse, reparability or recycled content.

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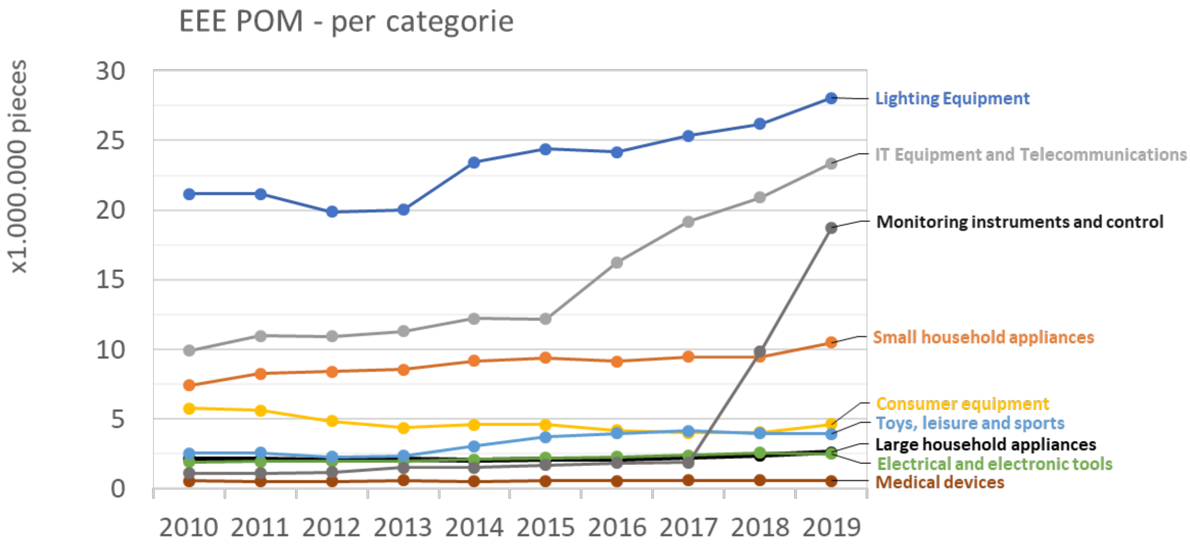
Appendix

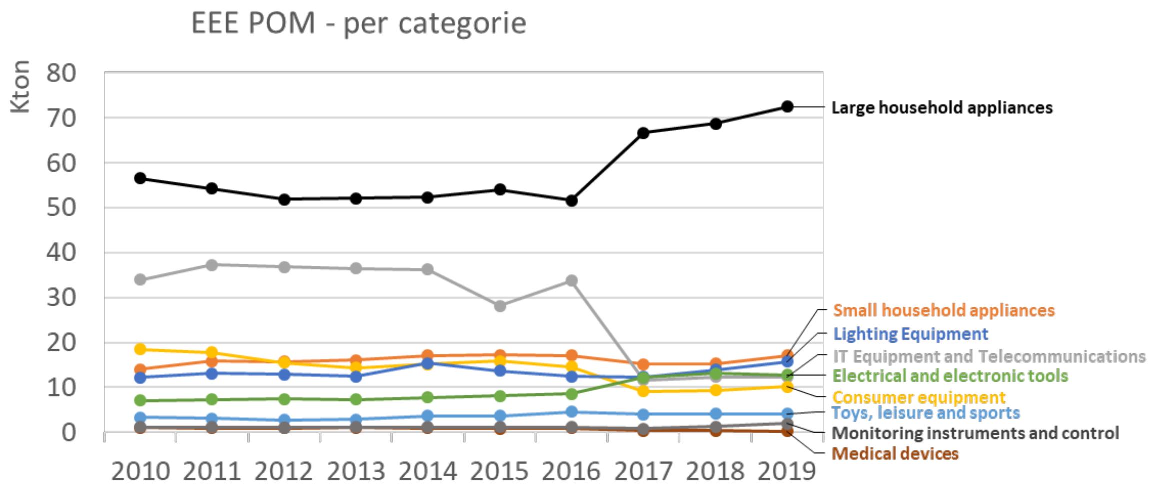
A1. Material- and carbon footprint of CSG

bevat zowel EEE als n-EEE	COICOP (1999)	Koolstofvoetafdruk (CO_2 eq.) kton	ton/capita	%	Materiaalvoetafdruk kton	ton/capita	%
		10.740	1,72	100%	10.718	1,71	100%
Textiel		**2.872**	**0,46**	**27%**	**3.149**	**0,50**	**29%**
Kleding	03.1	2.053	0,33	19%	2.444	0,39	23%
Schoeisel	03.2	548	0,09	5%	471	0,08	4%
Huishoudtextiel	05.2	271	0,04	3%	234	0,04	2%
Meubel		**1.107**	**0,18**	**10%**	**1.161**	**0,19**	**11%**
Meubelen, stoffering, vloerbekleding	05.1	1.107	0,18	10%	1.161	0,19	11%
EEE		**1.707**	**0,27**	**16%**	**1.506**	**0,24**	**14%**
Huishoudelijke apparaten	05.3	598	0,10	6%	551	0,09	5%
Gereedschap voor huis en tuin	05.5	246	0,04	2%	214	0,03	2%
Telefoon- en faxtoestellen	08.2	57	0,01	1%	49	0,01	0%
Audio- en videoapparatuur, foto- en filmapparatuur en gegevensverwerkende apparatuur; Andere grote duurzame goederen voor recreatie en cultuur	09.1 en 09.2	806	0,13	8%	693	0,11	6%
Overige consumptiegoederen		**5.055**	**0,81**	**47%**	**4.902**	**0,78**	**46%**
Vaat- en glaswerk en huishoudelijke artikelen	05.4	325	0,05	3%	503	0,08	5%
Goederen en diensten voor het dagelijks onderhoud van de woning	05.6	989	0,16	9%	728	0,12	7%
Andere artikelen en ander materieel voor recreatie, tuinen en huisdieren	09.3	1.612	0,26	15%	1.997	0,32	19%
Kranten, boeken en schrijfwaren	09.5	549	0,09	5%	414	0,07	4%
Lichaamsverzorging	12.1	1.090	0,17	10%	820	0,13	8%
Artikelen voor persoonlijk gebruik, n.e.g.	12.3	489	0,08	5%	440	0,07	4%

(source: Vercalsteren et al., 2017)

A2. EEE POM per product category





Note: the trend break between 2016 and 2017 for 'Large household appliance' and 'IT Equipment and telecommunications' is due to the recalculation of the conversion factors.
(source: Recupel, 2019b*)*

A3. Recupel - EEE in stock - categories

bruingoed		
	TV	Televisie (MET beeldbuis)
		Televisie (Flatscreen)
	Overige	Camcorder / Videocamera / Actioncam / Dashcam
		Projector / Dia projector / Beamer
		Home audio component (Home cinema set, DAC, Streamer, Platenspeler, Tuner, Versterker, Receiver, CD speler, Cassette dec
		Fotocamera (al dan niet digitaal) / Losse flitser en andere accessoires voor camera (elektrisch)
		DVD speler / DVD recorder / Blu ray speler / Hard Disc Recorder (met / zonder DVD speler) / Videorecorder / Video-DVD-co
		Hoofdtelefoon (met en zonder draad) los gekocht / Oortjes
		Overig audio/video apparaat (elektrisch)
		Audiosysteem (audio- en hifitorens) / Audio streamingsysteem of speaker(s)
		Bluetooth speaker / Draagbare radio / CD speler / DVD speler / Memorecorder / Personal radio / MP3 speler / Autoradio (u
		Muziekinstrument (elektrisch) (geen speelgoed) + Versterker / Luidspreker
		Luidsprekerset (los extra aangeschaft) / Soundbar
		Schotelantenne / Satellietontvanger
		Wekker radio (met of zonder CD functie)
		Box om digitale televisie/satelliet tv te ontvangen (vb: Digibox / Digicorder / B box,...) / Mediaspelers (Apple TV / Chr
DHZ		
	Huis	Overig gereedschap (elektrisch)
		Verfafbrander (elektrisch) / Heteluchtpistool
		Compressor
		Zaagmachine (elektrisch) (Afkortzaag / Cirkelzaag / Decoupeerzaag / Reciprozaag / Lintzaag / Zaagtafel / Tegelzaagmachin
		Boormachine (Schroefmachine / Boorhamer / Tafelboormachine)
		Lasapparaat (elektrisch) / Soldeerapparaat
		Schuurmachine (band- en vlakschuurmachine) / Slijpmachine / Schaafmachine
	Tuin	Hogedrukreiniger
		(Robot)grasmaaier (elektrisch)
		Pomp / filter (vijver / zwembad / aquarium)
		Overig tuingereedschap (elektrisch)
		Haagschaar / Snoeischaar (elektrisch) / Boordsnijder (met nylondraad) / Grastrimmer / Bladblazer / Bladzuiger
ICT		
	Computer	Desktop computer
		Laptop / Notebook / Chromebook / 2 in 1
	PC monitor	Computer scherm (MET beeldbuis)
		Computer scherm (Flatscreen)
	Telecom	Mobiele telefoon / Smartphone
		Overig telecom apparaat (elektrisch) (Walkietalkie / Pieper / los Antwoordapparaat / Headset (bluetooth) / Babyfoon / Sm
		Thuistelefoon (vast of draadloos)
	Overige	Palmtop / PDA / Organiser
		Tablet / iPad
		Overig IT apparaat (elektrisch)
		GPS-toestel / Navigatiesysteem voor auto/fiets/buitensport (niet ingebouwd)
		Printer / Scanner / Kopieerapparaat / Multifunctionele printer / Faxapparaat / 3D printer / Labelprinter
		Bewakingscamera / Bewakingsmonitor / Alarminstallatie
		Externe harde schijf / NAS
		E-book / E-reader
		Muis (draadloos) / Toetsenbord (draadloos) / PC speakers / Webcam
		Digitale fotolijst
		Rekenmachine / Kaartlezer internetbankieren
		Deurbel (draadloos / elektrisch)
		Router / WiFi repeater / WiFi extender / Access point / Adapter / Switch / Wifi router
Overig		
	Health/sport	Overig medisch apparaat (elektrisch) (bijv. Stappenteller / Gehoorapparaat) / Fitnesstracker
		Elektrisch of Elektronisch Sport- / recreatie- / ontspanningsapparaat (bijv. cross trainer / roeimachine / fiets hometra
		Lichaamsthermometer (elektronisch) / Bloeddrukmeter (elektronisch) / Hartslagmeter / Astma inhalator / Aerosol
		Elektrische - fiets / Step / Waveboard / Hoverboard
		Rolstoel (elektrisch)
	Speelgoed	Elektrisch gemotoriseerd speelgoed (bijv. auto/trein op afstandbediening, bewegende pop, ...) / Drone
		Spelcomputers (draagbaar en niet draagbaar)
		Speelgoed met een elektr(on)ische functie (Gezelschapsspelen, educatief geluidweergevend speelgoed en speelgoedmuziekins
	Overige	Afstandsbediening (los gekocht)
		Zaklamp / Fietslampje (los)
		Weerstation / Buitenthermometer (elektrisch)
		Batterij oplader / Powerbank
		Gasmelder / Hittemelder / Rookmelder / Bewegingsmelder
witgoed		
	groothuishoudelijk	Vaatwasser / Afwasmachine
		Droogkast / Wasdroger / Droogzwierder (los)
		Oven / Stoomoven
		Diepvriezer
		Koelkast / Combi koelkast (met vriesvak) / Wijnkoelkast
		Dampkap
		Airco apparaat (losstaand)
		Kookplaat (electrisch) met/zonder ingebouwde afzuiger
		Wasmachine / Wasdroog combi
		Microgolfoven / Combi Microgolfoven + Oven

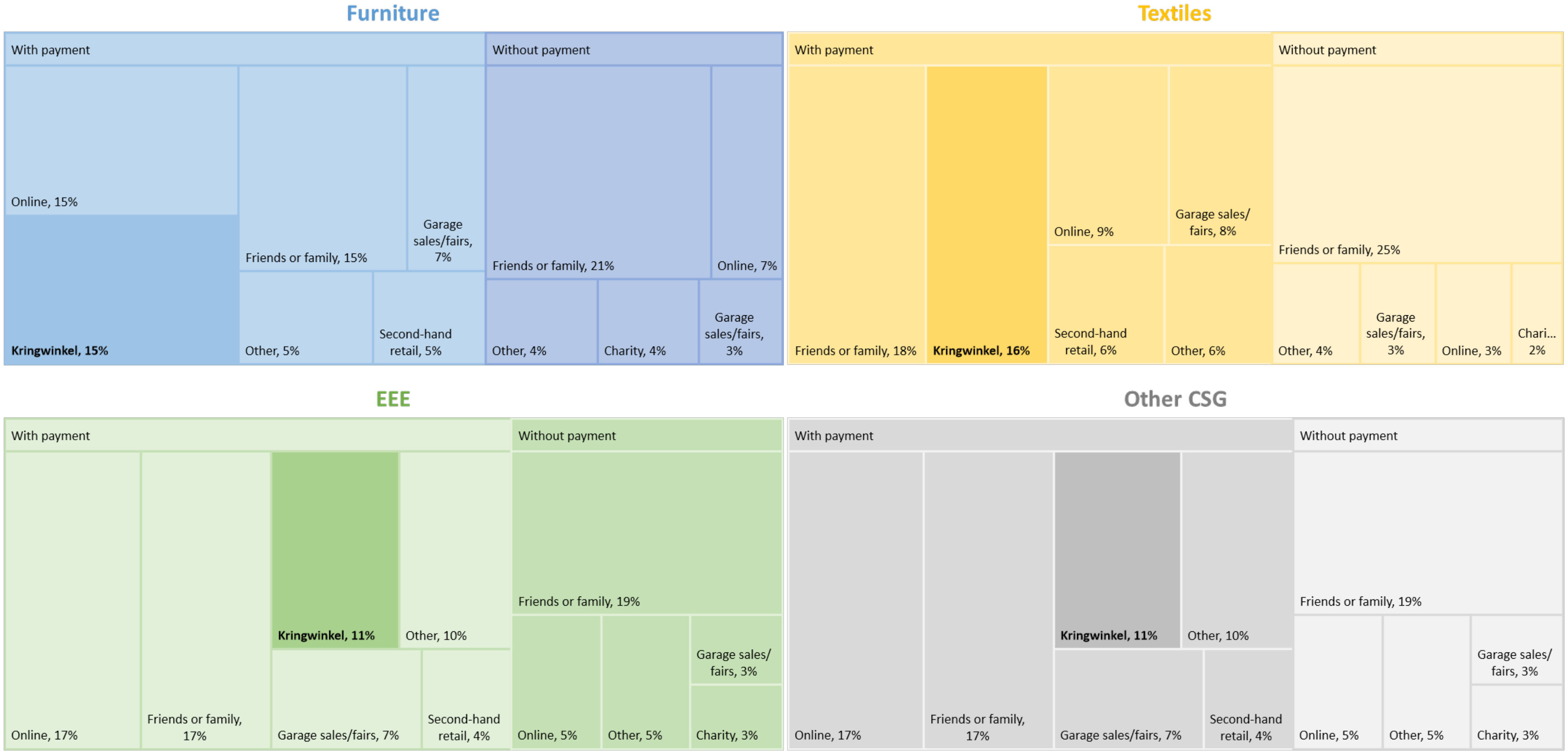
	Fornuis
KHH - keukenapperatuur	Blikopener (elektrisch) / Mes (elektrisch) / Messenslijper (elektrisch)
	Biertap (elektrisch) / IJsmachine / IJsblokjes machine (niet ingebouwd in koelkast)
	Koffie- / Espresso apparaat / Koffiemolen (elektrisch) / Melkopschuimer
	Grill / Inbouwgrill (geen microgolffunctie)
	Friteuse / Frituurpan / Airfryer
	Fondueset / Gourmetset / Steengrill / Grillplaat / Barbecue (elektrisch) / Kook- of warmhoudplaat (1 t/m 3 pits) (elektr
	Keukenrobot / Keukenmachine / (staaf)Mixer / Foodprocessor / Snijmachine / Blender / Milkshaker / Cocktailshaker / Sapc
	Waterkoker / Stoomkoker / Rijstkoker (elektrisch) / Kokendwaterkraan
	Overig klein huishoudelijk apparaat (elektrisch)
KHH - persoonlijke verzorging	Zonnebank
	Gezichtsbruiner / Infraroodlamp
	Overig persoonlijke verzorging apparaat (elektrisch)
	Scheerapparaat / Baardtrimmer / Tondeuse / Epileerapparaat / Ladyshave / Neustondeuse / Bodygroom
	Personenweegschaal (elektrisch)
	Mondhygiëne apparaat (Elektrische tandenborstel, Monddouche, Flosapparaat, Tongschraper)
	Haardroger / Haardroogkap / Krulset / Haarstyler / Haarkrultang / Haarkrulborstel
KHH - Overige	Kruimeldief / Kruimelzuiger / Ruitenreiniger
	Naaimachine / Breimachine / Lockmachine
	Stofzuiger (incl. robotstofzuiger) / Waterzuiger
	Tapijtreiniger / Stoomreiniger / Boenmachine / Electrische dweil
	Elektrische deken / Voetwarmer / Massagekussen
	Strijkijzer / Kledingstomer
	Klok / Wekker (elektrisch / elektronisch)
	Ventilator / Ventilatorkachel / Elektrische kachel / Oliebadradiator / Terrasverwarmer (elektrisch)
	Luchtverfrisser / Luchtontvochtiger / Luchtbevochtiger / Luchtreiniger (elektrisch)

A4. Use status of EEE in households

		In use	Not in use	
		In use	Functional	Faulty
White goods	Large household appliances	96%	3%	1%
	SHH - Kitchen appliances	85%	14%	1%
	SHH - Personal care	87%	11%	1%
	SHH - Other BW	88%	10%	2%
	SHH - Other	87%	11%	2%
Brown goods	TV (CRT)	72%	24%	4%
	TV (Flatscreen)	95%	4%	1%
	Other	80%	16%	3%
DIY&Garden	House	85%	13%	2%
	Garden	87%	10%	2%
	Computer	86%	7%	7%
ICT	PC Monitor (CRT)	48%	31%	20%
	PC Monitor (Flatscreen)	88%	10%	2%
	Telecom	85%	8%	7%
	Other	87%	10%	3%
Others	Health/sports	84%	13%	3%
	Toys	70%	27%	3%
	Other	88%	10%	2%
Total		**86%**	**11%**	**2%**

SHH: small household appliances
(source :Recupel, 2019a*)*

A5. Reuse channels for CSG



(source: Delanoeije & Bachus, 2020)

A6.Municipal solid waste

HHAfval detail - (ton)	2013	2014	2015	2016	2017	2018	2019
verpakkingsglas	192.929	193.532	195.483	193.172	191.481	192.278	193.556
wit glas	75.107	76.154	77.945	78.852	80.054	81.830	82.015
gekleurd glas	87.596	86.991	88.362	87.384	87.121	86.159	82.241
glas gemengd	30.227	30.387	29.176	26.935	24.307	24.289	29.300
papier en karton	454.383	446.202	428.627	425.024	406.994	406.817	398.841
pmd	93.915	92.871	92.983	94.626	95.024	97.491	104.041
kunststofverpakkingen	39.801	39.676	40.468	41.838	42.039	43.411	52.614
metalen verpakkingen	26.723	25.771	25.639	26.164	26.210	26.732	26.933
drankkartons	10.457	10.325	10.564	10.503	10.234	10.041	9.930
residu	14.939	15.060	14.130	13.819	14.119	14.755	14.564
pmd-zak	1.994	2.040	2.181	2.303	2.424	2.552	
metalen gemengd/kroonkurken (excl. pmd)	32.359	31.648	31.136	33.339	33.522	33.265	34.904
kunststoffen gemengd/piepschuim (excl. pmd)	32.460	33.599	35.489	37.439	39.560	43.239	45.711
gft	272.035	274.713	256.007	269.328	262.373	254.157	268.691
groenafval	455.687	464.518	420.922	439.297	418.395	420.579	444.969
snoeihout en boomstronken	115.492	108.515	100.452	96.129	93.595	91.065	102.987
tuinafval gemengd	340.195	356.003	320.470	343.168	324.801	329.515	341.982
textiel	48.634	48.484	49.972	52.557	53.641	53.643	54.696
bouw- en sloopafval	477.888	430.750	382.153	380.633	342.269	338.656	358.062
houtafval	162.208	161.963	161.742	170.879	175.991	186.199	203.859
AEEA	71.155	71.474	69.605	72.720	69.697	68.229	69.404
Overig selectief afval	34.108	33.146	32.734	33.298	32.487	33.452	35.502
autobanden	1.970	1.687	1.687	1.745	1.815	2.134	2.198
vlakglas	10.744	10.726	10.197	9.988	9.635	10.045	10.938
dierlijk afval	33	30	8	9	8	8	7
geneesmiddelen	344	428	402	400	403	417	393
kga	13.754	13.295	13.272	14.216	14.056	14.477	15.520
plantaardige en dierlijke oliën en vetten	7.263	6.980	7.168	6.940	6.570	6.371	6.446
selectief ingezameld afval	**2.327.764**	**2.282.899**	**2.156.851**	**2.202.312**	**2.121.434**	**2.128.005**	**2.212.236**
excl. Bouw en sloopafval, groenafval & GFT	**1.122.154**	**1.112.918**	**1.097.769**	**1.113.054**	**1.098.397**	**1.114.613**	**1.140.514**
grofvuil	198.536	181.952	151.724	152.173	144.160	148.485	151.701
huisvuil	773.080	776.208	774.813	773.946	762.752	767.641	754.117
veegvuil		8.705	9.161	9.740	10.037	9.987	10.615
gemeentevuil	44.987	34.463	43.812	41.684	36.898	33.091	34.552
totaal restafval	**1.016.604**	**1.001.328**	**979.510**	**977.543**	**953.847**	**959.204**	**950.985**
totaal huishoudelijk afval	**3.344.368**	**3.284.227**	**3.136.361**	**3.179.855**	**3.075.282**	**3.087.209**	**3.163.222**
excl. Bouw en sloopafval, groenafval & GFT	**2.138.758**	**2.114.246**	**2.077.279**	**2.090.597**	**2.052.245**	**2.073.817**	**2.091.500**
	52%	53%	53%	53%	54%	54%	55%

(source: OVAM)

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