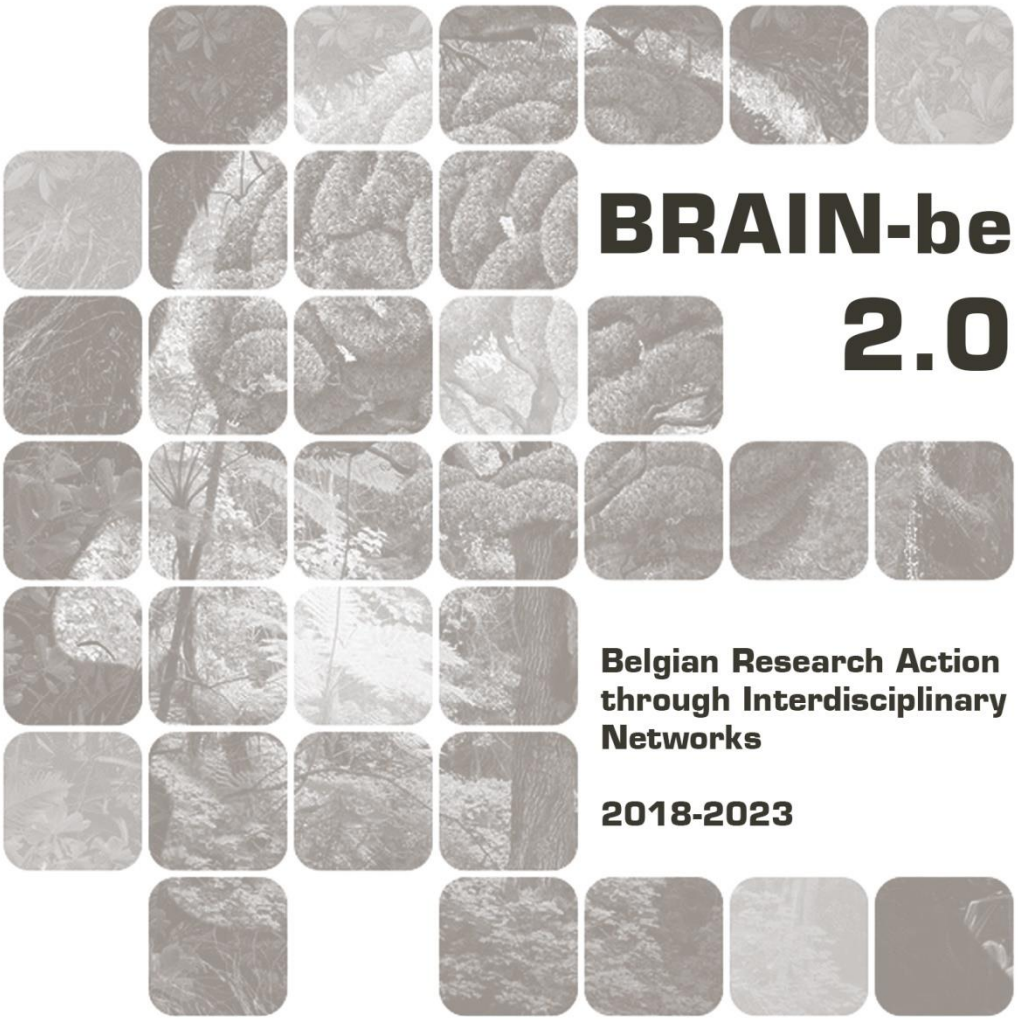

BEvitalise

Revitalising the Belgian Circular Consumer: No time to waste food, nor electronics

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Pillar 3: Federal societal challenges

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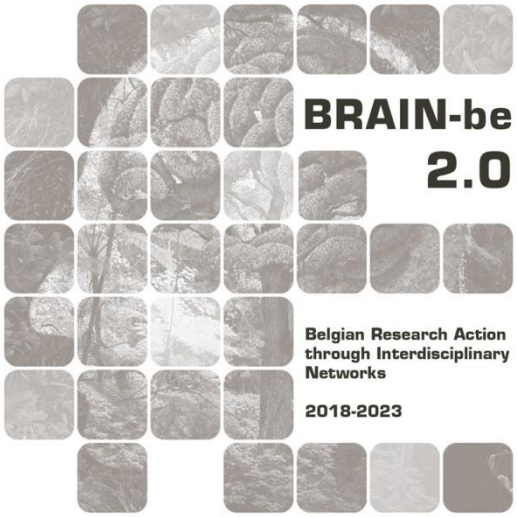

NETWORK PROJECT

BEvitalise

Revitalising the Belgian Circular Consumer: No time to waste food, nor electronics

Contract - B2/223/P3/BEvitalise

FINAL REPORT

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Published in 2024 by the Belgian Science Policy Office
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Bjornavold, Amalie, Van Schoubroeck, Sophie, Anougmar, Soukaina. BEvitalise: Revitalising the Belgian Circular Consumer: No time to waste food, nor electronics. Final Report. Brussels: Belgian Science Policy Office 2024 – 86 p. (BRAIN-be 2.0 - (Belgian Research Action through Interdisciplinary Networks))

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ABSTRACT

Belgium's continued transition to a circular economy has the potential to deliver important benefits – from reduced pressure on the environment, supply security, and increased competitiveness, innovation, and growth. Consumers have a vital role to play in this transition to deliver these benefits.

The project intends to understand Belgian households' food and electronic waste decisions, with a view to providing federal authorities with scientific evidence on how they can promote climate-conscious behaviour patterns. BEvitalise has conducted research using discrete choice experiments on Belgian consumers' discarding decisions in two domains: (1) minimising household food waste and (2) minimising household hoarding of waste electrical and electronic equipment.

BEvitalise results highlight the need for improved label design and educational efforts to address misconceptions to reduce food waste. In a study with 967 Belgian consumers, respondents widely misunderstood the "best-before" date, confusing it with the "use by" date, and showed no clear preference for label types like "look, smell, taste," indicating label ineffectiveness. Many participants discarded products regardless of quality, highlighting the need for better label design and education to reduce food waste.

With regard to electronic waste, in a study with 453 Belgian respondents, 71% reported hoarding old devices at home, mainly as backups (64%), due to data security concerns (22%), or lack of awareness of retention and hoarding devices (36%). Findings show that guarantees of data removal and monetary incentives could encourage proper disposal, while transparent information on device recycling and reuse (e.g. by charities) builds trust. Raising awareness of disposal sites for waste electronic and electrical equipment is also key.

1. INTRODUCTION

BEvitalise has undertaken research on Belgian households' food and electronic waste decisions, with a view to providing federal authorities with scientific evidence on how they can promote circular and climate-conscious behaviour patterns. Understanding the preferences underlying Belgian consumers' decision processes is key to transforming the linear economic model based on the 'take-make-consume-throw away' pattern into a circular one. Specifically, BEvitalise has conducted research on Belgian consumers' preferences in two domains: (1) minimising household food waste and (2) minimising household waste electrical and electronic equipment (WEEE), which is the world's fastest-growing solid-waste stream.

BEvitalise employed discrete choice experiments (DCEs), a non-market valuation approach that gathers insights into preferences through repeated hypothetical choices made by respondents (Mariel et al., 2021). This method comprises the design of a choice survey to generate data, statistical analysis to estimate preferences from the collected data, and the application of the resulting model to derive welfare measures or conduct policy analyses.

Food waste experiment

In Belgium, food waste is a significant environmental and social issue. Research indicates that Belgium wastes around 345 kg of food per capita annually, one of the highest levels in Europe. Food waste further contributes to 8% of the country's greenhouse gas emissions (OVAM, 2023; European Commission, 2024). The issue spans households, businesses, and the food industry, highlighting inefficiencies across the supply chain.

BEvitalise investigated why consumers discard edible food, focusing on cooking cream, and surveyed 967 Belgian respondents, representing the population in terms of region, age, income, and education. While participants generally demonstrated a wish to *try* to minimise food waste, several behavioural tendencies emerged. Consumers exhibited widespread misunderstanding of the best-before date's meaning (referring to the quality of the product, as opposed to the "use by date"). There was no clear preference for specific label types, such as "look, smell, taste" or "often good after," suggesting a potential clarity and effectiveness of current labels lack. Additionally, consumers were more likely to discard opened cooking cream regardless of its quality, favouring fresh packages, which indicates that existing labels do not effectively encourage them to assess product quality before disposal. These findings highlight the need for improved label design and educational efforts to address misconceptions and reduce food waste.

Electronic waste experiment

Like much of Europe, Belgium faces significant challenges in managing the increasing electronic waste stream, driven by rapid product obsolescence and inadequate recycling infrastructure. Informal recycling practices and illegal exports compound environmental and health risks, while a lack of consumer awareness about disposal options leads many to stockpile or improperly discard electronics, resulting in resource loss and environmental damage (Rautela et al., 2021; OECD, 2021). The WEEE Directive (2012/19/EU) has been updated to manage WEEE growth in Europe, with increased collection and recycling targets. The 2019 target was 65% of the weight of electronic equipment put

on the market in the previous three years, but this target has not been reached (Eurostat, 2021). Shifting to a circular economy can help meet these targets. However, consumer behaviour, such as improper sorting or hoarding of WEEE at home, is a significant barrier. Despite Belgium's awareness of the importance of recycling, optimising WEEE's natural resource savings largely depends on consumer actions and the efficiency of collection and separation systems (De Meester et al., 2019).

BEvitalise investigated what would make consumers more likely return their electronic waste. Based on a survey with 453 Belgian respondents, 71% stated that they keep old devices at home, mainly as backups (64%) or due to concerns about data security (22%), or lack of awareness and consciousness around storing these devices at home (36 %). Mobile phones are more likely to be stored at home than laptops. To encourage people to drop off their electronics at a collection point, respondents strongly favoured data removal guarantees and preferred their electronics to be reused (especially for charity) and recycled. They were also more likely to dispose of their products if they received higher compensation, especially cash, as well as environmental donations and vouchers. Respondents revealed a preference for container parks as a disposal site, possibly due to a lack of awareness of alternative sites or data protection reasons. The results thus reveal that most Belgian consumers store old electronics at home, but under the right conditions, they would dispose of their devices. These conditions should support recycling and charity-based reuse, guarantee data removal, and higher compensation options.

Policy recommendations

Based on the BEvitalise results, in consultation with stakeholders, policy recommendations can be summarised as the following:

Policy recommendations to reduce food waste encompass a range of interconnected strategies. Improving consumer awareness, labelling, and engagement is paramount. Educational campaigns should focus on teaching consumers sensory checks (look, smell, taste) to reduce unnecessary disposal after "best before" dates. Tailored messaging for specific groups, such as large families or young adults, can further enhance effectiveness, given that our results showed that older respondents were more likely to look, smell and taste a product before disposing of it. Clearer labelling is also vital, with additional text on "best before" products (e.g. "Safe to consume after this date if quality is maintained" or "Often good after") to guide informed consumer decisions. Nonetheless, decisions on upcoming regulations on labelling at the EU level should be awaited before decisions are made at the Belgian level.

Retailers and schools should play a central role in efforts to reduce food waste. Retailers that are in direct contact with the consumer could also display educational messages in stores, while schools can introduce food literacy lessons to improve label comprehension and promote waste reduction. Embedding food waste education into school curricula fosters long-term behavioural changes but requires regional collaboration and robust national support. Though transformative, such initiatives may take time to yield results. Tracking food waste levels and using data-driven insights to adapt strategies could ensure efforts remain effective and responsive to evolving needs. A dedicated food waste fund could provide the financial backing necessary for these initiatives.

Effectively tackling food waste demands a coordinated and multi-layered and multi-stakeholder response. Addressing misconceptions about labelling, enhancing consumer education, and fostering

collaboration across stakeholders are crucial steps. Governments, retailers, and industry stakeholders must work together by building coalitions, professionalising the food donation sector, and incentivising surplus food redistribution through tax breaks. Tailored strategies for different target groups are essential, with innovative approaches needed to engage disengaged individuals. These actions, supported by data-driven monitoring and adaptive strategies, pave the way for meaningful food waste reductions, fostering a more sustainable and resource-efficient future.

Policy recommendations to improve the recycling and disposal of electronic waste, such as laptops and mobile phones, include providing clear and transparent information about the fate of devices after they are handed in at collection points—whether they are repaired and reused or recycled. Ensuring the guarantee of personal data removal and explaining the subsequent use of the devices can help build consumer trust in the process. Additionally, incorporating monetary incentives could significantly increase participation in collection programmes. In the hypothetical scenario in the BEvitalise study, consumers preferred to dispose of their devices in container or recycling parks, possibly due to trust and data protection concerns or a lack of awareness about other options - raising awareness about other available collection points is therefore crucial.

These policy recommendations were validated through discussions with experts from industry, policy, and civil society. In exploring ways to discourage hoarding of electronic devices, key additional solutions were also identified: encouraging the return of discarded electronics through appealing consumer incentives, such as in-store rewards or deposit schemes, to promote responsible disposal. Raising awareness of electronic waste collection points and improving their accessibility was also seen as crucial, as also highlighted by the BEvitalise results. Integrated studies on consumer behaviour, particularly the emotional and psychological factors behind hoarding electronic devices, were emphasised as vital for designing effective interventions, including periodic reminders to consumers every 3-5 years to encourage proper disposal. Educational initiatives were recognised as essential for fostering long-term behavioural change, with the integration of electronic waste management into school curricula to instil responsible habits in future generations. Awareness campaigns targeting diverse groups could further broaden the reach of these efforts. Financial incentives, such as reducing VAT on repair services, were proposed to make repairs more affordable and promote sustainability, alongside lowering labour costs and supporting quality certifications for repair services. These measures align with broader initiatives at the EU level like the Repairability Index and Eco-Design regulations, which aim to enhance the sustainability of electronic products and encourage repair over replacement.

2. STATE OF THE ART AND OBJECTIVES

BEvitalise addresses the role of consumers in transforming the Belgian economy into a circular one. By better understanding consumer behaviour in the areas of i) food waste and ii) WEEE, the project provides concrete policy recommendations for decision-makers, businesses, and civil society on how we can first reduce food waste and the associated impacts on the environment, and secondly, reduce consumption of WEEE and discarded e-waste to recycle what we no longer want, refurbish, reuse, and repair what we can.

2.1. THE TRANSITION TO A CIRCULAR FOOD SYSTEM

The transition to a circular economy hinges on the principle of intensifying and extending the use of products, thereby reducing the need for new ones. However, applying this concept to food systems presents unique challenges. Unlike abiotic materials, food cannot be kept in the economy through strategies like sharing, repairing, or recycling. Food products are consumed once, and standard circular economy strategies aimed at prolonging product life are less relevant. Instead, circularity in food systems focuses on meeting consumers' nutritional needs with less production, thus reducing the associated environmental impacts and resource use (Vermeyen et al., 2021). Achieving this requires rethinking production, consumption, and waste management to minimise resource inefficiencies and environmental harm (Ellen MacArthur Foundation, 2021).

Food waste, particularly at the consumption stage, is not only an additional waste stream but also represents a loss of all the material inputs used throughout the production process, including water, energy, and labour (Gustavsson et al., 2011; FAO, 2013). Addressing consumer-level food waste is, therefore, a high priority in creating a sustainable food system (Criel & Fleurbaey, 2019). Identifying behaviours and practices that contribute to food waste is also key to encouraging a shift to reduce food waste.

Globally, food waste remains a significant issue, with estimates suggesting that 30–50% of food intended for human consumption is lost or wasted across the supply chain (FAO, 2019; Xue et al., 2017). Private households are the largest contributors to food waste in developed countries, with the consumption stage having the most significant environmental and economic impacts due to resource accumulation during transportation, handling, and commercialisation (Scherhaufer et al., 2018). Furthermore, the environmental costs of food waste are staggering, contributing to approximately 8–10% of global greenhouse gas emissions (UNFCCC, 2024). Consequently, minimising household food waste is a key step toward achieving circularity in food systems (Schmidt & Matthies, 2018).

Why do consumers waste food?

Household food waste stems from a range of behaviours and practices, including poor planning, improper storage, and misinterpretation of food labels. Schanes et al. (2018) outline the key stages of household food management: planning, shopping, storing, cooking, eating, and leftover management. Each stage influences whether food is consumed, repurposed, or discarded. Research by Van Geffen et al. (2020) identifies behaviours such as failing to save leftovers, avoiding “old” food due to perceived health risks, and suboptimal storage practices (e.g. leaving perishables out of refrigeration) as major contributors to waste. Food processing, smart packaging, and improved storage methods are key strategies in achieving a circular food system. A lack of shopping discipline further exacerbates waste. Consumers often overestimate their needs, fail to adhere to shopping plans, or lack the time and

creativity to plan meals effectively (Von Kameke & Fischer, 2018). High-income households with young children are particularly prone to waste, due to preferences for fresh food and inadequate storage practices (Østergaard & Hanssen, 2018). These findings underscore the need for targeted interventions to improve consumer behaviour and reduce waste. A large-scale Danish survey identified that the primary drivers of food waste are perceived behavioural control and routines associated with shopping and the reuse of leftovers. Additionally, planning routines were found to have an indirect influence on food waste reduction (Stancu, Haugaard, & Lähteenmäki, 2015).

Misinterpretation of date labels is a significant driver of consumer-level food waste. Many consumers erroneously view “best-before” dates as indicators of food safety rather than quality, leading to the premature disposal of edible food. The "best before" date specifies the period during which a product retains its optimal quality, such as taste, texture, or appearance, provided it is properly stored. It does not indicate that the product is unsafe after this date, although its quality may decline. This date is typically used for items such as dry, canned, or frozen goods. In contrast, the "use by" date indicates the point beyond which a food product is no longer safe to consume due to potential health risks. This is commonly seen on highly perishable foods such as fresh meat, fish, and ready-to-eat meals. Studies reveal that 84% of consumers discard food near the best-before date at least occasionally (Neff et al., 2019). Consumers may not understand these label date definitions and, therefore, may use food date labels to evaluate food safety, thus discarding food that has passed its label date in order to avoid food-borne illness (Kavanaugh & Quinlan, 2020). Streamlining and standardising label terminology could mitigate these effects. Ambiguous labelling is, in turn, a major contributor to food waste. This has a substantial end result: 10% of Europe’s 88 million tonnes of annual food waste is due to a misunderstanding of date marking (Philippidis, 2019).

The type of packaging has an impact on perceived freshness, product liking and consumers' purchase intention (Kroese, 2017). Wilson et al. (2017) found that larger package sizes exacerbate waste, especially when combined with ambiguous date labels. A case study conducted in Germany identified health risk reduction and utility maximisation as primary drivers of food waste. The increasing consumer preference for higher-quality and fresher products has further worsened this issue (Hermanussen, Joy, & Egamberdiev, 2022). Similarly, a survey in the United States found that concerns about foodborne illnesses and the desire for fresh food were the most common reasons for discarding edible items (Neff, Spiker, & Truant, 2015). These findings underscore the importance of maintaining product quality and freshness during distribution and storage, which can be achieved through the appropriate selection of packaging materials and technologies (Marsh & Bugusu, 2007).

How to reduce household food waste?

Reducing household food waste requires a multifaceted approach. Understanding the psychological factors behind food waste is crucial. Studies have examined the gap between consumers' intentions to reduce waste and their actual behaviours. Factors such as opportunity, ability, and social influences play significant roles in this discrepancy. Interventions that enhance consumers' planning, purchasing, and food management skills have been shown to be effective (Shan et al., 2024).

Educational interventions have proven effective in addressing this issue, with targeted messages increasing understanding of date labels by up to 82% (Turvey et al., 2021). Additionally, innovative labelling strategies, such as replacing “best-before” with “highest quality date,” can better communicate the purpose of these labels and reduce food waste (Đorđević et al., 2020). Educational

campaigns, technological innovations, and behavioural nudges can foster more sustainable practices. For instance, promoting the use of leftovers, optimising storage practices, and clarifying food labels can significantly reduce waste. Cultural shifts, such as embracing imperfect produce and reducing portion sizes, also play a role, as well as creatively utilising leftovers, are additional strategies that can drive change (Quested et al., 2013). Cultural and regional differences play a role in the success of these interventions, with Northern European countries typically performing better due to higher environmental awareness and established waste-reduction policies (Van Geffen et al., 2020).

Eco-design packaging stands out from conventional packaging by incorporating key attributes, such as the use of recyclable materials (e.g. glass) and resealability, which are vital for waste reduction (Boesen, Bey, & Niero, 2019). Additionally, eco-design packaging can signal sustainable food products, such as organic items, distinguishing them from conventional alternatives (Magnier, Schoormans, & Mugge, 2016). Consumers who prioritise sustainable food choices are generally less likely to waste these products. Collectively, these insights highlight the potential of packaging innovation to simultaneously enhance sustainability and reduce food waste. Research on sustainable packaging and storage solutions has shown that technologies like vacuum sealing and biodegradable packaging can significantly extend the shelf life of perishable products (von Massow et al., 2019).

The findings of Zeinstra et al. (2021) indicate that incorporating visual cues can reduce food waste among a small subset of consumers for products labelled with a "best-before" date. For products labelled with a "use-by" date, the study recommends using icons that convey a clear “stop” association, paired with the text prompt “Do not use after date” to enhance consumer understanding and compliance (ibid.). Examples of such combinations are illustrated in Figure 1 below.

Figure 1. Examples of labels incorporating visual cues to reduce food waste

Reducing Food Waste in Belgium

Belgium exemplifies the global food waste challenge, with inefficiencies observed throughout the supply chain and consumer behaviours exacerbating the issue. In Flanders, around 900.000 tons of food is thrown away each year. About a quarter happens at the household level (Braekevelt et al., 2023). A white paper from OVAM shows that the amount of edible food waste from households has increased by 5% compared to five years ago (OVAM, 2023). In Flanders, households discarded an average of 22 kg of edible food per capita per year (OVAM, 2024; Belga News Agency, 2024), and this is estimated at approximately 15 kg per year in Wallonia (Environnement Wallonie, 2022), reflecting a broader trend of high per capita waste in Belgium compared to neighbouring countries such as France and Germany (Eurostat, 2023). As OVAM stated in a press release: “if you do have to throw food away, this lost food can still be put to valuable use with organic waste collection or home composting.” However, since households still do not adequately sort food waste, it cannot be

recovered or repurposed. Ultimately, any food that ends up in the residual waste bag is destined for the incinerator (Belga News Agency, 2024).

Consumer behaviour is central to addressing food waste in Belgium. Research highlights that poor planning, over-purchasing, and confusion over food labelling ("best-before" vs. "use-by" dates) are significant contributors to household food waste, also in Belgium (Aschemann-Witzel et al., 2015; Hebrok & Boks, 2017). More than 70% of Belgians have been shown to discard food near or shortly after the best-before date, even when it remains safe to consume (FUSIONS, 2020).

Addressing household food waste in Belgium

Reducing food waste offers both social and environmental benefits. Environmentally, it mitigates greenhouse gas emissions, conserves water and energy, and alleviates pressure on land use. Socially, redistributing surplus food to vulnerable populations addresses food insecurity (Parfitt et al., 2010). Organisations like the Belgian Food Banks Federation and Rikolto play critical roles in these efforts, redistributing tonnes of surplus food annually to low-income households (Rikolto, 2023). Additionally, reducing food waste aligns with broader efforts to combat climate change and promote sustainable development (FAO, 2023).

In line with the 21 targets of the Federal Circular Economy Roadmap (as well as Circular Flanders, Circular Wallonia, and the Brussels Regional Circular Economy Strategy), further awareness-raising efforts are needed to encourage circular behaviour. Belgium has implemented several policies and innovations to combat food waste, which is first of all regulated at the EU level. Food labels in the EU, including the "best before" and "use by" dates, are regulated under Regulation (EU) No 1169/2011 on the provision of food information to consumers (commonly known as the FIC Regulation). This regulation establishes mandatory requirements for food labelling across all EU member states to ensure consumers receive accurate, clear, and understandable information about the products they purchase. Despite these distinctions, the EU recognises that many consumers misunderstand these labels, leading to unnecessary food waste. Efforts are underway to improve consumer education and revise regulations to enhance clarity. Labelling is mandatory, except for certain exemptions, such as unprocessed fresh fruits and vegetables. Acknowledging the role of date marking in contributing to food waste, under the European Green Deal's 'Farm to Fork' strategy, the European Commission intends to revise Regulation (EU) No 1169/2011 on food information to consumers (FIC Regulation). One key aspect of the proposed revisions involves updating the rules for date marking on food products ('use by' and 'best before' dates), as these are often misunderstood and misused by consumers. While the European Commission was expected to present its proposal in 2023, it has not been included in the 2024 work programme or the tentative agenda for upcoming Commission meetings. The timeline for introducing this proposal remains unclear.

The Belgian Federal Plan Against Food Waste, introduced in 2015, aligns with the UN's Sustainable Development Goals by aiming to halve food waste by 2030. Key measures include encouraging food donations, standardising date labelling, and incentivising preservation innovations (Belgian Federal Government, 2015). Innovations are increasingly taken into use by supermarkets, that now offer "ugly" produce at discounted prices, and apps like Too Good To Go and Phenix enable consumers to purchase surplus food at reduced costs, particularly in urban centres such as Brussels, Antwerp, and Ghent (Rikolto, 2023). To mark the International Day Against Food Loss on September 29, OVAM, in collaboration with De Kostwinners (a collective of partner organizations dedicated to combating food

loss), launched a campaign to intensify efforts against food waste. The "Wat-je-nog-liggen-hadGPT" tool offers Flemish residents a way to repurpose food leftovers.

The food waste landscape in Belgium is nonetheless complicated by regional disparities. Flanders' action plan (2021–2025) promotes circular food systems and mandates organic waste sorting for businesses (OVAM, 2021). Wallonia's REGAL 2.0 plan prioritises education and food redistribution platforms, while Brussels' "Good Food Strategy 2.0" (2022–2030) targets waste prevention practices in restaurants and canteens. These initiatives underscore the need for localised strategies to address the unique challenges faced by different regions. At the federal level, in late 2021, the Belgian federal government approved the Federal Action Plan for a Circular Economy (2021–2024), which includes measures to address food waste (Circular Flanders, 2021). This plan complements regional initiatives and focuses on areas under federal jurisdiction, such as product standards, consumer protection, public procurement, employment, and taxation. The plan emphasises the importance of collaboration between federal and regional authorities through the Intra-Belgian Platform for Circular Economy (IBPCE). The Federal Council for Sustainable Development has provided feedback on the plan, highlighting the need for clear objectives, timelines, and governance mechanisms, as well as addressing social challenges and regulatory barriers associated with the transition to a circular economy (Circular Economy European Platform, 2021). This federal initiative aligns with the European Commission's Circular Economy Action Plan, which aims to make sustainable products the norm in the EU and focuses on sectors with high resource use, including food (EEA, 2024).

Belgium's approach to food waste demonstrates the importance of a multifaceted strategy involving consumer education, policy reform, and technological innovation. By fostering behavioural changes, promoting innovative solutions, and strengthening redistribution networks, Belgium can serve as a model for sustainable food waste management. These efforts, combined with targeted interventions across the value chain, and particularly encouraging consumers' reduced food waste, are essential to mitigate environmental impacts and enhance food security both locally and globally.

Reducing food waste in BEvitalise: Initiatives relating to the circular economy of the food system have principally focused on production processes, while less action has been taken on food consumption. Further, coherent and clear information about the impact of products on consumer preferences is currently missing (Vermeyen et al., 2021). BEvitalise has, therefore, elicited public preferences of Belgian citizens regarding packaging and labelling – that will allow us to better understand how consumers make discarding decisions and how we can encourage them to make more informed decisions related to food waste by providing recommendations as to how it is possible to address these challenges.

2.2. THE TRANSITION TO A CIRCULAR WEEE SYSTEM

While housing, mobility, food, and fast-moving consumer goods are considered major sustainability challenges, the consumption of electrical and electronic equipment and the resultant waste electrical and electronic equipment have become the world's fastest-growing solid-waste stream. Rapid technological advancements, increased affordability, a growing variety of devices, and shorter product lifespans have fuelled the surge in production and consumption of WEEE, which, in turn, has dramatically increased WEEE generation.

Discarded WEEE contains potentially harmful materials that pollute the environment and contribute to climate change due to their production's carbon footprint. By transitioning to a circular economy, materials can be recirculated into the economic system, reducing the extraction of primary materials and minimizing waste. The Global E-waste Monitor (2020) reported an annual WEEE growth rate of 3–4%, reaching 57.4 million metric tons in 2020, a 21% increase over five years, and is projected to reach 74.7 million metric tons by 2030. In 2019, Europe led in per capita WEEE generation at 16.2 kg per person, totalling 12 million metric tons. Belgium's per capita contribution was notably high at 20.4 kg (Forti et al., 2020). Despite relatively higher formal recycling rates in Western Europe, 46% of WEEE remains undocumented, often being dumped, traded, or recycled in non-environmentally sound ways.

In addition to improperly managed WEEE, the hoarding of unused EEE presents another challenge. On average, four non-working and nine working but unused devices are stored per EU household, contributing to approximately 10 million metric tons of stockpiled equipment (Baldé et al., 2022). This practice, coupled with high consumption rates and limited repair options, results in significant environmental, economic, and social implications. For instance, consumer electronics like smartphones are resource-intensive, with 81% of their CO_2 emissions stemming from raw material extraction during production (European Economic and Social Committee, 2019).

The EU, consuming 25–30% of globally produced metals while producing only 3% domestically, relies heavily on imported raw materials. This dependence is exacerbated by unethical mining practices in non-EU countries. Unregulated e-waste disposal also poses severe health risks due to exposure to hazardous materials (Forti et al., 2020). Transitioning to a circular economy—focused on reusing, refurbishing, remanufacturing, and recycling—offers a sustainable solution. End-of-life EEE can be reintegrated into the economy, preserving value, reducing material dependency, and improving resource efficiency. Recycling one ton of mobile phones, for example, can yield significantly more precious metals than ore extraction, including 50–150 kg of copper, 500–700 g of silver, and 150–400 g of gold (Forti et al., 2020).

Why do consumers hoard electronic waste?

Consumer behaviour significantly impacts WEEE management. Many consumers store unused devices, while others opt for recycling centres, household waste, or take-back programmes. Key barriers to recycling include perceived inconvenience, data security concerns, mistrust in recycling processes, and insufficient financial incentives (Bai et al., 2018; Romagnoli et al., 2022).

Addressing these challenges requires enhancing convenience, transparency, and trust in the recycling process. Financial incentives, such as discounts or compensation, and accessible collection points can encourage participation. Exploring preferences for various electronics and region-specific behaviours, particularly in Belgium, is essential for developing effective systems (Thukral et al., 2023).

Key drivers motivating the storage of electrical and electronic devices revolve around the perceived benefits of keeping them, as well as the barriers to disposal. These benefits include the potential use of devices for backup storage, resale in the future, spare parts, data security, emotional attachment, or gifting to family and friends (Romagnoli et al., 2022; Islam et al., 2021). Barriers to disposal often involve a lack of information on proper disposal methods, distrust in the recycling process, and the inconvenience of participating in disposal (ibid.). Due to these factors, along with their compact size

that makes them easy to store, mobile phones are among the most commonly stored items in households (Islam et al., 2021).

Beyond storage, common disposal methods for WEEE include recycling through designated collection points, donations to charity or gifting to family members, selling to second-hand markets, door-to-door collection, retailer collection, and disposal with household waste (Islam et al., 2021). Various studies have found that disposal choices are influenced by consumer attitudes toward the environment (Echegaray and Hansstein, 2017), education (Maskey and Singh, 2017), and factors such as gender and age (Milovantseva and Saphores, 2013). Ultimately, disposal behaviour is shaped by consumers' awareness of and knowledge regarding available collection options. However, consumer preferences can vary based on geographic location, making it essential to consider studies specific to Belgium. Research on consumer preferences for WEEE collection services in Belgium indicates that preferences differ by product type (Mansuy, Verlinde, and Macharis, 2020). A Choice-Based Conjoint analysis conducted in Brussels reveals that collection services should be tailored to accommodate consumer preferences for different categories of products. For example, consumers show little preference for a collection service specifically for mobile phones, in contrast to other electronic devices (Mansuy, Verlinde, and Macharis, 2020).

Reducing household electronic waste in Belgium

The WEEE Directive (2012/19/EU) was recast to manage waste growth and promote the circular economy. Targets for 2019 required Member States to collect 65% of the weight of electronic equipment placed on the market in the previous three years. Despite this, many countries, including Belgium, fell short, achieving a 51% collection rate for EEE POM and 65% for WEEE generated in 2020 (Baldé et al., 2022). France’s 2021 repairability index and Belgium's forthcoming 2026 initiative aim to influence consumer choices by rating appliances on repairability, promoting sustainable consumption.

The European Commission’s 2020 Circular Economy Action Plan (CEAP) targets the entire product lifecycle, emphasising sustainable consumption, waste minimisation, and resource longevity. WEEE, containing up to 69 elements, offers a critical source of secondary raw materials. Refurbishing and remanufacturing also generate jobs and provide affordable electronics for low-income individuals, fostering social and economic benefits (Bressanelli et al., 2021).

The three regions of Belgium delegate the responsibility of waste collection to the municipalities (Recupel 2023). The majority of the municipalities are part of an intermunicipal association (intercommunales) to organise waste management (ibid.).

The value chain of waste electrical and electronic equipment (WEEE) in the Belgian market, depicted in Figures 2 and 3, encompasses six key phases: placing on the market, usage and storage, disposal (discarding), collection and sorting, reuse and treatment, and regulation, reporting, and control (Huisman, 2013). The first phase, placing on the market, involves the initial introduction of a product (European Union, 2012). This is followed by the usage and storage phase, where electrical and electronic equipment (EEE) is actively used or stored by consumers and businesses. When EEE is discarded, it transitions to WEEE, entering the disposal phase. During collection and sorting, WEEE is disposed of by consumers and businesses, and then sorted for subsequent processing. In the reuse and treatment phase, some devices are repaired, refurbished, and cleaned for resale as second-hand products within Belgium or abroad (Huisman, 2013). Devices unsuitable for reuse are treated by

operators to remove hazardous substances and recover valuable materials for recycling or other applications, while non-recoverable materials are incinerated or sent to landfills. The regulation, reporting, and control phase ensures compliance monitoring, documentation, and enforcement of WEEE-related policies. However, despite these formal processes, a portion of WEEE generated in Belgium is illegally exported to other countries, circumventing proper treatment and recycling procedures (Huisman, 2013).

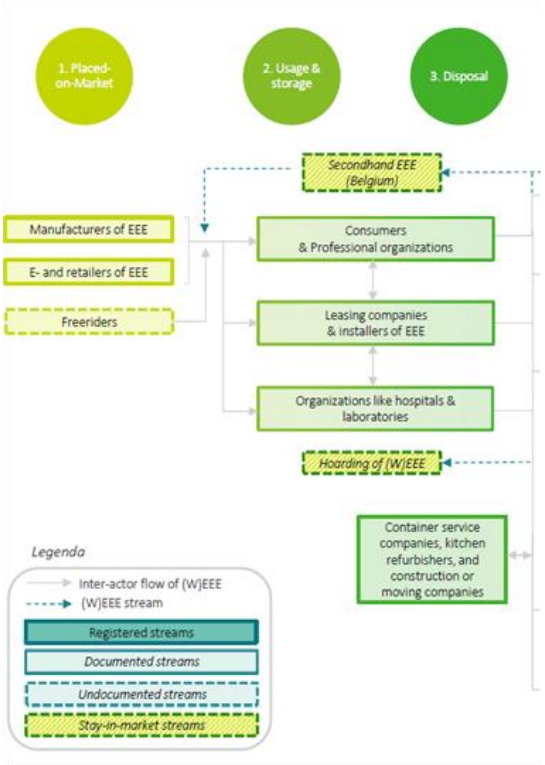

Figure 2. Value chain of waste from electrical and electronic equipment in the Belgian market. Source: Recupel (2023)

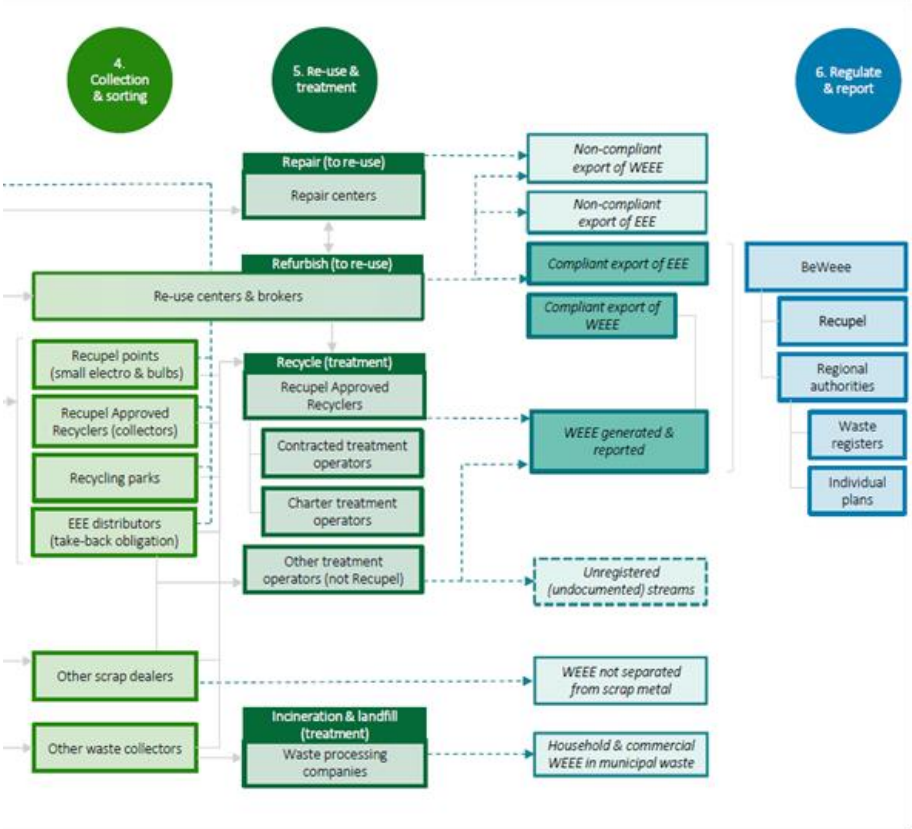

Figure 3. Value chain of waste from electrical and electronic equipment in the Belgian market. Source: Recupel (2023)

Reducing WEEE in BEvitalise: In the case of WEEE, several factors are believed to hinder the recycling of WEEE, including concerns over data security, the perceived value of products, the inaccessibility of return points, and a lack of clarity regarding proper recycling procedures. Alongside convenience, financial compensation, care for the environment, culture, and social norms, awareness are key motivators for acting on WEEE. Consumers need to be informed, while infrastructure should be easily available. While much research focuses on how consumers dispose of municipal solid waste streams, less research focuses on how consumers dispose of durable goods, such as WEEE (Mansuy et al., 2020). A major goal of BEvitalise is therefore to understand consumers' preferences for disposal of WEEE. A better understanding of consumers' preferences can provide guidance for actors involved in WEEE disposal and collection, and will allow for targeted policy approaches that allow for Belgium to reach both national and European targets.

BEvitalise gains a deeper understanding of Belgian consumers' preferences regarding the disposal of unused electronic and electrical equipment (EEE) can guide companies and the Belgian government to improve their (W)EEE collection rates. This study aims to identify factors motivating consumers to bring unused electronic devices to collection points instead of storing them at home.

The following research questions are addressed:

1. What are the preferences of Belgian consumers regarding the disposal of unused laptops and mobile phones?

2. Does the type of device (laptop or mobile phone) influence these preferences?

To answer these questions, a Discrete Choice Experiment (DCE) was conducted for both device types. Laptops and mobile phones were chosen as they are the most commonly "hibernated" EEE products (Islam et al., 2021). While organisations often provide laptops to employees, interviews with IT team leads at a university and a private company revealed that 60–90% of employees opt to retain their work laptops for personal use after the predefined work period. Consequently, consumers, not organisations, are responsible for their disposal.

This research aligns with United Nations Sustainable Development Goal (SDG) 12: Responsible Consumption and Production, which emphasises sustainable resource management and waste reduction through prevention, recycling, and reuse. By examining consumer behaviour towards unused EEE disposal, the study contributes to the development of efficient collection systems, reducing e-waste and promoting the recycling and reuse of valuable materials. This helps conserve resources, reduce environmental pollution, and support sustainable development initiatives.

Investigating Belgian consumer behaviour on food and electronic waste & reducing social desirability bias in Discrete Choice Experiments

BEvitalise develops strategies for consumer waste minimisation based on the stated preference method of discrete choice experiments (DCEs). BEvitalise has set up two discrete choice experiments within the fields of (i) food waste and (ii) waste electrical and electronic equipment. DCEs are a non-market valuation method based on repeated fictional choices made by respondents to elicit their preferences. Monetary attributes and levels can also be incorporated into a DCE, making it possible to determine a target population's willingness to pay (WTP) for, or accept (WTA), an intervention. Given the hypothetical nature of the method, respondents may overstate their WTP or WTA, and in certain cases, do not answer truthfully due to social desirability bias. BEvitalise contributes to the state-of-the-art literature by minimising these biases using targeted tools to increase the accuracy of its results (Larson, 2019).

Recent methodological developments and the state-of-the-art

BEvitalise set out to develop strategies for consumer waste minimisation based on the stated preference method of discrete choice experiments (DCEs). DCEs are a non-market valuation method based on repeated fictional choices made by respondents to elicit their preferences. Monetary attributes and levels can also be incorporated into a DCE. Therefore, it is possible to determine a target population's willingness to pay (WTP) for, or accept (WTA), an intervention.

The two DCEs that have been conducted in BEvitalise seek to provide useful insights to guide policymakers in Belgium’s transition to a circular economy. One of the principal policy strategies used to promote a circular economy is reducing consumption by influencing consumer behaviour and attitudes to circular products. Nonetheless, behaviour is deeply embedded in social contexts and habits, and is therefore highly resistant to change. Understanding this behaviour, and the trade-offs consumers face when making different circular consumption decisions, is therefore key to developing policies that seek to influence and change consumer behaviour. There is therefore a need to identify, promote, and leverage consumer behaviours that support the transition to circular economy. Conversely, we also analyse behaviours that hinder circularity, address the barriers people face, and make policy recommendations accordingly.

DCEs, used in BEvitalise, and behavioural experiments enable the isolation of the drivers of consumer choice and allow us to test how information provision influences consumer decision-making. Specifically, DCEs model consumers' choices while identifying their preferences (Louviere, 2000). The DCE assumes that respondents' utilities for a good, service, or policy are derived from the characteristics of that good, service, or policy, along with a stochastic and random element. Choices between alternatives thus reflect the utility of those alternatives, as derived from random utility theory (McFadden, 1973). Unlike a traditional questionnaire, our research identifies and values the multi-dimensional characteristics of consumer decision-making and examines the trade-offs between different dimensions regarding circular consumption patterns. BEvitalise proposes specific solutions for policymaking, including i) improved labelling and packaging design to reduce food waste and ii) enhanced collection systems to increase convenience for consumers to reduce WEEE. By encouraging producers and policymakers to adopt improved design patterns and norms, this initiative facilitates the collective convergence of practices surrounding circular economy-inspired methods and policies, accelerating the transition to a circular Belgian economy.

Given the hypothetical nature of the method, respondents may overstate their WTP or WTA, and in certain cases do not answer truthfully due to social desirability bias. BEvitalise contributes to the state-of-the-art literature by minimising these by using targeted tools to increase the accuracy of our results (Larson, 2019). This research project reduces hypothetical bias, for instance, by emphasising consequentiality (i.e. the consequence of the respondent's choices), using real products to replicate real purchasing situations, in addition to innovative reminders to respondents to behave as they normally would behave (Doyon et al., 2015).

The conceptual foundation of a DCE assumes that respondents' preferences for a good, service, or policy can be broken down into utilities derived from its specific characteristics, alongside a stochastic or random component. According to random utility theory (McFadden, 1973), choices between alternatives are driven by the utility associated with each option. The random utility framework relies on statistical design principles to create choice cards, which present various options distinguished by a set of attributes and levels. Respondents select their preferred option from a series of mutually exclusive alternatives, typically two or three. A baseline option (e.g. a status quo alternative) or an opt-out option (a "do nothing" choice) is often included to allow respondents the freedom not to choose if none of the presented options is preferable or if they find them less desirable than their current situation (Bjornavold, 2021). DCEs offer several advantages, as detailed below:

Selected strengths of discrete choice experiments and why they are used in BEvitalise

- Unlike traditional surveys, DCEs generate a relative ranking of attribute importance, enabling policymakers to identify and prioritise key barriers and facilitators to change. This insight helps refine policies and strategies to address specific challenges more effectively.
- DCEs excel in contexts where change involves multiple dimensions and understanding trade-offs between these dimensions is essential. They can identify and quantify the value of individual characteristics (attributes and levels) of a good, service, or policy, making them particularly useful when policymakers need measures of specific policy elements (Holmes et al., 2017).
- DCEs can estimate the value of changes in public goods, including environmental services and health outcomes, especially where revealed preference data is unavailable. They are also

capable of estimating non-use and use values for changes outside current market or observed conditions (Johnston et al., 2017).
- The format of DCEs allows customisation of choice sets to reflect realistic scenarios that respondents may face, enhancing relevance and applicability (Holmes et al., 2017).
- DCEs provide rich data, as respondents repeatedly express preferences for a good, service, or policy across varying conditions, such as different payment levels.

Although DCEs are practical for valuing non-market goods and when direct preference elicitation is not feasible, their results should be interpreted cautiously. Hypothetical bias—a common limitation of DCEs—can arise when respondents overstate their willingness to pay (WTP) due to the hypothetical nature of the choices. To address this, reliability and validity tests should be integral to DCE studies.
Socially desirable responding is an additional concern for all survey-based research and as such – stated preferences research, including DCEs. While respondents ideally provide honest and accurate responses, a concern relates to individuals instead of providing socially desirable responses, such as over-reporting positive behaviour or under-reporting negative behaviour. If respondents do demonstrate socially desirable responses, the validity of the results attained is compromised. Ex-ante strategies aim to reduce bias during the survey design phase by highlighting the potential consequences of respondents' choices, a concept known as consequentiality. These strategies may include offering additional payments or services and using reminders, such as "cheap talk" scripts, to encourage respondents to behave as they normally would (Doyon et al., 2015). In contrast, ex-post strategies focus on analysing data after collection to identify and address implausible responses. This can be achieved by using post-experimental questions to assess respondents' willingness to pay (WTP) or their certainty about their choices. Additionally, combining stated preference data with revealed preference data provides another effective way to mitigate hypothetical bias (Colombo et al., 2020).

As Larson (2019) explains, social desirability bias takes place when survey participants do not respond according to their attitudes, values, or behaviours. By responding differently, the participant may view certain answers as socially preferred. As such, a survey participant's answers can differ to their actual attitudes, values, or behaviours for reasons of:

1. **Impression management**: to appear better to others present, which can especially be the case in face-to-face and telephone surveys
2. **Self-deception:** to feel good about themselves
3. **Identity definition**: to conform to a certain vision the respondent has of themselves

Social desirability bias is a frequently discussed problem in the literature (Gittelman et al., 2015). As Tourangeau and Yan (2007) find, this is often found with respondents underreporting alcohol consumption, smoking, bankruptcy, criminal behaviour, and energy consumption for example. On the other hand, overreporting has also been found when it comes to voting, income, exercise, energy conservation and the purchasing of organic food for example (Brownback & Novotny, 2018; Hariri & Lassen, 2017; Larson, 2018). As BEvitalise focuses on increasing environmentally conscious behaviour on the road to a circular economy, such biases are something the project has taken seriously in the design and set-up of the project.

Direct reduction of hypothetical and social desirability bias in BEvitalise

Even though anonymous and self-administered surveys may reduce impression management compared to face-to-face surveys (Dodou & De Winter, 2014), Brenner and DeLamater (2016) found

that differences between face-to-face and anonymous surveys are slim. Social desirability bias may still exist as respondents may be looking to define their identities or feel good about themselves. To account for differences in impression management, BEvitalise has conducted its DCEs surveys both online and offline and has also used a Real Choice Experiment for food waste. The researchers will, therefore, first control for such biases in the case of face-to-face or online surveying techniques. In addition to online survey distribution, the data collection occurred at supermarkets and train stations at various times of the day and week.

Increasing the cognitive load of subjects (e.g. asking them to remember a set of numbers) has also been shown to reduce bias (Stodel, 2015). One challenge regarding DCEs lies in the cognitive burden placed on respondents relating to complex choices between alternatives, attributes and levels. Respondents usually fare better when faced with fewer easier trade-offs, and such response bias can be avoided with careful design. Nonetheless, given that discrete choice experiments are complex, we will avoid adding to this cognitive load and can conject that their inherent complexity can reduce social desirability bias. Moreover, ensuring respondent anonymity to avoid identity definition and including questions that can neutralise answers that make the respondent appear socially responsible may help in reducing social desirability bias (Larson, 2019).

As mentioned above, a known limitation of DCEs relates to their hypothetical nature, leading to the risk of hypothetical bias. Without an economic commitment on behalf of the participants in the study, results can be tarnished by inconsistencies and over-estimation of both general and individual willingness-to-pay estimations (Bazzani et al., 2017). To also mitigate the potential for hypothetical bias, BEvitalise uses Real Choice Experiments (Gracia, 2014; Hung and Verbeke, 2018), where real products are used. By allowing and incentivising participants to behave in a way that they normally would behave in a purchasing decision, the DCE will increase the consequence of the respondent's choices and, in turn, the consequentiality of the survey. As discussed above, emphasising consequentiality reduces the hypothetical bias of DCEs (Doyon et al., 2015).

3. METHODOLOGY

3.1.1. METHODOLOGY OF THE FOOD WASTE STAKEHOLDER ANALYSIS

A stakeholder analysis and impact assessment was conducted to identify and gather data on the key players in the field of food waste in Belgium. This decision-support tool is commonly used to understand the roles of individuals or organisations that are impacted by, can influence, or have a vested interest in decision-making (Bendtsen et al., 2021). The analysis relied on desk research, including reports and governmental action plans, to gather information on stakeholders involved in the circular economy, food waste, or both.

The research involved identifying websites of relevant organisations and exploring their connections to other programmes or stakeholders to compile a comprehensive list of contacts. The identified organisations were categorised based on their business structure – profit, non-profit, public, private, or research institute – as well as the regions in which they operate. Following data collection, a power-interest matrix was created to determine the extent to which these stakeholders should be engaged in related projects, thus determining their potential impact.

The results of this analysis informed recommendations for the project's further development, including the validation of the project's policy recommendations. Stakeholders mapped were involved in the formulation and validation of the project's final policy recommendations.

3.1.2. METHODOLOGY OF THE FOOD WASTE DISCRETE CHOICE EXPERIMENT

Theoretical Framework

To understand consumers' valuation of food items they are about to discard, it is impossible to use revealed preference data for several reasons. Firstly, these decisions are made in private, so no data is available on households' decision-making process when discarding food items and understanding decisions made related to wasting food. Thus, stated preference methods are needed to elicit these preferences. As discussed in section 2, conducting a DCE is the optimal method in this context. The theoretical framework for the food waste experiment study is grounded in the concept of a referendum discrete choice experiment, a method that presents respondents with a binary decision: to support or oppose a particular option (Carson et al., 1998). In this DCE, participants are faced with a straightforward choice concerning a food product—cooking cream—and deciding whether to use it or discard it. Cooking cream was chosen as the product in the DCE because it is a basic consumer product with a bestbefore date that is widely used and known in Belgium. This belief was later confirmed in the retrieved sample, where 85.71% claimed they use cooking cream. Dairy products are also a highly wasted product in Belgium (Criel & Fleurbaey, 2019). This framework aligns with the binary outcomes associated with the proposed policy measures, which aim to assess the effectiveness of strategies designed to reduce household food waste (Rolfe & Bennett, 2009). It is essential to recognise that increasing the number of alternatives can complicate decision-making. To mitigate this complexity, it is advisable to limit choices, thus preventing respondents from feeling overwhelmed (Weng et al., 2021).

In our study, the status quo option is represented by the decision to either retain or discard the cooking cream. Simplifying the choice structure enhances response efficiency, as fewer, less complex trade-offs yield more accurate and reliable responses (Johnson et al., 2013). Research suggests that greater choice complexity can lead to random errors and imprecision in responses (OECD, 2018), often resulting from respondent fatigue when faced with an excessive number of options (Bech et al., 2011). Considering these factors, we have adopted a referendum DCE methodology to inform and support potential policy recommendations aimed at mitigating food waste.

Experimental Design
Referendum Discrete Choice Experiment

The experimental scenario instructed respondents to imagine themselves in December 2023, the survey deployment period, preparing a dish that required cooking cream. Upon opening their refrigerator, they discovered an existing pack of cooking cream alongside a new pack. Respondents had to choose between using the cream in the fridge or discarding it in favour of the newer option. Each choice set presented respondents with a cooking cream characterised by unique attribute levels, requiring them to weigh the decision between option 1 (using the existing cooking cream) and option 2 (discarding it in favour of the new one). They were provided with the following statement:

"It's December 2023. Imagine you're in your kitchen, ready to cook a dish that needs cooking cream. As you open your fridge, you find a package of cooking cream. Do you choose to ***use this package of cooking cream*** *for your dish, or do you decide to* ***throw it away and grab a new package?*** *You have a new package of cooking cream available in your house."*

Figure 4. The hypothetical scenario presented to respondents in the food waste DCE

The choice of cooking cream as the focus product for the DCE stems from its status as a widely used and familiar consumer item in Belgium, a fact confirmed by the survey sample, where 85.71% of respondents reported regular use of cooking cream. Furthermore, dairy products are known to be one of the most wasted food products among Belgian consumers.

Attributes and Levels

Each participant encountered six distinct choice cards, each comprising two options. The limited number of choice cards was intentionally designed to minimise cognitive burden, thereby enhancing the quality of responses. Respondents were assigned to one of three blocks, each containing six unique choice cards, culminating in a total of 18 unique cards.

The experimental design—including the selection of attributes and their respective levels—was guided by the findings of van den Berg (2023) and finalised by Dr Anougmar, Dr Van Schoubroeck, and Dr Bjornavold, based on findings from a focus group with Belgian consumers and a pilot study conducted with 120 respondents. An overview of the four attributes, their definitions, and corresponding levels is provided in Table I. The DCE design was optimised for statistical efficiency based on the D-efficiency paradigm.

TABLE I. ATTRIBUTES AND THE CORRESPONDING LEVELS OF FOOD WASTE DCE

Attributes	**Definitions**
Best before date	This is the best before data of the cooking cream, which will be indicated on the packaging in supermarkets. • November 2023 (“a month ago”) • December 2023 (“this month”) • June 2024 (“in 6 months”)
Type of label	This is the type of label on the packaging of the cooking cream that indicates until when the cream is safely consumable. • No information

	• "Look, smell and taste after the best before date."
(Un)Opened	Indicates whether or when the cooking cream has been opened. • Unopened • Opened 2 days ago • Opened 3 days ago • Opened 7 days ago
Packaging	Indicates in what type of packaging the cooking cream will be sold in, in the supermarket. • Plastic • Can • Carton

An example of a choice card can be seen in Figure 5. With each choice card, a link to Table I and the explanation of the hypothetical scenario could be found if the respondent required a comprehensive review of all the facts again.

Figure 5. Choice card example from the food waste DCE: this choice card comes from the Dutch version of the survey

3.1.3. THE REAL-LIFE EXPERIMENT ON FOOD WASTE TO REDUCE SOCIAL DESIRABILITY BIAS IN STATED PREFERENCE SURVEYS

As mentioned above, to mitigate the potential for hypothetical bias, BEvitalise additionally used what is referred to as Real Choice Experiments (RCEs) (Gracia, 2014; Hung and Verbeke, 2018), where real products are used. By allowing and incentivising participants to behave in a way that they normally would behave in a purchasing decision, the DCE will increase the consequence of the respondent's choices and, in turn, the consequentiality of the survey. As discussed above, emphasising consequentiality reduces the hypothetical bias of DCEs (Doyon et al., 2015). In addition, to control for social desirability bias, we conducted the survey both online and offline in the case for the RCE.

A Best-Worst Scaling (BWS) experiment was conducted in a real-world supermarket context. BWS allows consumers to select both the best and worst options from a set of alternatives, a task more natural than rating on a scale (Van Schoubroeck et al., 2023). Introduced by Finn & Louviere (1992), BWS assumes that extreme choices are made reliably, consistent with adaptation level theory (Louviere et al., 2013). BWS has been applied in food label research, such as McLeod et al. (2023), who used it to examine how consumer preferences for sustainability labels shift based on provided information. There are three BWS types: object, profile, and multi-profile. In object-based BWS (Case 1), respondents select the best and worst from a set of objects without detailed attribute descriptions, making it ideal for simple, routine decision-making (Flynn & Marley, 2014).

For this project, the object-based approach was used. Respondents chose the best and worst attributes from decision sets, with the number of sets determined by their cognitive capacity. The data were collected and analysed using counting or modelling methods (Aizaki & Fogarty, 2023). BWS experiments often use a "balanced incomplete block design" (BIBD) to ensure alternatives appear equally often without fatigue (Louviere et al., 2013; Wakeling & D., 2001).

In this experiment, ten distinct packages (two packaging types and five labelling alternatives) were shown five times across ten subsets. Respondents selected which package they would keep the longest and shortest after the expiration date. The order of the alternatives and subsets was randomised to avoid positional bias. Data analysis used both counting and modelling approaches. The counting method calculates Best (B), Worst (W), and Best-Worst (BW) scores (Flynn & Marley, 2014), with individual scores determined by subtracting the number of times a package was chosen as the worst from the best (White, 2021).

Preparation of Packages: To eliminate bias, each package is neutralised by removing brand names and labels. Packages are painted white, leaving only the type of packaging and date label visible. Five different 'best-before' date labels, derived from literature and public consultation by the European Commission, are applied:

	English version of date labels	Dutch version of date labels
1	Best before 1/5/2024	Ten minste houdbaar tot 1/5/2024
2	Best quality before 1/5/2024	Beste kwaliteit voor 1/5/2024
3	Best before 1/5/2024. Then check look, smell, taste	Ten minste houdbaar tot 1/5/2024. Hierna kijk, ruik, proef
4	Best before 1/5/2024. Often good after	Ten minste houdbaar tot 1/5/2024. Vaak goed na
5	Best before 1/5/2024	Ten minste houdbaar tot 1/5/2024

These labels are applied to two types of packaging (glass and carton), resulting in ten distinct package types for the experiment. This design allows us to assess consumer understanding and preference for different date labels, addressing the misinterpretation of 'best-before' dates that contributes to food waste (Philippidis et al., 2019).

Data collection

Ten sets of five packages were shown to participants in different locations. People were asked to voluntarily participate in the experiment. By scanning a QR-code people were able to take the survey. The survey was developed in Qualtrics. First, they needed to fill out questions on the use of cooking cream in their daily life as well as questions on how environmentally friendly they perceive themselves. Next the BWS questions were shown and finally a series of demographic questions was listed. Three different locations were considered for organising the experiment, two different supermarkets and the weekly outdoor market. This decision was made given the direct link with food. The experiment was organised at the following locations: Jumbo Tessenderlo (supermarket), Theaterplein Antwerp (open-air market), and Delhaize Oostende (supermarket). At Jumbo Tessenderlo the stand was located near the entrance and exit while at Delhaize Oostende the stand was in the supermarket near the dairy and bread section. At Theaterplein Antwerpen, the stand was located at the food and drinks section of the market.

Figure 6. Experiment stand with Master's student Stefanie Caenen at Jumbo Tessenderlo

3.2.1. METHODOLOGY OF THE ELECTRONIC WASTE STAKEHOLDER ANALYSIS

A stakeholder analysis and impact assessment was carried out to identify and gather data on key players in the field of electronic waste management in Belgium. This decision-support tool is widely used to understand the roles of individuals or organisations affected by, capable of influencing, or holding a vested interest in decision-making processes (Bendtsen et al., 2021). The analysis was based on desk research, including reports and governmental action plans, to collect information on stakeholders involved in the circular economy, electronic waste management, or both.

The research involved identifying the websites of relevant organisations and exploring their connections to other programmes or stakeholders to compile a comprehensive list of contacts. These organisations were categorised by their business structure – profit, non-profit, public, private, or research institute – and by the regions in which they operate. Subsequently, a power-interest matrix was developed to evaluate the degree to which these stakeholders should be engaged in related projects, helping to determine their potential influence and importance.

The findings of this analysis will guide recommendations for the project's further development and will remain available for use in subsequent phases. Stakeholders mapped were involved in the formulation and validation of the project's final policy recommendations.

3.2.2. METHODOLOGY OF THE ELECTRONIC WASTE DISCRETE CHOICE EXPERIMENT

The study perspective is based on the research question – "What are the discernible preferences among Belgian consumers regarding the disposal of their unused laptop or mobile phone at a collection point?" – and the research objective, i.e. understanding what could motivate consumers to bring their old electronic devices that they no longer use to collection points, instead of keeping them at home. Based on the study perspective, a hypothetical scenario is created, in which the respondents will have to make their choices on disposing of electrical equipment stored at home. The following scenario was presented to the respondents (in Dutch and French):

"You found a laptop/phone last week while cleaning up at home that you no longer use. In the meantime, you have already stored all the data (e.g. photos, documents) you want to keep somewhere else, and are now considering getting rid of your old laptop/phone. Suppose you do not plan to resell or give the old laptop/phone to anyone."

The scenario underwent iterative adjustments to enhance its realism. Initially, it included a reference to the original purchase price of the laptop (or phone). However, this detail was omitted since not many people would recall the initial cost of their device, particularly after prolonged use. This modification also aimed to increase the scenario's generalisability depending on the type of equipment have in their homes. Additionally, the statement "You have already stored all the data… and now want to get rid of your laptop" was changed to "…and are now considering getting rid of your old laptop." The original wording risked biasing respondents towards a forced decision between the two alternatives to hand in their old device, potentially overlooking the option to retain it at home (the status quo).

To minimise the hypothetical bias, which is typical of a DCE, a combination of several of the previously mentioned techniques were used. The techniques were chosen based on their feasibility and the implied cognitive burden they impose on respondents through extra information, questions, or tasks. First, to increase the realism of the hypothetical scenario described earlier, an illustration depicting a

person finding an old laptop or mobile phone was shown in combination with the hypothetical scenario. The illustration tried to make respondents more immersed in the scenario. Next, right before respondents were shown the choice sets, they were asked to indicate their 'actual' choices: "Take your time and make your choice based on what you would actually do in the situation as previously described, not what you think would seem best. There are no right or wrong answers, only your personal and sincere response is essential to the quality of our research." This statement also tried to address the social desirability effect by encouraging respondents to provide their personal, individual insights. Lastly, a variation of referencing designs was employed to address the respondents' possible familiarity with the situation in question. Since the preferences of disposal for both laptops and mobile phones are studied, the survey started with questions asking which of the two devices respondents kept at home or possessed (if respondents wouldn't have any of these lying at home). Based on their answers, the respondents were directed to either the choice experiment on laptops or mobile phones. Through this survey design, contextual realism could be enhanced.

Final selection of attributes

Based on the iterative feedback collected in focus groups conducted with experts and a focus group with consumers, the following six attributes were selected for the DCE: type of collection point, method of handing in, data removal, next use, compensation price, and compensation mode. Although the 'interaction' attribute received a low relevance score from the focus group participants, it was clear they preferred a self-service system for handing in their old devices. It was assumed that the attribute's name was misleading and that participants did not find interaction with an employee important, but rather valued the self-service system. Therefore, the attribute was included in the final selection, but redefined as 'type of drop-off.' The attribute 'data security' was redefined as 'data removal' to emphasize the guarantee of personal data removal. Lastly, the compensation mode 'eco voucher' was changed to 'electronic voucher.' The final selection of attributes and levels, as it was shown to respondents in the experiment, can be found in the table below.

TABLE II. FINAL ATTRIBUTES AND LEVELS SELECTED FOR THE ELECTRONIC WASTE DISCRETE CHOICE EXPERIMENT

Attributes	Definitions and levels
Collection point	This is the location where you hand in your old laptop The 4 collection points in our experiment are the following: • **Supermarket** • **Electronic store** • **Second-hand store** • **Container park**
Type of drop-off	This is how you hand in your old laptop at the collection point. The 2 types of drop-off in our experiment are the following:  **Deposit machine:** you *independently* hand in the laptop at the collection point (similar to a deposit machine for glass bottles).  **Staff member**: you hand over the laptop to an *employee* at the collection point.
Data removal	This refers to the possibility of receiving a certificate that guarantees the deletion of your data (e.g., photos, documents) after turning in the old laptop. Whether or you not you get a certificate is indicated in our experiment by:  **Guarantee** of data removal  **No guarantee** of data removal
Next use	This is the purpose for which the old laptop will be used after it is returned. The 4 purposes for which the laptop can be used afterwards in our experiment are:  **Reused by individual:** the laptop is refurbished and subsequently sold to an individual.  **Reuse by charity:** the laptop is refurbished and then reused by charity.  **Recycled**: the raw materials are retrieved from the old laptop to be reused.  **No information** available about the next use.
Compensation price	This is the compensation amount you receive after you hand in your old laptop. De 4 amounts in our experiment are: • **€0** • **€5** • **€10** • **€20**
Compensation mode	This is how you will receive the compensation price after you hand in your old laptop. The 4 compensation modes in our experiment are:  **Cash**  **Electronics voucher** that you can use when purchasing an electronic product.  **Environmental donation:** the amount is automatically donated to an environmental organization.  **None**, when the compensation price is €0.

The experimental design of the WEEE discrete choice experiment

For this DCE, the software programme Ngene was used to generate the choice sets based on an efficient design. Prior parameters were selected based on the pilot study conducted on mobile phones as part of the BEvitalise pilot study done for the WEEE DCE a year earlier.

The choice sets were presented in a pair-wise format. Additionally, a status quo option was included, enabling respondents to retain their existing device at home and thereby avoid forced choices. An unlabelled design was adopted, wherein the alternatives within a choice set were generic (e.g. Option A and Option B). This approach was chosen because the alternatives for returning an old device did not exhibit distinct characteristics.

A total of 12 choice sets, divided into two blocks, were generated. The number of choice sets was determined as the least common multiple of the number of attributes (6), levels per attribute (2 and 4), and alternatives (2). These 12 choice sets were identical for both the mobile phone and laptop experiments. To reduce cognitive load and minimise the risk of participant fatigue during the choice experiment, the choice sets were divided into two survey versions, each containing six choice sets. Participants were randomly assigned to one of the two blocks.

The figure below illustrates an example of a choice set. Pictograms representing the attribute levels were included to enhance understanding.

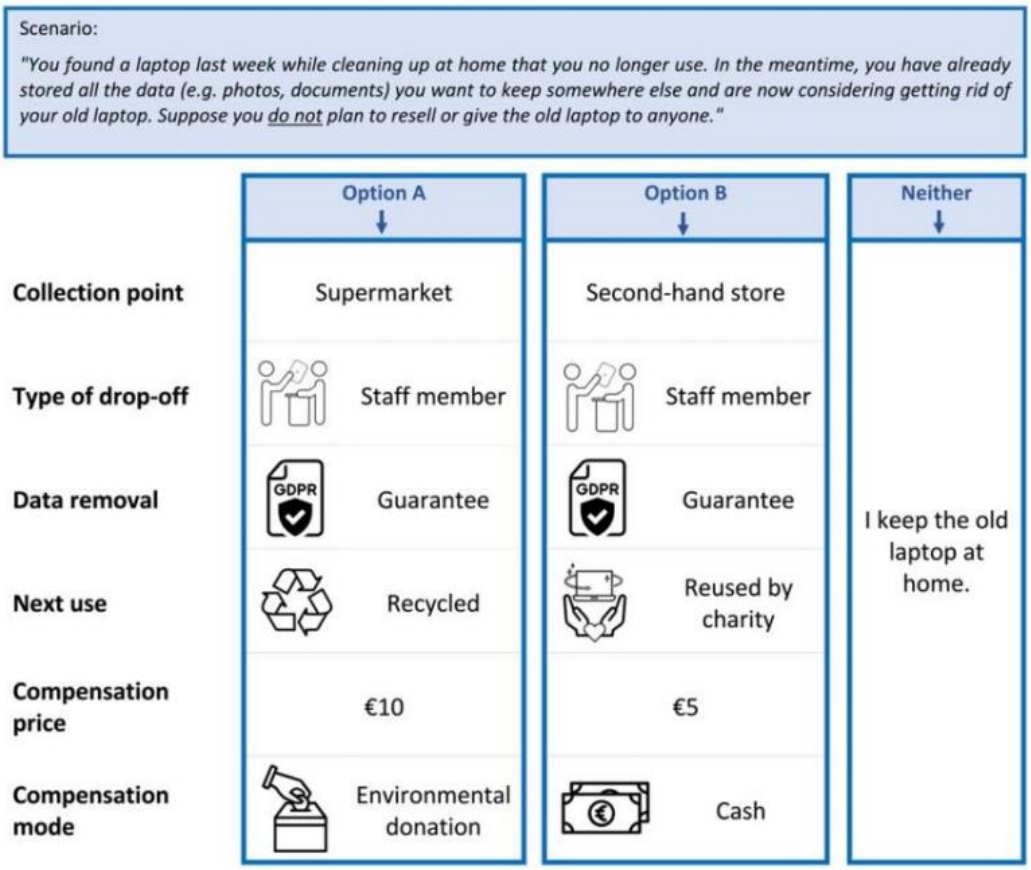

Figure 7. Example of (translated choice set) presented to respondents in the electronic waste DCE

Development of the questionnaire

The discrete choice experiment formed part of a broader questionnaire consisting of six sections. The first section assessed respondents' eligibility by enquiring whether they owned a mobile phone or laptop. The second section gathered information about respondents' current circumstances, such as whether they retained an old phone or laptop at home, details about these devices, and their current behaviour related to the study, including the frequency of purchasing new laptops or phones.

The third section included questions designed to capture respondents' environmental attitudes, such as membership in environmental groups. Including these questions in DCEs is recommended to better characterise respondents' behaviour (Johnston et al., 2017), as a positive environmental attitude typically correlates with a greater likelihood of engaging in pro-environmental practices. For instance, individuals who express concern for nature are more likely to participate in environmentally beneficial

activities, such as recycling (Faccioli et al., 2020). To date, most stated preference studies incorporating environmental attitudes have sought to link them to WTP (willingness to pay) values for environmental conservation (see examples in Faccioli et al., 2020). However, there is ongoing debate regarding whether environmental attitudes reliably predict WTP values. While findings generally indicate a positive association, some studies suggest these attitudes are not significant determinants (Faccioli et al., 2020). Moreover, despite their potential correlation with WTP, environmental attitudes alone often prove insufficient to predict actual behaviour. This suggests that individuals may perceive the environmental good as a cause worthy of support, rather than something they are personally willing to pay for (Börger & Hattam, 2017).

The fourth section introduced the choice experiment. First, the hypothetical scenario, attributes, and levels were described in detail, which is crucial to minimise the risk of respondents making unobservable assumptions about the attributes and levels in the choice sets (Bridges et al., 2011). The choice sets were presented to respondents in a random order to mitigate any bias arising from the sequence in which they appeared (Mangham et al., 2009). Following the choice experiment, respondents were asked a series of reflection questions to assess their understanding of the choice sets and determine whether they had considered all attributes in their decisions (Johnston et al., 2017). Finally, sociodemographic characteristics were collected.

Once developed, the questionnaire was pre-tested by BEvitalise project experts and a small sample of target respondents to evaluate the clarity of the choice experiment and ease of comprehension, as recommended by Mangham et al. (2009). Based on their feedback, adjustments were made to the presentation of the attribute and level descriptions and the wording of some questions in other sections of the questionnaire.

4. SCIENTIFIC RESULTS AND RECOMMENDATIONS

4.1. RESULTS OF FOOD WASTE STUDY

4.1.1. RESULTS OF FOOD WASTE STAKEHOLDER ANALYSIS AND IMPACT ASSESSMENT

A stakeholder is defined as an organisation that influences or is influenced by organisational activities within this context (Kujala et al., 2022). Identified stakeholders can provide valuable insights into the strategies currently employed to manage food waste, thereby helping to determine which policies could be most effective for implementation. Stakeholders were engaged at various stages of the project to validate and refine findings, as well as to introduce alternative perspectives that may need consideration. Table III presents an overview of the 64 stakeholders identified and the corresponding data collected.

TABLE III. Stakeholder mapping for Belgian stakeholders relevant to food waste

Organisation	**Type**	**Region**
BAL	Non-Profit	Wallonia
Belgische Federatie van Voedselbanken (BFVB)	Non-Profit	Belgium
Bond Beter Leefmilieu (BBL)	Non-Profit	Flanders
Canopea	Non-Profit	Wallonia
Circular Wallonia	Public	Wallonia
Comeos	Non-Profit	Belgium
De Kostwinners	Non-Profit	Flanders
Delhaize	Private	Belgium
Écoconso	Non-Profit	Wallonia
Ecolo	Political party	Wallonia
EIT Food	Non-Profit	Belgium
Empty My Fridge	Non-Profit	Belgium
enVie	Non-Profit	Belgium
FAO	Public	United Nations
FAVV-AFSCA	Public	Belgium
FEVIA	Non-Profit	Belgium
Flanders' FOOD	Research Institute	Flanders

Foodbag	Private	Belgium
FoodWIN	Non-Profit	Belgium
Foresightee	Private	Belgium
Froenten	Non-Profit	Flanders
Groen	Political Party	Flanders
Hello Fresh	Private	Belgium
Herw!n	Non-Profit	Flanders
Hogeschool VIVES	Research Institute	Belgium
ILVO	Public	Flanders
in BW	Private	Walloon Brabant
Indaver	Private	Belgium
Intradura	Non-Profit	Flemish Brabant
Ipalle	Public	Wallonia
Leefmilieu Brussel	Public	Brussels
Lidl	Private	Belgium
Listonic	Non-Profit	Belgium
Manger Demain	Non-Profit	Wallonia
No Waste	Non-Profit	Belgium
OLIO	Non-Profit	Belgium
OVAM	Public	Flanders
Phenix	Non-Profit	Belgium
Political Parties	Public	Belgium
Private Consumers	Private	Belgium
PVDA	Public	Belgium
Renewi	Public	Belgium
REO Veiling	Private	Belgium

Restaurants	Private	Belgium
Service Public Wallonie (SPW)	Public	Wallonia
Supermarkets	Private	Belgium
Test Aankoop	Research Institute	Belgium
TooGoodToGo	Private	Belgium
Universities	Research Institute	Belgium
VBAMT	Non-Profit	Flanders
VBB	Non-Profit	Brussels
Velt vzw	Non-Profit	Flanders
VITO	Research Institute	Flanders
Vlaanderen Circulair	Public	Flanders
VLACO	Non-Profit	Flanders
VLAM	Public	Flanders
VMM (Vlaamse Milieumaatschappij)	Public	Flanders
Voedselteams	Non-Profit	Flanders
WWF	Non-Profit	Belgium

Description of the stakeholders

In addition to this table, descriptions of the stakeholders' activities are put together to see in which specific ways they (can) contribute to the reduction of food waste. The stakeholders in this analysis have different functions and focus within this context, so it is useful to have information about their main interests. This list of stakeholders has been reviewed and validated by a member of the BEvitalise follow-up committee from FoodWIN.

Belgische Federatie van Voedselbanken – BFVB (https://www.foodbanks.be)
[Belgian Federation of Foodbanks]
Companies with large food surpluses often donate these products to the food bank. They will then sort and distribute the goods to people that can't afford to sustain themselves based on their (lack of) income. In this way, food banks help reduce wasted food and play an important societal role as a voluntary system that provides goods for the people in need.
Examples of Belgian food banks are **BAL**, **VBAMT,** and **VBB.**

Bond Beter Leefmilieu – BBL (https://www.bondbeterleefmilieu.be)
[Bond Better Living Environment]

BBL supports and unites different types of environmental- and nature associations, citizens, governments, and companies in their switch towards a more sustainable society based on a circular economy. They work with these parties to initiate and realize sustainable, achievable, and innovative solutions for current transition challenges, focusing on energy, agriculture, nutrition, mobility, and landscape planning.

Canopea (https://www.canopea.be)
As a federation of environmental associations, Canopea represents 130 organisations that initiate different types of actions ranging from locally to internationally focused projects. With a focus on accelerating the ecological transition, they monitor public policies and proposals to implement innovative solutions in these plans and try to improve democratic participation in decision-making.

Circular Wallonia (https://economiecirculaire.wallonie.be)
This department of the Walloon government is focused on the transition towards a circular economy and provides resources for implementing various solutions. These recommendations apply to different fields of work and are not solely related to food waste; however, more specific guidelines should be found in their agenda.

Comeos (https://www.comeos.be)
This company serves as an association and representative for the Belgian trade market regarding food and non-food items, where members have excess to their platform of expertise. It provides a network to discuss decision making within this sector, or to brainstorm about new projects. They also support in closing agreements between different trade links.

De Kostwinners (https://dekostwinners.be)
This platform provides tips and information to motivate consumers to minimize their food waste in various ways by keeping them up to date via email. Partners of this initiative (launched by the Flemish government) are, for example, **Too Good To Go**, **VLACO**, **Flanders' FOOD**, **Herw!n**, **FoodWIN**, and **VLAM**.

Écoconso (https://www.ecoconso.be)
This organisation encourages eco-consumption that respects both environment and health. By providing information per product category on ways to implement more sustainable choices in consumers' behavior, they spread awareness on the topic and initiate campaigns to stimulate sustainable development with their focus on consumption.

EIT Food (https://www.eitfood.eu)
This pan-European organisation creates connections within the current food system to stimulate new ideas and inventions that can change the food sector. Co-funded by the European Union, they focus on accelerating innovation to generate a future-fit food system that can provide healthy and sustainable nutrition for everybody.

Empty My Fridge (https://www.emptymyfridge.com)
The app developed within this initiative can be used to track the expiration dates of the foods that consumers have in their fridges, so they have an overview of the products they still have at home while doing groceries. Furthermore, the app provides recipes that combine almost outdated items to reduce the amount of bought food wasted in households.

enVie (https://www.envieatelier.be/en)
To prevent vegetables from being wasted, enVie initiated a company that prepares soups made from the surpluses of Belgian farmers and retailers.

The team consists of people who are (re)entering the labor market after a long-term period of unemployment, which also has a positive social impact.

Food and Agriculture Organisation of the United Nations – FAO (www.fao.org/home/en/)
The goal of this agency is to realize a world without hunger and poverty. The amount of food meant for consumption that is wasted yearly has become a field of interest for this organisation. By conducting research and providing information about these topics, it has become an important stakeholder for the United Nations. The State of Food and Agriculture (SOFA) is one of FAO's annual major publications.

FAVV-AFSCA (https://www.favv-afsca.be)
The FAVV (Flemish department) or AFSCA (Walloon department) is the Belgian federal agency for the safety of the food chain that monitors the safety and quality of our products.
To do so, they have multiple laboratories that analyze a range of products and provide a database of companies that meet their conditions.

FEVIA (https://www.fevia.be/nl)
The federation of the Belgian food industry represents Belgian food producers to guide them towards a more sustainable production approach. Divided into 27 sectors and including over 700 production companies for qualitative foods and drinks, this group of producers covers almost 90% of the employee turnover of the Belgian food production market.

Flanders' FOOD (https://www.flandersfood.com/en)
This platform for the Flemish agri-food industry supports its members in finding innovative solutions for sector-related improvements in their companies. They play a key role in exploring and implementing those solutions by providing research- and/or financial support for and in collaboration with the involved parties.

FoodWIN (https://foodwin.org)
With its team of experts, this nonprofit focuses on preventing food waste in collaboration with various organisations.
By providing information on possible strategies and the motivation to look for new possibilities, they try to reduce the pressure on our valuable resources and, for this reason, prefer prevention over redistribution.

Foresightee (https://www.foresightee.com)
Foresightee provides a logistic system for companies to forecast their stocks more accurately to prevent food from piling up in the distribution chain because of wrong estimations.
As a partner of **Vlaanderen Circulair**, Imex Istart, and the European Commission, this team has established a machine learning algorithm suitable for large-scale companies.

Froenten (no website available)
In the Froenten application, users – in this case targeted at individual consumers – can see the harvest season for certain fruits and vegetables and how to preserve them.
This stimulates the consumers only to buy products that are in season and can be locally found. As a result, transport costs and the environmental impact of importing those products from foreign countries can be reduced.

Besides **Froenten** and **Empty My Fridge**, there are other consumer apps, such as **Listonic** (an app for making grocery lists), **No Waste** (an app to track the foods you

have still left at home) and **Phenix** (an app focused on avoiding throwing out food surpluses) that also focus on reducing consumer food waste.

Hello Fresh (https://www.hellofresh.be)
Founded as a service that delivers prepacked fresh ingredients and an included recipe, Hello Fresh sparked the convenience of getting pre-planned meals delivered at home. Since customers can choose the number of dishes they want per week, this system prevents the overconsumption of food by adjusting the portions to the desired schedule. A comparable Belgian service – with a similar approach – would be **Foodbag** (https://www.foodbag.be)**.**

Herw!n (https://herwin.be)
Herw!n is committed to supporting the realization of social relations based on the transition to a circular economy by connecting various entrepreneurs that work around this topic. As an advocate and interlocutor between these local employees and government agencies, they currently represent over 10.000 staff members that strive toward a sustainable society.
One of the projects that are realized by this organisation is FLAVOUR.

Instituut voor Landbouw-, Visserij-, en Voedingsonderzoek – ILVO
[Flanders Research Institute for Agriculture, Fisheries, and Food] (https://ilvo.vlaanderen.be)
The Flemish government's independent scientific research department gives insight into the latest developments regarding agriculture, fisheries, and nutrition. By performing interdisciplinary research, they aim to optimize sustainable development within different types of sectors to gain maximal benefits from this transition.

in BW (https://www.inbw.be)
As an innovative economic and environmental partner, in BW responds to the needs of local partners and customer-consumers.
Their main focus is on adapting to the constantly changing landscape of digitalization and decarbonization by providing a public service for water storage/distribution systems and the collection/sorting of waste.

Indaver (https://www.indaver.com)
This municipal facility provides the collection, processing, and recuperation of waste materials. Indaver sorts out the waste that gets collected in different types of garbage bags and is responsible for the processing of compostable food waste. By adapting to the most recent technologies, they aim to achieve more sustainable waste management.

Intradura (https://www.intradura.be)
As a collection facility, Intradura is responsible for waste management in 19 Flemish-Brabant regions. They collect waste at home, remove waste from recycling parks, and empty underground garbage containers. Besides functioning as a waste facility, they also provide information for consumers to minimize their total waste.

Ipalle (https://www.ipalle.be)
Ipalle is active in the field of wastewater treatment, the collection and processing of waste, and the recuperation of energy. Monitoring different types of installations, they have access to various recycling parcs where either collected or turned in waste is allocated to an efficient processing system.

Leefmilieu Brussel/**Bruxelles Environnement** (https://leefmilieu.brussels)
[Living Environment Brussels]

This environmental- and energy administration of the Brussels Capital Region focuses on the making and execution of policies regarding the sustainable environment in Brussels. It aims to improve the quality of life within this region by facilitating the transition towards a more ecologically, ethically, and socially just society.

Manger Demain (https://www.mangerdemain.be)
The Manger Demain – Eating Tomorrow – strategy has been introduced in Wallonia to facilitate local food initiatives that provide quality food and that ensure the preservation of the environment. Farmers and other actors that strive for a more sustainable food system are connected and included in projects regarding for example more sustainable catering.

OLIO (https://olioex.com)
This organisation provides a platform for neighbors to connect with each other or with local businesses to share their food surpluses. By giving the option to exchange leftovers, they make it possible for individuals to minimize their waste. This approach is used for different types of household products, which stimulates a sustainable circular economy.

Openbare Vlaamse Afvalstoffenmaatschappij – OVAM (https://ovam.vlaanderen.be)
[Public Flemish Waste Company]
This service-providing organisation from the Flemish government strives towards more sustainable management regarding the recuperation of waste and materials. By implementing the concept of different types of bags, the processing of the materials can be executed more sustainably and stimulates consumers to separate their garbage.

Political Parties
In the political landscape of Belgium, there are a lot of different views on environmental topics. As a decision-making organ, the parties can have a big impact on our society. Parties that did put sustainable food or agriculture related topics on their agenda are, for example, **Groen**, **PVDA,** and **Ecolo** which can be found on their websites: respectively
https://www.groen.be, https://www.pvda.be and https://ecolo.be.

Private consumers
Private consumers are responsible for the biggest share of food waste in Belgium and can, therefore, be seen as the most important stakeholder. This is the reason why the focus of the BEvitalise project lies in stimulating more sustainable consumer behavior by understanding the drivers for their decision-making.

Renewi (https://www.renewi.com)
As a provider of garbage containers, Renewi stimulates consumers to separate their household waste. In this way, it is easier for waste processing companies to optimize their installations and the composting process. They aim to be the leading waste-to-product company by providing sector-specific solutions that focus on gaining value from the waste.

REO Veiling (https://www.reo.be)
This auction is one of the biggest (inter)national markets in fresh fruits and vegetables and represents an important link between producers and consumers. They check and redistribute the products efficiently, so they are as fresh as possible for the consumers. Together with **enVie,** they process their surpluses in soups to use the leftovers.

Restaurants
Besides individual consumers and supermarkets, the catering industry also faces food waste.

Even though restaurants have tried to respond to this, the Belgian stakeholders seem to need to catch up. Some of them collaborate with **Too Good To Go** so that less of their already prepared dishes go to waste. Companies like **FoodWIN** also provide toolboxes for different sectors, including industrial kitchens, to support reducing food waste on a bigger scale. When it comes to catering, Unie Belgische Catering and Horeca Vlaanderen are actively involved in the reduction of food waste in this industry.

Service Public de Wallonie – SPW (https://spw.wallonie.be)
This public service secures a connection between regional institutions, citizens, businesses, and associations. This two-sided opportunity of providing information on societal topics can also be related to food waste by, for example, the introduction of the Plan REGAL to provide tips on how to reduce waste during different steps in the consumption cycle.

Supermarkets
As the most important distributors for private consumption, supermarkets have a big impact on the amount of food waste thrown out daily. Important stakeholders in the Belgium market would be **Delhaize** and **Lidl** since they both are focused on adding sustainable products to their range and have an outspoken vision of reducing food waste.

Test Aankoop (https://www.test-aankoop.be)
This research institute provides statistics on subjects that are important for consumers to take into account before they purchase any product or service, which also include food waste-related topics such as how to stock certain products or efficient ways to organize your fridge. They contribute to the education of consumers looking for reliable information and can, in this way, impact their choices.

TooGoodToGo (https://toogoodtogo.be/nl-be)
This service makes it easy for consumers to get leftovers from different companies for a reduced price, to minimize the food that gets thrown out. Restaurants, bakeries, supermarkets, etc., can decide to partner up with TooGoodToGo and offer products to be picked up by users of the application, which provides the connection between supply and demand. The Zero Food Waste Week is an initiative of this company.

University Research Institutes
Research institutes of several Belgian universities look into a variety of topics related to (the reduction of) food waste. These findings can be used to implement newfound knowledge and are accomplished by, e.g., the **VUB** and **Hogeschool VIVES** that not only conducted research but also stimulated new projects to be realized. For example, the JUST KEEP IT challenge and De Restjesfabriek have resulted from this research. In addition, there is a variety of universities, under which one of them is the **University of Antwerp**, that are involved in **Vlaanderen Circulair.**

Vereniging voor Ecologisch Leven, Koken en Tuinieren – Velt vzw (https://velt.nu)
[Association for Ecological Living, Cooking and Gardening]
Over the past 45 years, Velt has promoted a sustainable lifestyle in households, gardens, and kitchens. By striving for a society where ecology is a central driver and where instances make wise use of resources, they want to create awareness about the impact we have with our current ways of production and consumption.

Vision on Technology – VITO (https://vito.be)
This independent research organisation is working in the cleantech and sustainable development field as they aim to accelerate the transition to a more sustainable world. By conducting research, they try to minimize innovation risks for small companies and strengthen the economic and societal values within Flanders.

Vlaanderen Circulair (https://vlaanderen-circulair.be/nl)
[Circular Flanders]
As the Flemish counterpart of **Circular Wallonia**, Vlaanderen Circulair forms a partnership between governments, companies, and consumers to exchange knowledge on the circular economy. They provide different programs and approaches that can be integrated into current strategies to transition towards a more sustainable society.

VLACO (https://www.vlaco.be)
This association emphasizes the importance of promoting the closure of the biological cycle, by uniting governments and companies that process organic-biological waste.
They conduct quality tests on input- and output stream and provide labels based on the results, to stimulate companies to improve their waste processing. VLACO has also been involved in the realization of the Plan-eet application.

Vlaams Centrum voor Agro- en Visserijmarketing – VLAM (www.vlaanderen.be/vlam/)
[Flemish Centre for Agro- and Fishing Marketing]
By promoting Flemish agriculture and fishing, the government stimulates the production and consumption of local products. Introducing consumers to these local foods implies more conscious decision making, that can have an effect on their purchasing behavior. Regarding the topic of food waste, this could therefore be an interesting stakeholder.

Vlaamse Milieumaatschappij – VMM (https://www.vmm.be)
[Flemish Environmental Agency]
The Vlaamse Milieumaatschappij helps to adjust and prepare environmental policies through research and measurements on related topics. They focus on water, air, and environment while working towards a sustainable society that will secure a safe environment for our current and future generations.

Voedselteams (https://www.voedselteams.be)
This movement of active producers and users connects a group of volunteers that organize the collection of their own foods. As a so called “food team”, they collectively purchase locally or regionally produced products and collect it weekly from a common depot. This stimulates local producers by developing a reliable community of consumers.

World Wide Fund for Nature – WWF (https://wwf.be/nl)
Known as an organisation that is committed to the faith of nearly extinct animal species and the conservation of natural areas, the World Wide Fund for Nature also focuses on informing individuals about the impact of their (food) purchasing decisions by conducting research. As this is an internationally established organisation, they can have a big influence.
One of their projects related to food waste is Eat4Change.

Power-Interest Matrix: Stakeholders relevant to reducing Belgian food waste

A power-interest matrix is often used in stakeholder mapping as a tool to define to which extent stakeholders should be involved in the project. On the two axes, power (ability of organisations to influence based on their market position) and interest (level of vested interest in the topic/project) are defined to indicate their importance (Eriksen-Coats, 2021). Stakeholders are divided into four categories based on their power and interest: monitor, keep informed, keep satisfied, and manage closely (Johnson and Scholes, 1999). As seen in Figure 8, this results in quadrants where stakeholders can be put in according to their involvement.

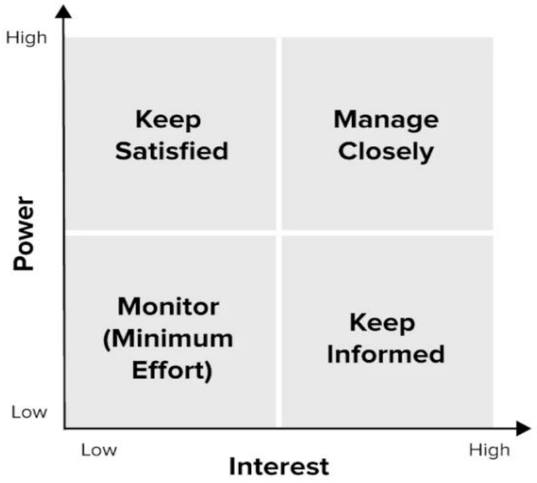

Figure 8. Power-interest matrix

Since the data collected to decide on the level of power and interest for this report, however, are estimated by the researcher – based on the descriptions of the stakeholders and the capacity they have in their active field – no differences between stakeholders will be present within a quadrant and are therefore based on alphabetical order.

TABLE IV. Organisations categorised in power-interest matrix

Monitor	Keep Informed	Keep Satisfied	Manage Closely
in BW	Canopea	Circular Wallonia	BBL
Ipalle	Comeos	Écoconso	BFVB *
REO Veiling *	De Kostwinners *	Flanders' FOOD *	EIT Food *
Universities	Empty My Fridge *	FoodWIN *	FAO *
Velt vzw	enVie *	Foresightee *	FAVV-AFSCA *
VITO	FEVIA *	Leefmilieu Brussel	Hello Fresh *
VLAM	Foodbag *	Political Parties	ILVO
VLACO	Froenten *	Private Consumers	Indaver
Test Aankoop	Herw!n	Restaurants	Manger Demain *
WWF	Intradura	SPW	OLIO *
	Listonic *	Vlaanderen Circulair	OVAM
	No Waste *	VMM	Renewi
	Phenix *		Supermarkets
	Voedselteams *		Too Good to Go *

**organisations exclusively focused on food (waste)*

This overview was used to select and involve stakeholders from each category within the project to ensure a variety of opinions on the topic: their views were requested to formulate and validate the BEvitalise policy recommendations based on the project results. These are the organisations with relatively the most power and interest and, therefore, the most relevant to include in the project (Nguyen and Mohamed, 2018). The asterisk * indicates organisations that are exclusively focused on food (waste). The ones without a mark have a broader scope within the field of sustainable development and the transition to a circular economy. This divide could also be an indicator of the relevance of the stakeholders for future collaborations.

4.1.2. RESULTS OF THE FOOD WASTE DISCRETE CHOICE EXPERIMENT

Data collection

The food waste discrete choice experiment was distributed by Dynata (a software company that collects first-party data) to a wide variety of potential Belgian respondents (i.e. probability sampling). The survey was designed, collected, and analysed in compliance with the University of Antwerp's ethical standards, which employ the 'Ethical Code for Scientific Research in Belgium' and the 'European Code of Conduct for Research Integrity' as guidelines.

Surveys distributed across Belgium collected 3,267 responses. The survey, constructed in Qualtrics, included the designed DCE, behavioural questions regarding food waste, and reflective questions on the DCE. Two versions were prepared: one in Dutch for Flemish respondents and another in French for Walloon participants.

From the 3,267 responses collected, 1,609 respondents originated from Flanders and 1,658 respondents from Wallonia. Yet, some errors were made with how the survey was distributed to its target audience as 272 respondents in the Walloon dataset reported they lived in Flanders and 45 respondents lived in Wallonia while being given the Flemish survey. So, these respondents were filtered out of their wrong sub-dataset and were added to the right sub-dataset. With all incomplete data removed, the final dataset was composed of 967 respondents, representative of the Belgian population in terms of region, gender, age, income, and education, as shown in the table below.

TABLE V. SOCIO-DEMOGRAPHIC SAMPLE

Demographic	Value	Sample (n = 967)
Region	Flanders	61.01%
	Wallonia	38.99%
Gender	Male	47.78%
	Female	52.22%
Age	18-24	10.75%
	25-34	15.93%
	35-44	15.93%
	45-54	16.75%
	55-64	16.75%
	65+	23.89%
Income per month	€1001-2000	21.20%
	€2001-3000	23.06%
	€3001-4000	21.20%
	€4001-5000	20.68%
	> €5000	13.86%
Number of household members	Average size	2.58
Number of years living in Belgium	Always	88.93%
	Not always	11.07%
Education	Primary education	2.28
	Secondary education	42.71
	Bachelor	34.54
	Master	18.72
	PhD	1.76

The choice cards were structured so that respondents chose between retaining the cooking cream or discarding it, with the latter option as the opt-out choice. Based on the random utility model, five models were estimated to analyse the results of the discrete choice experiment: a Conditional Logit Model (CLM), a Mixed Logit Model (MXL), an MXL with interaction effects, a Latent Class Model (LCM), and an LCM with membership variables. The dataset was screened for protest responses (indicating that a respondent disapproves or disengages with the questionnaire for e.g. ideological reasons, and does not respond based on true preferences), identifying four respondents who selected the opt-out option on every choice card due to lack of interest in food waste. A total of 70 responses (7.24%) were excluded, including 62 respondents who indicated difficulty understanding the choice cards. These exclusions were not replaced to maintain the integrity of demographic quotas. Models were estimated using 1000 Halton draws, and maximum likelihood estimation was applied, leveraging Stata software.

Among the models, the Mixed Logit model with interaction terms demonstrated the best fit, highlighting the value of incorporating interaction terms. The findings emphasise the importance of understanding heterogeneity in consumer preferences to design effective interventions. Results of both the basic Mixed Logit model and the Mixed Logit model with interactions are presented in the tables below. Mixed logit models (MXL) differ from conditional logit models in that they allow for preference heterogeneity across individuals, so the coefficients in the model vary across decision-makers, which implies that decision-makers have differing preferences (Hole, 2013). Partially in reaction to the perceived limitations of the conditional logit approach in this regard, the random parameters logit (RPL) or mixed logit model has gained traction among discrete choice modellers (McFadden & Train, 2000; Train, 1998).

TABLE VI. MIXED LOGIT MODEL OF FOOD WASTE DCE

Model parameter	Mean	SD
Alternative specific constant (opt-out)	-3.289*** (0.212)	1.350*** (0.123)
Best-before date: November 2024 (“a month ago”)	-1.179*** (0.151)	2.110*** (0.237)
Best-before date: June 2024 (“in 6 months”)	1.070*** (0.167)	-1.134*** (0.268)
Type of label: “Look, smell and taste after the best-before date”)	-0.005 (0.121)	0.413 (0.377)
Opened 2 days ago	-0.630*** (0.204)	-0.533* (0.310)
Opened 3 days ago	-1.530*** (0.178)	0.235 (0.295)
Opened 7 days ago	-3.016*** (0.196)	2.336*** (0.272)
Packaging: Can	-0.487*** (0.149)	0.222 (0.399)
Packaging: Plastic	-0.213 (0.141)	-0.081 (0.271)

Note. parentheses: standard errors. *** = significant at the 0.01 level, ** = significant at the 0.05 level, * = significant at the 0.1 level. All numerical values are rounded to three decimal places.

In the general Mixed Logit Model, the reference categories for the model parameters were the following: for the best-before date, it was December 2023 (“this month”), for the type of label, the reference category was “No information”, for Opening time, it was “Unopened”, and finally for type of packaging the reference category was “carton”, the most common type of packaging currently used for cooking cream in Belgium. The results of the general Mixed Logit Model showed that switching packaging from a carton to a can decreased utility by 0.487, making respondents more likely to discard canned cooking cream despite its longer shelf life (Brooklyn, 2022). Similarly, a product that was opened 7 days ago, as opposed to 2 or 3, was a dominant factor in discarding decisions. In contrast, products with 6 months of remaining shelf life had positive coefficients, encouraging retention, most likely due to the assumption that the quality of the product did not decline. The alternative specific constant (or, in other words, the opt-out option of discarding the cooking cream) showed a significant negative coefficient in the general mixed logit model. This suggests a general preference for retaining the cooking cream under the specified attribute conditions and a clear preference for respondents to seek to minimise food waste.

We incorporated interaction terms to better capture preference heterogeneity. These effects examine how characteristics such as age, income, and food-related behaviours interact with attributes, providing a more detailed understanding of how different respondent groups value various aspects of food-related choices. Including these interactions enables more nuanced insights into decision-making, enhancing the overall explanatory power of the model. Significant interactions were identified using the backward elimination procedure, with the final models retaining only those that were statistically significant— a common approach in discrete choice modelling.

The variables included as interaction effects in the model are “consideration of the best-before date when shopping,” “checking the best-before date before discarding,” “consideration of label information,” and “age.” These interactions indicate that conscious shoppers value extended shelf life and are less influenced by expired products past their best-before date. In essence, people who consider the best before date when shopping find having a product that expires in 6 months especially important when deciding to keep the product, as do people who first look, smell, and taste before discarding the cooking cream. These more conscious shoppers also attribute less importance to the fact that a cooking cream expired a month ago. Yet, this still influences them to discard the cooking cream, just less so. People who often look, smell, and taste their cooking cream exhibit a more negative ASC, meaning that they are generally more inclined to throw away the cooking cream. The same can be said for older people. Older respondents and those checking stock before shopping were more waste-conscious. People who immediately discard a food product once it reaches its best before date pay a very high importance to the date. If their cooking cream expired a month ago, they are very likely to discard it. On the other hand, people who often make use of services which provide food which is about to expire acclaim a positive weight to products whose best-before date was a month ago, suggesting that they are more likely to use cooking cream which has technically been best consumed a month ago. The same applies to individuals who frequently purchase discounted food products because of the product’s proximity to expiration. Finally, people who check their stock of food products before shopping for items that are about to expire exhibit a negative relation with the fact that a product expired a month ago. This suggests that awareness and conscious behaviours play a significant role in reducing food waste.

TABLE VII. MIXED LOGIT MODEL WITH INTERACTION EFFECTS OF FOOD WASTE DCE

Model parameter	Mean	SD
Alternative specific constant (opt-out)	-0.162 (0.373)	0.970*** (0.167)
Best-before date: November 2024 ("a month ago")	-2.508*** (0.489)	-1.611*** (0.230)
Best-before date: June 2024 ("in 6 months")	0.227 (0.246)	0.180 (0.678)
Type of label: "Look, smell and taste after the best-before date")	0.001 (0.134)	0.662** (0.267)
Opened 2 days ago	-0.696*** (0.197)	-0.150 (0.356)
Opened 3 days ago	-1.586*** (0.179)	0.128 (0.389)
Opened 7 days ago	-3.316*** (0.227)	2.492*** (0.283)
Packaging: Can	-0.503*** (0.152)	-0.285 (0.343)
Packaging: Plastic	-0.213 (0.143)	-0.182 (0.274)
Consider best-before date when shopping * **Best-before date**: June 2024 ("in 6 months"	0.768*** (0.254)	-1.335*** (0.254)
Look, smell and taste before discarding ***Best-before date**: June 2024 ("in 6 months"	0.594*** (0.222)	-0.194 (0.474)
Consider information label * Opened 7 days ago	1.325*** (0.383)	-0.690 (0.544)
Age * **Alternative specific constant** (opt-out)	-0.198*** (0.046)	-0.098 (0.071)
Look, smell and taste before discarding* **Alternative specific constant** (opt-out)	-0.723*** (0.097)	0.152*** (0.057)
Frequently purchase discounted food * **Best-before date**: November 2024 ("a month ago")	0.635*** (0.159)	-0.063 (0.141)
Immediately discard food product after best-before date * Best-before date: November 2024 ("a month ago")	-1.945*** (0.593)	3.051*** (1.058)

Consider best-before date when shopping * **Best-before date**: November 2024 ("a month ago")	-0.689*** (0.265)	-0.723** (0.346)
Check food products at home before shopping * **Best-before date**: November 2024 ("a month ago")	-0.785*** (0.267)	-0.456 (0.671)
Whether they used services/apps to combat food wate * **Best-before date**: November 2024 ("a month ago")	0.319** (0.145)	0.170 (0.191)

Note. parentheses: standard errors. *** = significant at the 0.01 level, ** = significant at the 0.05 level, * = significant at the 0.1 level. All numerical values are rounded to three decimal places.

LCM models with two classes were used to investigate sample differences further. The 2-class LCM, chosen for its predictive quality (87.6%), revealed class-specific preferences. Class 1 (47.4%) was more influenced by informational labels and less by packaging material. These individuals place less emphasis on best-before dates and opened products, aligning with the efficacy of informational nudges. In contrast, Class 2 (52.6%) showed greater sensitivity to expiration dates and opened product conditions. This class relies more on best-before dates and opened-product statuses. Membership[1] LCMs incorporating independent variables (e.g. age, shopping habits) provided deeper insights into class segmentation. Class 1, comprising more waste-conscious individuals, considered informational labels (e.g. "look, smell, and taste") more significant and were less likely to discard cooking cream unless it had been open for 7 days. In contrast, Class 2 members placed higher importance on whether the product had been opened 2 or 3 days ago. Membership variables revealed that older individuals, those who frequently look, smell, and taste their food or buy discounted near-expiry products, were more likely to belong to Class 1.

TABLE VIII. LATENT CLASS MODEL

Model parameter	**Class 1** **Coefficient**	**Class 2** **Coefficient**
Alternative specific constant (opt-out)	-3.899*** (0.487)	-1.651*** (0.198)
Best-before date: November 2024 ("a month ago")	-0.907*** (0.275)	-1.340*** (0.158)
Best-before date: June 2024 ("in 6 months")	0.027 (0.320)	0.744*** (0.159)

[1] A membership function can be used to estimates the probability of a respondent belonging to a particular class based on their characteristics. This function incorporates independent variables, such as age and household income, into the fractional multinomial logit model, assuming these variables are constant across alternatives and choice occasions for each individual.

Type of label: "Look, smell and taste after the best-before date")	0.488* (0.294)	0.038 (0.110)
Opened 2 days ago	-0.203 (0.459)	-0.546*** (0.199)
Opened 3 days ago	-0.603 (0.367)	-1.204*** (0.176)
Opened 7 days ago	-1.905*** (0.350)	-2.701*** (0.213)
Packaging: Can	-1.644*** (0.383)	0.298* (0.172)
Packaging: Plastic	-0.256 (0.400)	-0.135 (0.154)
Class share	**0.474**	**0.526**

Consumers' rejection of the option to discard the cooking cream in the general (with only main effects) Mixed Logit and Latent Class models underscores a strong commitment and wish to minimise food waste. Nonetheless, several factors shape this decision-making process. A notable example is consumers' lack of consideration for products labelled with a best-before date of "one month ago." This lack of consideration leads to the premature disposal of cooking cream, reflecting a widespread misunderstanding of the best-before label, which refer to the quality level rather than safety.

Furthermore, consumers display no clear preference for products either displaying no label or a product with the "look, smell, taste" Label. This label fails to resonate with consumers, and this lack of preference highlights an opportunity to refine label designs to improve their clarity and enhance comprehension. Another key factor influencing disposal behaviour is whether the packaging has been opened. Utility decreases for consumers the longer the product has been opened, even if its quality remains suitable for use. This suggests that the "look, smell, and taste" label is failing to effectively encourage consumers to assess the product's condition before making disposal decisions.

4.1.3. RESULTS OF REAL-LIFE FOOD WASTE EXPERIMENT

A total of 119 respondents completed the real-life food waste experiment, with 58 from Jumbo Tessenderlo, 35 from Theaterplein Antwerp, and 26 from Delhaize Oostende. After excluding incomplete responses and those without consent, the final sample consisted of 101 respondents. Of these, 29 were identified as "bad" respondents based on criteria such as survey completion time, inconsistent answers, and straight-lining behaviour. These respondents were removed, leaving a final sample of 89 for analysis.

Socio-demographic data from the real-life experiment is summarised in Table IX. The sample was predominantly female (n=57), with a fairly even age distribution in the 40-49 age range (around 20 participants each). Fewer respondents were in the 50-59 (n=13) and 60-69 (n=12) categories, and only 5 were over 69. Most participants had at least a secondary education. The majority had a two-person household (n=40), with the most common weekly grocery budgets between 50-99 EUR and 100-199 EUR (n=56 total). Equal numbers spent 300 EUR weekly (n=11 and n=9). The sample represented all five provinces of Flanders, with the most participants from Antwerp (n=25) and Limburg (n=38), followed by Flemish Brabant (n=8), East-Flanders (n=8), and West-Flanders (n=10).

TABLE IX. SOCIO-DEMOGRAPHIC DATA OF REAL-LIFE EXPERIMENT

Sample characteristics	Total sample (n=89)
Gender	
Female	57
Male	30
Non-specified	2
Age category	
<30	19
30-39	20
40-49	20
50-59	13
60-69	12
>69	5
Education level	
Secondary School	34
Bachelor	27
Master	24
PhD	2
Other	2
Household size	
1	11
2	40
3	10
4	18
More than 4	10
Household weekly budget	
<49 EUR	11
50-99 EUR	28
100-199 EUR	28
200-299 EUR	13
>300 EUR	9
Living area (province)	
Antwerp	25
Limburg	38
West-Flanders	10
East-Flanders	8
Flemish Brabant	8

Quantitative results

Respondents were first asked if they use cooking cream and whether it is plant-based. Results indicate that 66% use cooking cream, and 20% use plant-based varieties. Among those who use cooking cream (n=77), 87% store it in the refrigerator, regardless of whether the package is opened. When asked about purchasing sustainable products, 71% agreed with the statement, "I try to buy sustainable products and services."

Table X summarises the results of the counting and modelling analyses of preferences. It shows the sum of the longest (B) and shortest (W) preservation times for each package, as well as the difference (BWS) and rankings. The top three packages for longest preservation were: carton with “Best before 1/5/2024 then check look, smell, taste,” glass with “Best before 1/5/2024,” and glass with “Best quality before 1/5/2024.”

The conditional logit model confirmed the counting approach results, showing a slight preference for glass packages. All packaging and date label alternatives were significant at $p < 0.01$. They were all preferred over the carton package with the label "Best before 1/5/2024," which was used as the benchmark. Additionally, BW scores per respondent were calculated and used for further analysis.

TABLE X. BEST-WORST SCALING SCORES OF THE REAL-LIFE FOOD WASTE EXPERIMENT

				Counting analysis				*Conditional logit model*			
Type of package	**Dutch version of date label**	**English version of date label**	**N°**	**B**	**W**	**BWS**	**Rank**	**Mean**	**P**	**Standard error**	**Share of preference**
Carton	Ten minste houdbaar tot 1/5/2024	Best before 1/5/2024	1	11	51	-40	10	0	-	-	0.0243
Carton	Beste kwaliteit voor 1/5/2024	Best quality before 1/5/2024	2	7	15	-8	9	0.9411	0.000162*	0.2494	0.0623
Carton	Ten minste houdbaar tot 1/5/2024 hierna kijk, ruik en proef	Best before 1/5/2024 then check look, smell, taste	3	20	5	15	1	1.6332	5.50e-10*	0.2633	0.1244
Carton	Ten minste houdbaar tot 1/5/2024 vaak goed na	Best before 1/5/2024 often good after	4	13	17	-4	8	1.0964	0.000134*	0.2871	0.0727
Carton	Ten minste houdbaar tot 1/5/2024 	Best before 1/5/2024 	5	1	5	-4	7	1.0547	5.06e-05*	0.2602	0.0698
Glass	Ten minste houdbaar tot 1/5/2024	Best before 1/5/2024	6	20	10	10	2	1.6891	5.03e-08*	0.3099	0.1315
Glass	Beste kwaliteit voor 1/5/2024	Best quality before 1/5/2024	7	15	5	10	3	1.7746	1.02e-08*	0.3098	0.1433
Glass	Ten minste houdbaar tot 1/5/2024 hierna kijk, ruik en proef	Best before 1/5/2024 then check look, smell, taste	8	7	1	6	6	1.5957	9.81e-07*	0.3260	0.1198
Glass	Ten minste houdbaar tot 1/5/2024 vaak goed na	Best before 1/5/2024 often good after	9	14	7	7	5	1.6118	2.29e-07*	0.3115	0.1218
Glass	Ten minste houdbaar tot 1/5/2024 	Best before 1/5/2024 	10	10	2	8	4	1.6785	1.58e-07*	0.3201	0.1302

On the one hand, a conditional logit model was estimated (based on the BW scores) for sub-groups like 'sustainable aware' vs. 'not sustainable aware' and 'born in 1984 or after' vs. 'born before 1984'. Statistical tests (Mann-Whitney-Wilcoxon) showed no significant differences in preferences based on age or sustainability awareness. On the other hand, product characteristics like material and date labels did influence respondents' discarding behaviour. Spearman's rho analysis revealed a weak but significant positive correlation (rho = 0.091, $p < 0.01$) between preference and glass packaging, suggesting glass is favoured over carton for preservation.

The figure below shows a boxplot with date labels on the y-axis and BW scores on the x-axis. A lower preservation preference was observed for the labels "Best quality before 1/5/2024" and "Best before 1/5/2024 then check look, smell, taste." The highest preservation preference was for the label "Best before 1/5/2024 + 'before you waste' visual." However, overall, respondents' preferences varied greatly, reflecting a wide range of perspectives. To explain these results, additional qualitative information was asked from the respondents.

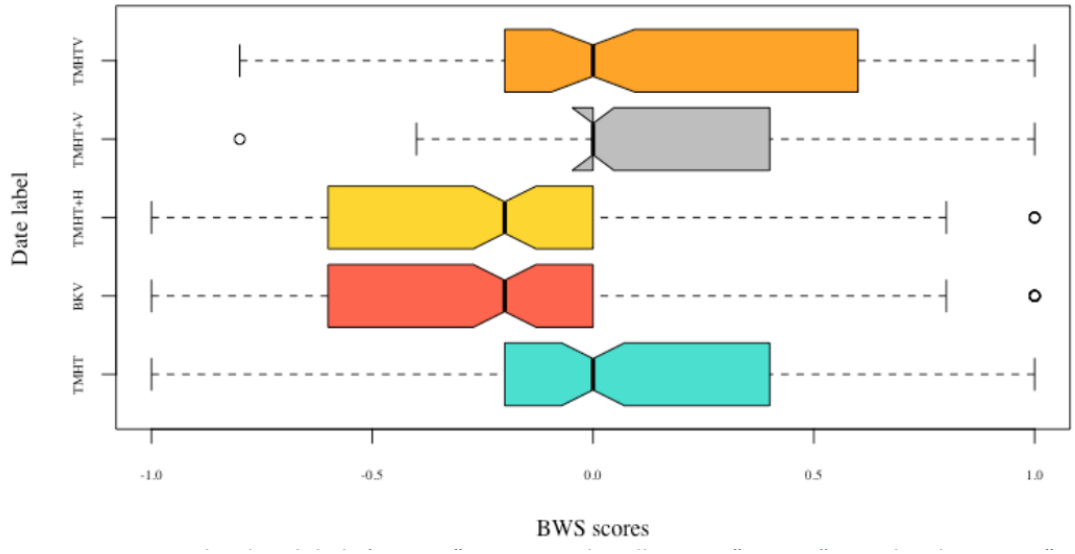

Figure 9. Best-worst scaling scores for date labels (starting below on the y-axis: TMHT: "Best before"; BKV: "Best quality before"; TMHT+H = "Best before + look taste smell"; TMHT + V = "Best before, good after"; TMHTV = Best before + visual")

Qualitative results

Respondents' Feedback

In the survey, respondents could explain their ratings in an open comment box, and informal discussions were held during the experiment. The responses were analysed using open coding (Strauss & Corbin, 1998), identifying 10 common keywords. The most common keyword was 'glass' (32 mentions), linked to transparency, sustainability, and artisanality. The second most common was 'text' (31 mentions), with respondents preferring short, clear text and some favouring visual elements. Other frequently mentioned keywords included 'packaging', 'carton', and 'look, smell, taste' (18, 14, and 13 occurrences, respectively). Some respondents suggested carton packaging preserves content longer due to lack of sunlight exposure, and the "look, smell, taste" reminder was viewed positively. Elderly participants expressed reluctance to participate, as they often consume products regardless of the date label (linked to results of the food waste DCE). There was also initial confusion about the "look, smell and taste" instruction. Additionally, some respondents struggled to understand the experiment's setup and BWS questions.

Conclusions of the food waste experiments

Consumers' general rejection of the option to discard the cooking cream package highlights a clear intention to minimise food waste. However, the complexity of consumer behaviour in this context reveals several key insights that point to barriers and opportunities for reducing unnecessary food waste.

Firstly, the strong aversion to products labelled with a "one month ago" best-before date underscores a significant misunderstanding of the label's intent. While best-before dates are designed to inform consumers about the optimal quality of the product rather than its safety, many consumers equate the passing of this date with an immediate risk of spoilage or harm. This misinterpretation could stem

from insufficient public education on the distinction between best-before and use-by dates, or from longstanding cultural practices that associate food labels with strict rules for consumption. This misunderstanding perpetuates wasteful behaviour, as consumers discard food that may still be perfectly safe and of good quality. Addressing this issue through targeted educational campaigns or clearer explanations on packaging could help bridge this knowledge gap.

The lack of a distinct preference for label types, such as “look, smell, taste” or “often good after,” reveals that current label designs are not resonating with consumers in a meaningful way. While these labels aim to encourage a sensory assessment of food before discarding it, their effectiveness may be limited by unclear messaging or insufficient prominence on the packaging. This finding suggests an opportunity to redesign labels with more impactful, easily understood messages or to incorporate visual cues that prompt sensory evaluation. Research could explore whether combining textual instructions with visual symbols, for instance, might improve comprehension and influence behaviour more effectively.

The tendency to discard cooking cream that has been opened for longer periods, even if its quality remains acceptable, highlights a critical gap in the influence of sensory-based messaging. Despite the presence of the “look, smell, and taste” directive, consumers may lack confidence in their ability to evaluate food quality accurately or may rely more heavily on preconceived notions about how long food remains safe to consume after opening. This behaviour may also reflect a general aversion to perceived risk, where consumers err on the side of caution to avoid potential health issues. Interventions could include providing additional guidance on packaging about typical storage durations for opened products or leveraging digital tools, such as apps, to help consumers monitor and assess the condition of their food.

The real-life experiment explored the effect of date labels and packaging on the discarding behaviour of Flemish consumers in an effort to additionally reduce hypothetical bias and social desirability bias. The BWS experiment revealed a preference for labels that encourage sensory evaluation of food quality, supporting initiatives like "Too good to go." Glass packaging was favoured, particularly for its perceived sustainability. To reduce food waste, the experiment indicates increasing consumer awareness of the "look, smell, taste" labels and providing better communication on packaging sustainability would be welcomed.

Collectively, these findings highlight critical areas for policy and practice to address the behavioural and informational barriers to minimising food waste. Enhancing public understanding of date labels, improving the design and visibility of food packaging labels, and fostering greater consumer confidence in sensory evaluation methods are all essential strategies. Furthermore, these interventions should be tailored to address demographic variations, as younger consumers, larger households, and certain cultural groups may exhibit distinct attitudes toward food waste. Addressing these nuanced behaviours could significantly contribute to reducing avoidable food waste and fostering more sustainable consumption practices.

To address the issue of food waste, a multifaceted strategy centred on consumer education, improved labelling, stakeholder engagement, and ongoing evaluation is essential. Public awareness campaigns should be launched to encourage sensory checks—such as looking, smelling, and tasting—when assessing the quality of products past their “best before” dates. Tailored messaging should be

developed to target specific demographic groups, such as large families or young adults, ensuring the communication resonates with their unique behaviours and needs. Additionally, improving labelling practices is critical. This could include mandating the use of clear, supplementary text on “best before” products, such as “Safe to consume after this date if quality is maintained” or “Often good after,” to clarify the label’s intent and reduce misinterpretations. As part of the Farm to Fork Strategy, the European Commission plans to propose revisions to EU rules on date marking. The goal is to prevent food waste linked to misunderstandings or misuse of these dates, ensuring that any proposed changes meet consumers’ information needs without compromising food safety. It is recommended that action at the Belgian level should await the outcome of the European Commission’s revision of Regulation (EU) No 1169/2011 on food information to consumers (FIC Regulation).

Engagement with retailers and educational institutions can further amplify these efforts. Retailers should be encouraged to display educational messages in-store, promoting responsible consumption and waste reduction behaviours. Simultaneously, food literacy lessons in schools can teach label comprehension and reinforce the importance of minimising food waste from a young age. Finally, a robust system for tracking and adjustment should be implemented. Monitoring food waste levels and analysing data will enable the refinement of strategies to ensure they remain effective and responsive to emerging challenges. Together, these interventions provide a comprehensive framework for reducing food waste and fostering sustainable consumer habits.

4.2. RESULTS OF THE ELECTRONIC WASTE STUDY

4.2.1. RESULTS OF THE ELECTRONIC WASTE STAKEHOLDER MAPPING AND IMPACT ASSESSMENT

Table XI presents a list of stakeholders associated with WEEE, the circular economy, waste policy, and consumer behaviour in Belgium, which was validated by a representative from Recupel. These stakeholders were identified based on the structure of the WEEE market and the organisation of the WEEE collection in Belgium. The list encompasses governmental institutions, research organisations, NGOs, federations, consumer groups, and companies involved in waste management. As mentioned for the food waste stakeholder analysis and impact assessment, the identified stakeholders provided valuable insights into the strategies currently employed to manage electronic waste, thereby helping to determine which policies could be most effective for implementation. Stakeholder perspectives were included in the project to introduce alternative perspectives that may need consideration, particularly for the formulation and validation of the policy recommendations.

TABLE XI. LIST OF ELECTRONIC WASTE STAKEHOLDERS IN BELGIUM

Organisation	**Type**	**Region**
Bebat	Non-profit	Belgium
Belspo	Public	Belgium
Bond Beter Leefmilieu	Non-profit	Flanders
Bruxelles Environnement	Public	Brussels
Bruxelles-Propreté	Public	Brussels
Canopea	Non-profit	Wallonia
CATAPA	Non-profit	Belgium
CF2D	Non-profit	Brussels
Circular Flanders	Public	Flanders
Circular Wallonia	Public	Wallonia
Circular.brussels	Non-profit	Brussels
Denuo	Non-profit	Belgium
Ecoconso	Non-profit	Wallonia
Federal Planning Bureau	Public	Belgium
GoodPlanet Belgium	Non-profit	Belgium
Herwin	Non-profit	Flanders
hub.brussels	Public	Brussels
Indaver Belgie	Private	Belgium
Interafval	Public	Belgium
Ipalle	Public	Wallonia
MCA Recycling	Private	Belgium
MINARaad	Public	Flanders
Natuurpunt	Non-profit	Flanders
Out of Use	Private	Belgium
OVAM (Openbare Vlaamse Afvalstoffenmaatschappij)	Public	Flanders
Recupel	Non-profit	Belgium
Recyca	Private	Belgium
Renewi	Private	Belgium
Repair Cafés	Non-profit	Belgium

Soil and Waste Department (DSD)	Public	Wallonia
Testaankoop	Non-profit	Belgium
Umicore	Private	Belgium
University of Antwerp	Research institute	Belgium
University of Gent	Research institute	Belgium
University of Leuven	Research institute	Belgium
VITO	Research institute	Flanders
Vlaamse Milieumaatschappij	Public	Flanders
VUB	Research institute	Belgium
Zero Waste Belgium	Non-profit	Belgium

Description of the stakeholders

A short description of the stakeholders' activities and experience is introduced in this section to identify the role they play in supporting circular consumer behaviour in Belgium. Information about stakeholders is derived from their websites, social media, and reports.

Bebat (http://www.bebat.be/)

Bebat organizes the collection and recycling of batteries in Belgium. It provides services for manufacturers/importers, schools, and collection points for more than 20 years.

Belspo (http://www.belspo.be/)

The Belgian Science Policy Office (BELSPO) is a Federal innovative administration supporting policy decision-making. BELSPO brings together many research programs and manages ten federal scientific institutes. It is co-funding the BEvitalise project under the framework programme BRAIN-BE 2.0 (BELSPO 2023); therefore, BELSPO scientific committee is involved in various project stages that aim to promote circular consumption patterns.

Bond Beter Leefmilieu (https://www.bondbeterleefmilieu.be/)

Bond Beter Leefmilieu (BBL) is a Flemish federation with more than 130 organisations that work at Flemish, national and international levels and focus on sustainability, including the circular economy. It aims to inspire policymakers, support its members, develop corporate cooperations, organize campaigns and projects, and share information about environmental issues. Bond Beter Leefmilieu is engaged in the project Fair ICT Flanders in collaboration with CATAPA and Ondernemers voor Ondernemers, that aims for companies, social organisations, governments and higher education institutions to take concrete steps to develop a sustainable ICT purchasing and processing policy (Fair ICT Flanders n.d.).

Bruxelles Environnement (http://www.environnement.brussels/)

The administration for the environment and energy in the Brussels-Capital Region is responsible for studying, monitoring, and managing waste in Brussels-Capital Region. Bruxelles Environnement is a stakeholder who can support circular behavior in Brussels-Capital Region through targeted policies.

Bruxelles-Propreté

This public administration is responsible for household waste collection in the Brussels-Capital Region. It acts under the authority of the Minister of the Government of the region in charge of Climate Transition, Environment, Energy, and Participatory Democracy.

Canopea (http://www.canopea.be/)

This federation based in Wallonia represents more than 130 associations and environmental NGOs whose actions range from local to international levels. Canopea aims to monitor public policies and proposals for concrete and innovative solutions in environmental pollution, agriculture, nature, mobility, energy, environmental health, food, tourism, and circular economy.

CATAPA (https://catapa.be/)

CATAPA is a volunteering organisation that works on the socio-environmental impact of mining since 2005. They work on sustainable development for projects in Latin America and Europe through awareness raising, networking, research, lobbying, exchange programs, and supporting farming communities. Their activities include the campaign Make ICT Fair, and the projects NEMO and Fair ICT Flanders (CATAPA n.d.).

CF2D (http://www.cf2d.be/)

This social economy organisation works in the field of ecological transition. Its activities cover (i) the reuse of EEE and the recovery of their components, (ii) the research & development in environmental activities and the social economy (iii) the creation of innovative socio-economic links. Its services include certified data destruction and repair of electronic equipment for companies and individuals.

Circular Flanders (http://www.vlaanderen-circulair.be/)

Circular Flanders is a partnership of government agencies, businesses, non-profit organisations, and knowledge institutions initiated by the OVAM, the Public Waste Agency of Flanders. CE Center, part of Circular Economy Flanders, is a research centre that conducts policy-relevant research in the context of the circular economy. Circular Flanders, together with The Shift, VVSG, and Bond Beter Leefmilieu, set up the project Green Deal Circular Purchasing in 2017 to promote circular purchasing of products, including ICT hardware (Circular Flanders n.d.).

Circular Wallonia (https://economiecirculaire.wallonie.be/)

This strategy of the Walloon government intends to coordinate, strengthen and amplify the regional dynamic in the circular economy. It is based on participatory and flexible governance that ensures the effective implementation of actions. Among other value chains, Circular Wallonia focuses on metallurgy (including rare metals and batteries).

Circular.brussels (https://www.circular.brussels/)

Circular.brussels is a socio-economic non-profit organisation that works on refurbishing and recycling used electrical and electronic equipment. They sustainably provide high-quality second-hand IT products and help reduce the Brussels-Capital Region's ecological footprint by collecting, reusing, and recycling discarded IT materials from companies.

Denuo (https://denuo.be/)

Denuo is the Belgian federation of the waste and recycling sector with more than 250 members and provides the essential link between used materials and reuse, recycling, and final processing. Denuo aims to (i) inspire and advise the government and producers to take the proper steps towards a circular economy; (ii) develop an ecosystem in which producers and material processors come together to develop innovative solutions for material flows; (iii) help its members to formulate and propagate common positions, inform and advise them about new regulations and their implementation.

Federal Planning Bureau (http://www.plan.be/)

The Federal Planning Bureau (FPB) is a public agency that studies economic, social, and environmental policy issues and their integration within sustainable development. FPB's activities include the collection and analysis of data, the investigation of alternatives, the evaluation of policy measures, and the formulation of proposals.

GoodPlanet Belgium (https://www.goodplanet.be/)

GoodPlanet Belgium is a non-profit organisation that aims to inspire people all over Belgium to create a sustainable society using projects, campaigns, and workshops. The organisation focuses on children and young people by providing educational content. In addition, they collaborate with businesses that strive to make a social impact. They are engaged in a campaign for mobile phone collection in schools in Brussels-Capital Region in collaboration with Recupel (GoodPlanet Belgium 2023).

Herwin (https://www.herwin.be/)

Herwin is a collective of over 100 Social Circular Entrepreneurs in Flanders that aims to strengthen social and circular entrepreneurship. They are involved in projects that promote the reuse (Kringwinkels) and repair of products to contribute to the transition to a circular economy (HERW!N 2023).

hub.brussels (http://hub.brussels)

This public agency supports businesses whose activities impact Brussels. They offer free advice, services, and tools in various sectors, including the circular economy.

Indaver Belgie (http://www.indaver.be/)

This company actively manages and treats industrial and household waste for the industry, waste collectors, and governments. Indaver recovers valuable raw materials and energy from these waste streams. The material recovery includes hazardous and non-hazardous substances, plastics, and lamps, common recovery materials from WEEE.

Interafval (https://interafval.be/)

Interafval is the partnership of VVSG, all Flemish inter-municipal waste associations, and local authorities responsible for local waste policy. This organisation acts as (i) an advisor providing information and advice to local administrations; (ii) an advocate that acts on behalf of municipalities and inter-municipal waste associations; (iii) a network organisation that enables the exchange of

knowledge and experience. Interafval is the link with Flemish authorities and associations active in waste management.

Ipalle (https://www.ipalle.be)

IPALLE represents 30 municipalities of Wallonia and is active in the areas of prevention, collection, and treatment of waste. They collaborate with several partners and monitor activities like recycling parks, recovery centres, door-to-door collection services, and wastewater treatment plants.

MCA Recycling (http://www.mca-recycling.com)

This company operates in office waste management and provides solutions for managing waste. Their activities include the destruction of confidential data and the waste management of electrical and electronic equipment.

MINARaad (http://www.minaraad.be/)

MINARaad is the strategic advisory council for the Environment, Nature, and Energy policy areas in Flanders. The primary responsibility of the MINARaad is to advise the Flemish Government and the Flemish Parliament and contribute to creating environmental policies. Their work covers the green economy transition and the development of material policy in the circular economy.

Natuurpunt (http://www.natuurpunt.be/)

This non-profit organisation is based on volunteering and manages natural areas in Flanders in different nature reserves. They aspire to make nature accessible to the public and organize various activities. One of their projects is a campaign in collaboration with Recupel and Out of Use that encourages ICT collection from companies, organisations, and individuals to collect money to support Natuurpunt (Natuurpunt 2023).

Out of Use (http://www.outofuse.be/)

Out of Use is a waste management company specializing in the reuse and recycling of materials. Out of Use offers companies and organisations a sustainable solution to reuse or recycle their ICT and WEEE. They offer services like data destruction, collection of WEEE, reuse of discarded equipment, recycling of e-waste, and dismantling data centers. Out of Use is involved in the ICT collection campaign together with Natuurpunt as mentioned above.

Openbare Vlaamse Afvalstoffenmaatschappij – OVAM (https://ovam.vlaanderen.be/)

OVAM is the Public Waste Agency in the Flanders region that aims to achieve sustainable waste and materials management and a transition to a circular economy through developing policies on waste, materials, or soil.

Recupel (http://www.recupel.be/)

Recupel is an organisation established by manufacturers and importers of EEE in Belgium to organize the collection and recycling of WEEE in a sustainable and cost-efficient way. It was set up as a response to the take-back obligation, which holds manufacturers and importers responsible for managing the equipment at their end of life (Recupel, "Everything there is to know about sorting and recycling in

Belgium" 2023). In addition, Recupel is engaged in various campaigns for mobile phone and small electronic device collection in collaboration with partners like Recyca, Natuurpunt, and Goodplanet.

Recyca (http://www.recyca.be/)

Recyca is a company collecting and brokering empty toner cartridges, inkjets, and e-waste in Belgium. E-waste is recycled to recover raw materials such as plastics and valuable metals.

Renewi (https://www.renewi.com/en/)

Renewi is a waste-to-product company that turns waste into valuable materials such as paper, metal, plastic, glass, wood, building materials, compost, and energy.

Repair Cafés (https://www.repaircafe.org/en/)

Repair Café is a meeting of people working together voluntarily to repair objects. Workshops are organized to teach how to repair defective objects, including electrical and electronic devices, instead of throwing them away. Tools and materials are provided in the places where Repair Cafés are located. Initiatives such as Repair Together in Wallonia and Brussels and Repair&Share in Flanders are part of the international network RepairCafé.org.

Soil and Waste Department - DSD (https://spw.wallonie.be/)

The Soil and Waste Department (DSD), part of the Public Service of Wallonia (SPW), is responsible for developing, implementing, and monitoring policies and regulations on waste and soil protection in Wallonia.

Testaankoop (https://www.test-aankoop.be/)

The Belgian consumer organisation aims to defend and protect consumers' rights, seek solutions for consumer-related problems, and help them assert their rights (freedom of choice, access to information, access to justice, right to education, health, safety, and a healthy environment). They conduct studies and tests to pinpoint which products and services have the best price-quality ratio, represent consumers in national and international commissions and government institutions, negotiate legal and economic advantages for consumers and defend their rights. Belgian consumers can consult the published research of the organisation through their website.

Umicore (http://www.umicore.com/)

This global circular materials technology company specializes in material science, chemistry, and metallurgy. Their goal is to develop, produce and recycle materials sustainably, contributing towards a global circular economy. Umicore launched together with Proximus the urban mining campaign "Don't Miss the Call" in 2020 with the aim of collecting 100,000 old mobile phones in one year (Proximus 2020).

University Research Institutes

A number of Research Groups of Belgian Universities conduct scientific research related to the circular economy. The Environmental Economics (EnvEcon) research group of the University of Antwerp and the Research Center for Economics and Sustainable Entrepreneurship (CEDON) of KU Leuven have

experience in research projects related to the circular economy. The Mobility, Logistics, and Automotive Technology (MOBI) Research Center of the Vrije Universiteit Brussel has worked on research projects on consumer preferences for EEE collection services and WEEE management in Brussels.

VITO (http://www.vito.be/)

VITO is an independent Flemish research organisation specializing in cleantech and sustainable development. Their research includes the fields of raw materials and circular economy. They advise companies and authorities to enable the transition to the circular economy.

Vlaamse Milieumaatschappij (http://www.vmm.be/)

Flanders Environmental Agency is an agency of the Flemish government that aims to contribute to a better environment in Flanders. In collaboration with other bodies and organisations, they support the preparation and implementation of environmental policies in Flanders. They also participate in the project Green Deal Circular Purchasing set up by Circular Flanders.

Zero Waste Belgium (http://www.zerowastebelgium.org/)

Zero Waste Belgium is a non-profit organisation that wants to raise awareness about waste by offering activities and support for individuals and professionals.

Power-interest matrix

The power-interest matrix is a popular method that helps to categorize stakeholders according to their interests and influence and classify them into key players, context setters, subjects, and crowds, as shown in **Error! Reference source not found.**. This tool can be used to identify the potential engagement of each stakeholder in the project.

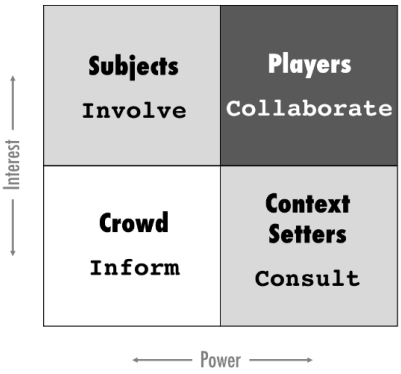

Figure 10. Power-interest matrix. Source: Guðlaugsson et al. 2020

Key players are stakeholders with both high influence and high interest who should be actively engaged. *Context setters* are actors with high influence but low interest in the project, requiring careful monitoring and management. *Subjects* exhibit high interest but low influence and can play a supportive role, offering valuable advice. The *crowd* category refers to stakeholders with low influence and low interest; they should be kept informed but do not need active involvement (Reed et al., 2009).

The classification of stakeholders can be performed within a focus group setting, through interviews, or by researchers and practitioners (Reed et al., 2009). Alternative approaches include rating stakeholders' power and interest using scores derived from questionnaires (Guðlaugsson et al., 2020) or through Strengths, Weaknesses, Opportunities, and Threats (SWOT) score assignments (Nelson, Dongjie, and Mwamlima, 2021).

The categorisation of stakeholders in this report is based on an assessment of their knowledge, experience, and networks concerning WEEE, circular economy, policymaking, and consumer behaviour. Information on stakeholder activities was sourced from websites, social media, reports, and academic literature. Due to limited data availability, stakeholders have not been prioritised within each category. An overview of the four categories is presented in Figure 11, in alphabetical order. Stakeholders involved in the circular economy or waste management but not specifically in WEEE are marked with an asterisk (*).

- **Key players (collaborate):** Belspo, Bruxelles Environnement, Bruxelles Propreté, Circular Flanders, Circular Wallonia, OVAM, Recupel, Soil and Waste Department.
- **Context setters (consult):** Bond Beter Leefmilieu, Denuo, Federal Planning Bureau*, Interafval, Ipalle, MINARaad*, Test Aankoop, Vlaamse Milieumaatschappij.
- **Subjects (involve):** CF2D, Circular.brussels, Indaver België, MCA Recycling, Out of Use, Recyca, Renewi, Umicore, University Research Groups.
- **Crowd (inform):** Bebat, Canopea*, CATAPA, GoodPlanet Belgium, Herwin, hub.brussels*, Natuurpunt, Repair Cafés, VITO*, Zero Waste Belgium*.

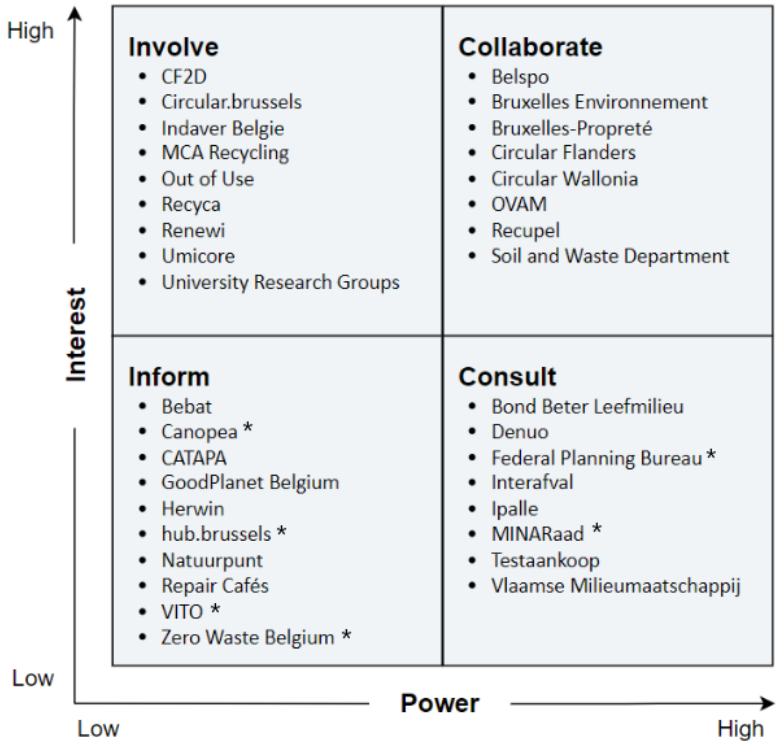

Figure 11 Power-interest matrix for stakeholders in the management of WEEE in Belgium

The results indicate that governmental institutions involved in waste policy within the Flemish Region, Walloon Region, and Brussels Capital Region are key players. Additionally, Recupel is classified as a key player due to its responsibility for organising the collection and recycling of WEEE in Belgium.

The category of *context setters* includes governmental institutions such as the Federal Planning Bureau, Interafval, Ipalle, MINARaad, and the Vlaamse Milieumaatschappij. While some of these organisations are engaged in waste policy, their focus is not exclusively on WEEE. Moreover, certain federations in this category, such as Bond Beter Leefmilieu and Denuo, have the potential to exert influence due to their extensive networks and expertise in circular economy and waste management policies. However, their active engagement in the WEEE sector is yet to be realised. The consumer organisation Test Aankoop is also categorised as a context setter, as its activities influence consumer behaviour, but it has not yet participated in WEEE-related initiatives.

The category of *subjects* comprises stakeholders familiar with the waste management sector, particularly WEEE, such as CF2D, Circular.brussels, Indaver België, MCA Recycling, Out of Use, Recyca, Renewi, and Umicore. However, these stakeholders currently have limited influence. This category also includes university research groups working on relevant topics.

The *crowd* category includes non-profit organisations such as Bebat, Canopea, CATAPA, GoodPlanet Belgium, Herwin, Natuurpunt, and Zero Waste Belgium, as well as the public agency hub.brussels, the research institute VITO, and collectives such as Repair Cafés. These stakeholders have both low influence and low interest in the WEEE sector, although some have been involved in related projects.

4.2.2. RESULTS OF THE ELECTRONIC WASTE DISCRETE CHOICE EXPERIMENT

The sample

The survey for the electronic waste DCE was developed using Qualtrics and distributed both online and offline to maximise sample diversity. Most respondents were reached via social media and mailing lists. In addition, respondents were also randomly recruited offline, with passers-by in supermarkets, electronics stores, and shopping streets in the 10 Belgian provinces and Brussels. They were asked to complete the questionnaire on a tablet. Data collection spanned from March to August 2024, resulting in 566 participants, of which 495 provided complete responses.

TABLE XII. SOCIO-DEMOGRAPHIC REPRESENTATION OF WEEE EXPERIMENT

	Both devices	Population (2021)
Gender		
Male	32%	49.3%
Female	67%	50.7%
Unknown	1%	-
Age		
16-24	32%	12.6%
25-34	19%	15.6%
35-44	13%	15.8%
45-54	15%	15.7%
55-64	12%	16.0%
Above 65	8%	24.3%
Region		
Antwerp	40%	16.4%
East Flanders	9%	13.4%
Flemish Brabant	13%	10.2%
Limburg	9%	7.6%
West Flanders	8%	10.4%
Brussels	3%	10.6%
Walloon Brabant	3%	3.5%
Hainaut	3%	11.6%
Liège	5%	9.5%
Luxembourg	1%	2.5%
Namur	3%	4.3%
Unknown	3%	-
Years in Belgium		
Always	92%	-
More than 10 years	4%	-
10 years or less	1%	-

5 years or less	2%	-
1 year or less	1%	-
Monthly Net Household Income*		
€0-€1000	3%	-
€1001-€2000	11%	-
€2001-€3000	24%	-
€3001-€4000	16%	-
€4001-€5000	16%	-
Over €5000	14%	-
Unknown	17%	-
Profession		
Fully employed	42%	70.5%
Partially employed	10%	
Not employed	3%	5.6 %
Retired	11%	23.9%
Student	31%	
Other	4%	
Educational level		
Primary	1%	10.1%
Secondary	30%	53.8%
Bachelor	36%	36.8 %**
Master	29%	
PhD	2%	
Unknown	2%	-

Note. Data about the Belgian Population retrieved from https://statbel.fgov.be/nl

*Gross income levels of the Belgian population can be found here: https://statbel.fgov.be/en/news/average-gross-income-3886-euros-month

***Includes those that completed professional technical and vocational post-secondary training (17.8%), retrieved from https://statbel.fgov.be/en/themes/work-training/training-and-education/level-education#figures*

As illustrated in Table XIII, the majority of respondents prefer purchasing new laptops or mobile phones (88%) over second-hand alternatives. Over half of the sample (59%) reported attempting to repair their devices when damaged. The majority of respondents reported to replacing their devices every 3-5 years (43%), and more than 5 years (43%). Most respondents are aware of at least one collection point for old laptops (71.0%) or phones (70.3%). Among these respondents, the most commonly recognised collection point for both types of devices is a container park, followed by electronics stores.

Regarding pro-environmental habits, the survey reveals that 45% of respondents take old batteries, light bulbs, and other e-waste to recycling points, while 55% do not. Regarding dietary choices, 85% consume meat and fish, with smaller percentages identifying as vegetarian (3%), pescatarian (3%), flexitarian (8%), or vegan (1%). In terms of environmental engagement, 21% are current members or

supporters of environmental organisations, 16% used to be members, and 63% have never been involved.

TABLE XIII. RESPONDENT'S ELECTRONIC EQUIPMENT CONSUMPTION HABITS

		Share of respondents
Consumption habits		
Repairs laptop/phone or buys new one (Repairment)		
	• New	41%
	• Repair	59%
Buys new or second-hand laptop/phone (Second-hand buyer)		
	• New	88%
	• Second-hand	12%
Frequency purchase of laptop/phone (Frequency)	• I don't know	3%
	• More than 5 years	43%
	• Every 3 to 5 years	43%
	• Every 2 year	6%
	• Every year	0%
	• I receive the device from my employer and don't buy it afterwards	4%
Pro-environmental attitudes		
Takes old batteries, light bulbs and other e-waste to recycling point (Recycle habits)	• No	55%
	• Yes	45%
Dietary choices (*) (Eco diet)	• Meat & fish	85%
	• Vegetarian	3%
	• Pescatarian	3%
	• Flexitarian	8%
	• Vegan	1%
Member or supporter of a nature and environmental organization or association (Eco membership)	• No, never	63%
	• No, but I used to be	16%
	• Yes	21%

Hoarding and disposal habits

There is a strong inclination to hoard old electronic devices, such as laptops and mobile phones, at home, as indicated by 71 % of the respondents. Less than one-third of respondents usually bring their old devices to a collection point. Giving old devices to relatives or friends is nearly as common. Less common methods of disposal are making use of a buy-back programme at, for example, electronic stores and selling the old device. Direct disposal of residual waste is minimal, chosen by only about 1% of respondents.

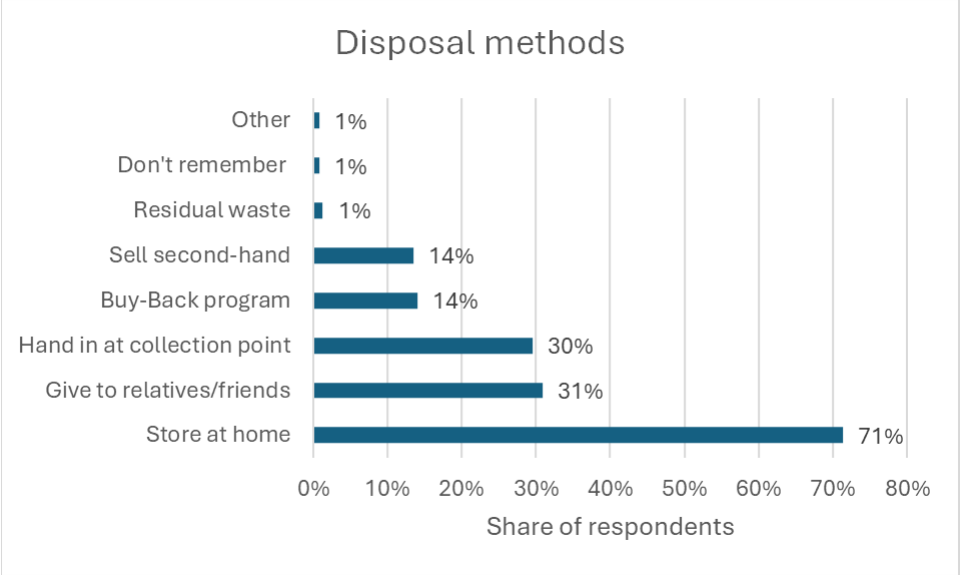

Figure 12. What respondents reported to doing with old electronic equipment

Figure 13 highlights the various reasons why respondents choose to keep their old laptops and phones rather than dispose of them. The most common reason for retaining both types of devices is to use them as backups in case the current device malfunctions. This is followed by unconscious retention, where respondents haven't actively considered whether to keep the device, as well as concerns about data security and storage. Other factors, such as uncertainty about how or where to dispose of the device and emotional attachment, also play a role, albeit to a lesser extent. A small percentage of participants retain old devices with the intention of selling them in the future.

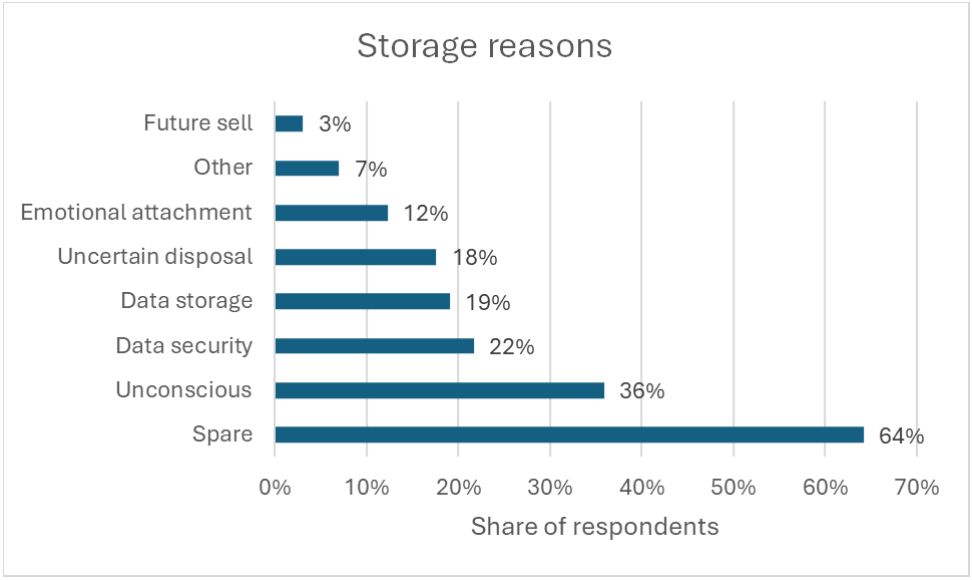

Figure 13. Reasons for respondents storing old laptops or phones at home

Results of the discrete choice experiment

The DCE data was analysed using Stata. Dummy coding was applied to all attributes except price, which was treated as a continuous variable. The opt-out option was coded as 0 for all attributes. Reference levels were set as follows: 'Container park' (Collection point), 'Staff member' (Type of drop-off), 'No guarantee' (Data removal), 'No information available' (Next use), and 'No mode' (Mode of compensation).

A mixed logit model was estimated to account for preference heterogeneity by assuming a distribution of preference weights across the sample. This model provides both mean coefficients and the standard deviation of effects across the sample. The estimates of the mixed logit model coefficients are largely consistent with those of the conditional logit model (which was first estimated but does not account for preference heterogeneity), although a few changes in significance and the signs of parameters are observed.

The alternative-specific constant (the opt-out), was not significant. This illustrates that respondents indicate no specific preference for keeping old devices at home. The results indicate that respondents are willing to return their devices under the right conditions. For the 'Collection point' attribute, the coefficients for 'Electronic store' and 'Supermarket' are negative and significant, indicating a preference for container parks over electronic stores and supermarkets. The 'Second-hand store' is not significant. Regarding the 'Type of drop-off', 'Deposit machine' is not significant, suggesting respondents did not have strong preferences for using deposit machines rather than handing the device to a staff member at the collection point. The 'Data removal guarantee' is significant and positive with a high coefficient, highlighting a strong preference for receiving a guarantee of personal data removal from the device, compared to not receiving such a guarantee. For the 'Next use' attribute, 'Reuse by charity', ‘Reuse by individual’ and 'Recycle' is significant and positive, indicating a preference for these end-uses (as opposed to not receiving any information about the next use of the device). Moreover, 'Recycle' has a higher coefficient than 'Reuse by charity', signifying a stronger preference for recycling the devices rather than donating them for reuse by charity. All compensation modes ('Cash', 'Voucher', and 'Donation') are significant and positive, indicating a preference for some form of compensation. 'Cash' has the highest coefficient, followed by 'Voucher' and 'Donation', suggesting a stronger preference for cash over other compensation methods. The 'Price' attribute is significantly positive, demonstrating that higher compensation amounts for collection positively influence the decision to hand in a phone or laptop.

TABLE XIV. RESULTS OF THE MIXED LOGIT ESTIMATIONS FOR ELECTRONIC WASTE DCE

Model parameter	Mean	SD
Alternative specific constant (opt-out)	0.104 (0.692)	3.848*** (0.000)
Collection point: Supermarket	-0.998*** (0.000)	0.670*** (0.007)
Collection point: Electronics store	-0.442** (0.018)	-0.478* (0.092)
Collection point: Second-hand store	-0.203 (0.246)	0.998*** (0.000)

Type of drop-off: deposit machine	-0.044 (0.769)	0.537*** (0.003)
Data removal guarantee	2.146*** 0.000	2.031*** (0.000)
Reuse: by charity	0.543*** (0.002)	0.100 (0.778)
Reuse: by individual	0.333** (0.038)	0.928*** (0.000)
Recycling	1.242*** (0.000)	-0.236 (0.383)
Cash	0.941*** (0.000)	1.071*** (0.000)
Voucher	0.851*** (0.002)	0.249 (0.413)
Environmental donation	0.743*** (0.002)	-0.131 (0.668)
Price	0.045*** (0.000)	0.046*** (0.006)

Note. parentheses: standard errors. *** = significant at the 0.01 level, ** = significant at the 0.05 level, * = significant at the 0.1 level. All numerical values are rounded to three decimal places.

Mixed logit with interaction effects

Five significant interactions were identified with the variable 'Age'. Firstly, there was a negative interaction with the ASC, indicating that older individuals were more likely to hand in their devices as opposed to keeping them at home. Additionally, older respondents tended to favour container parks over electronic stores and supermarkets, as shown by the negative interactions with both the Electronic Store and Supermarket attributes. In contrast, older people were more inclined to prefer an environmental donation as a form of compensation, as evidenced by the positive interaction with Environmental Donation. Lastly, younger individuals were more likely to seek compensation for handing in their old devices, as indicated by the negative interaction with Price, suggesting that younger people have a stronger preference for receiving compensation than older individuals. Further interaction effects showed that higher-income individuals were more likely to prefer using deposit machines over staffed drop-off points and were also more inclined to choose a data removal guarantee. Additionally, they showed a preference for donating devices for reuse by charity. Conversely, they expressed a 'dispreference' for vouchers, possibly due to the inconvenience of carrying and using them, as well as concerns over expiry dates. Higher-income respondents also favoured higher compensation for handing in devices, likely because they tend to own more expensive devices.

Conclusions of the Electronic Waste Discrete Choice Experiment

This study tackled the critical issue of the improper disposal of unused electronic devices, specifically mobile phones and laptops, among Flemish consumers. The primary aim was to explore the preferences and motivations that could encourage consumers to take their old laptops and mobile phones to collection points rather than storing them at home.

A discrete choice experiment (DCE) was conducted to achieve this goal, focusing on attributes such as 'Collection point' (container park, supermarket, electronic store, second-hand store), 'Type of drop-off' (deposit machine, staff member), 'Data removal' (guarantee or no guarantee), 'Next use' (recycling, reuse by charity, reuse by individual, no information), 'Compensation mode' (cash, voucher, donation, none), and 'Compensation price' (€0, €5, €10, €20). These attributes were selected based on insights from previous literature and focus groups with experts and Belgian consumers.

The data collected was analysed using three models: the conditional logit model, the mixed logit model (MXL), and the mixed logit model with interactions. General findings reveal that respondents indicate to hoard old devices at home – 71 % of respondents reported storing an old laptop or phone. The primary reasons for hoarding were for use as backup devices (64%), concerns about data security (22%), and a lack of awareness about proper disposal methods (36%). Mobile phones are more likely to be stored at home than laptops.

When it comes to disposal, the preferred collection point is a container park, with supermarkets being the least favoured. This preference may be linked to a lack of awareness of other disposal sites and concerns regarding data removal. There is no significant preference for drop-off methods, whether via a deposit machine or in person, though there is a very strong preference for data removal, and consumers prioritise guarantees of data removal (via certificates of complete data removal handed to consumers at drop-off station for example) and assurances (i.e. in the form of a guarantee or certificate) that the devices would be recycled or reused by charity or, with smaller preference, by individuals. Monetary compensation, in cash, with a voucher or via donations, significantly influenced their willingness to participate in collection programmes. Participants demonstrated a preference for cash over vouchers and donations as compensation for handing in phones. This finding aligns with previous studies (Qu et al., 2019; J. Wang et al., 2023; Zhang et al., 2019). A potential explanation is that cash offers greater flexibility than electronic vouchers, as it can be used for any purpose without time restrictions, whereas vouchers are typically limited to specific products and often come with expiration dates.

The analysis also highlighted significant preference heterogeneity among respondents. Older individuals were more likely to hand in devices rather than keep them at home, and they preferred container parks over electronic stores or supermarkets. They also showed a stronger preference for environmental donations as compensation. In contrast, younger individuals were more likely to seek cash compensation for returning old devices. Higher-income individuals preferred using deposit machines over staffed drop-offs, chose data removal guarantees, and supported device reuse by charity. They also disliked vouchers, possibly due to inconvenience and expiry concerns, and preferred higher compensation, likely due to owning more expensive devices.

These findings underscore the diverse factors shaping consumer behaviour in electronic device disposal, providing valuable insights for designing effective collection strategies. The results illustrate the need to provide clear, transparent information on the fate of devices after being handed in at collection points, such as whether they will be repaired for reuse or recycled. Ensuring the removal of personal data and explaining the next use of the device can build consumer trust. Additionally, offering monetary incentives could significantly boost participation in collection programmes. Raising awareness about alternative disposal sites is crucial for improving participation, as lack of knowledge

on disposal sites came out of the study, in relation to the significance of the container sites when disposing of a device.

4.2.3. POLICY RECOMMENDATIONS

Validation of BEvitalise Policy Recommendations

An interactive meeting was organised to formulate actionable policy recommendations with Belgian stakeholders to build on the results attained in BEvitalise. Participants included members of civil society, industry, subject-matter experts, researchers, and policymakers working in the fields of food waste and electronic waste. The meeting combined presentations, small group discussions, and collective reflection to ensure meaningful contributions from all participants.

The meeting's objective was to collaboratively refine and develop practical policy recommendations by leveraging stakeholders' expertise, experiences, and perspectives. It followed a structured, multi-phase format that encouraged active engagement through presentations, breakout group discussions, and plenary synthesis.

The meeting began with a **presentation of the BEvitalise results and draft recommendations**, during which the research team outlined the initial proposals, explaining the rationale and key findings. This ensured that all participants had a shared understanding of the starting point. Following this, the facilitator framed the challenge by emphasising the importance of developing realistic, actionable policies and encouraging participants to consider feasibility, available resources, and potential impact.

Participants were then divided into **break-out groups** based on their interests or expertise, with one group focusing on food waste and the other on electronic waste. Each group was moderated by government representatives to ensure productive discussions. Within these groups, participants followed a structured process. They began by identifying challenges and gaps in the draft recommendations. Next, they co-developed actionable solutions, collaboratively proposing specific steps to make the policies more practical and implementable. The groups then prioritised actions, distinguishing “quick wins” from longer-term solutions, using an impact-feasibility matrix to guide their decisions, described in more detail below.

The **impact-feasibility policy recommendations exercise** consisted of a structured method for evaluating and prioritising proposed policies or initiatives based on two key criteria: **impact** (the potential effectiveness of a measure in achieving its goals) and **feasibility** (the ease or likelihood of successfully implementing the measure). This exercise was intended to help identify the most promising and actionable recommendations so that the federal government can allocate resources accordingly.

Steps Taken to Conduct the Impact-Feasibility Policy Recommendations Exercise

The first step in the exercise was to define the policy goals and scope. The overarching goal was to reduce household food waste and electronic waste, with the geographical focus on Belgium and the target group being Belgian consumers.

Participants collaboratively generated policy recommendations, identifying potential measures or interventions to address the policy goal. This brainstorming stage ensured a broad range of ideas and perspectives were considered.

The proposed recommendations were then evaluated using two key criteria: **impact** and **feasibility**. Impact refers to the extent to which a measure could achieve its goals, while feasibility focuses on the practicality of implementation, factoring in financial, political, technical, or social constraints.

To systematically evaluate the recommendations, a matrix was used to map them visually based on their impact and feasibility. The recommendations were categorised into four quadrants, as shown in the figures below:

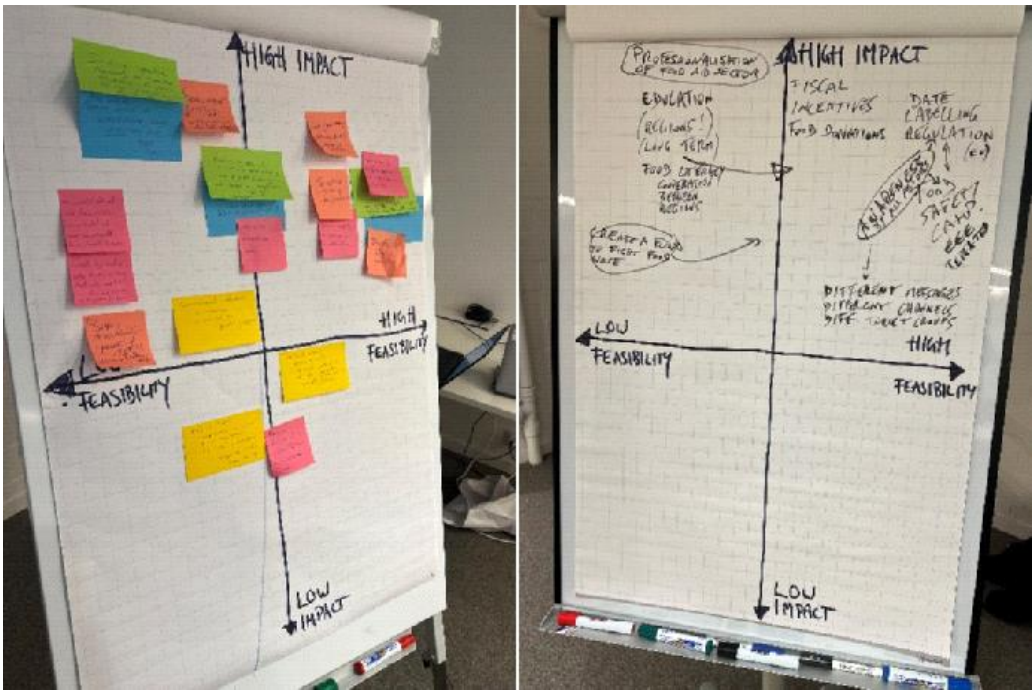

Figure 14. Impact-feasibility matrices used in final BEvitalise meeting.

- **High Impact, High Feasibility**: Identified as “quick wins” and prioritised for implementation due to their effectiveness and achievability.
- **High Impact, Lower Feasibility**: Valuable but requiring significant time, resources, or political effort, necessitating long-term strategies.
- **Low Impact, High Feasibility**: Easy to implement with limited benefits, yet useful as complementary actions.
- **Low Impact, Low Feasibility**: The least desirable measures, not prioritised unless circumstances change.

By following these steps, participants were able to generate, evaluate, and prioritise policy recommendations effectively, ensuring both their practicality and potential for impact.

In the **plenary session**, each breakout group presented its refined recommendations to the full audience. Rapporteurs shared key highlights, including the rationale behind the proposals, prioritised actions, and any challenges identified. This was followed by an open floor discussion, allowing participants to provide cross-group feedback, ask questions, and suggest further refinements. The

facilitator then summarised the most actionable and impactful recommendations, building consensus around key priorities.

By the end of the meeting, participants had collaboratively developed refined, actionable policy recommendations. The process ensured that diverse perspectives were incorporated, building on the findings of the BEvitalise studies. This inclusive approach fostered broad stakeholder buy-in and laid the groundwork for effective policy implementation.

The results from this study and event can be used as one the inputs to support the Federal Action Plan for Circular Economy 2025-2029 - that is in construction - but also for the Federal Action Plan for Sustainable Development. Frans Van Laer (FPS Economy, SMEs, Self-Employed and Energy) introduced participants to current discussions surrounding these: in late 2021, the Belgian government approved the **Federal Action Plan for a Circular Economy (2021-2024)**. This plan includes 25 proposals for measures that fall under federal competence, addressing areas such as product standards, consumer protection, public procurement, employment, and taxation. Currently, preparations for a new plan are underway, although it is in a very early stage with no certainty about the composition or priorities of the next government. Moreover, with regard to the **Federal Plan for Sustainable Development**, the federal plan aims to align with the Sustainable Development Goals (SDGs) and is similarly in its initial stages. It has the potential to incorporate measures that promote sustainable consumption and production, particularly under SDG 12. Input could be valuable in shaping this plan to ensure it effectively supports these objectives.

FOOD WASTE POLICY RECOMMENDATIONS

The food waste breakout group discussed several potential strategies to reduce household food waste in Belgium, focusing on both high-impact and feasible measures. These suggestions represent a range of diverse viewpoints and ideas, which require further exploration, consensus-building, and adaptation to the Belgian context. While some measures were widely supported, not all stakeholders fully agreed on all suggestions.

Below is a summary of the key policy recommendations and aspects discussed. What was clear was that a multi-faceted approach is essential, combining education, improved labelling, and systemic changes to drive a shift in consumer behaviour.

Figure 15. multi-action framework to reduce food waste

Educating consumers about the meaning of *"best before"* dates and encouraging sensory checks after these dates could significantly reduce unnecessary waste. Public awareness campaigns could deliver clear and targeted messages, emphasising the importance of assessing food quality through sight, smell, and taste rather than relying solely on printed dates. Tailored campaigns targeting specific groups, such as large families or young adults, would further enhance effectiveness by addressing the unique behaviours and needs of these audiences.

Improving the clarity and design of food labels represents another critical step. Mandating the inclusion of straightforward statements, such as *"Safe to consume after this date if quality is maintained"* or *"Often good after"*, can help bridge the gap in consumer understanding. Clear and uniform labelling regulations would ensure consistency across products and retailers, further reinforcing these messages. Nonetheless, awaiting the outcomes of expected updates on the FIC regulation is recommended before taking action at the national level.

Engaging retailers and schools can also play a vital role in addressing food waste. Retailers could display educational messages in stores, reminding consumers of the importance of sensory checks and proper storage practices. Simultaneously, incorporating food literacy into school curricula would foster long-term behavioural change, equipping future generations with the knowledge and skills needed to minimise food waste effectively.

These efforts could be supported by regular monitoring and evaluation. By tracking food waste levels and assessing the impact of implemented strategies, policymakers can refine their approaches and allocate resources to the most effective interventions.

Broader Strategic Considerations

Reducing food waste requires a coordinated approach across multiple levels, encompassing federal and regional governance as well as individual behavioural changes. To identify and prioritise effective interventions, we employed a feasibility-impact matrix to evaluate various strategies and actions aimed at minimising food waste, as shown in the Figure below. This framework allowed us to assess the practicality and potential impact of each action, ensuring that resources are allocated to the most promising initiatives.

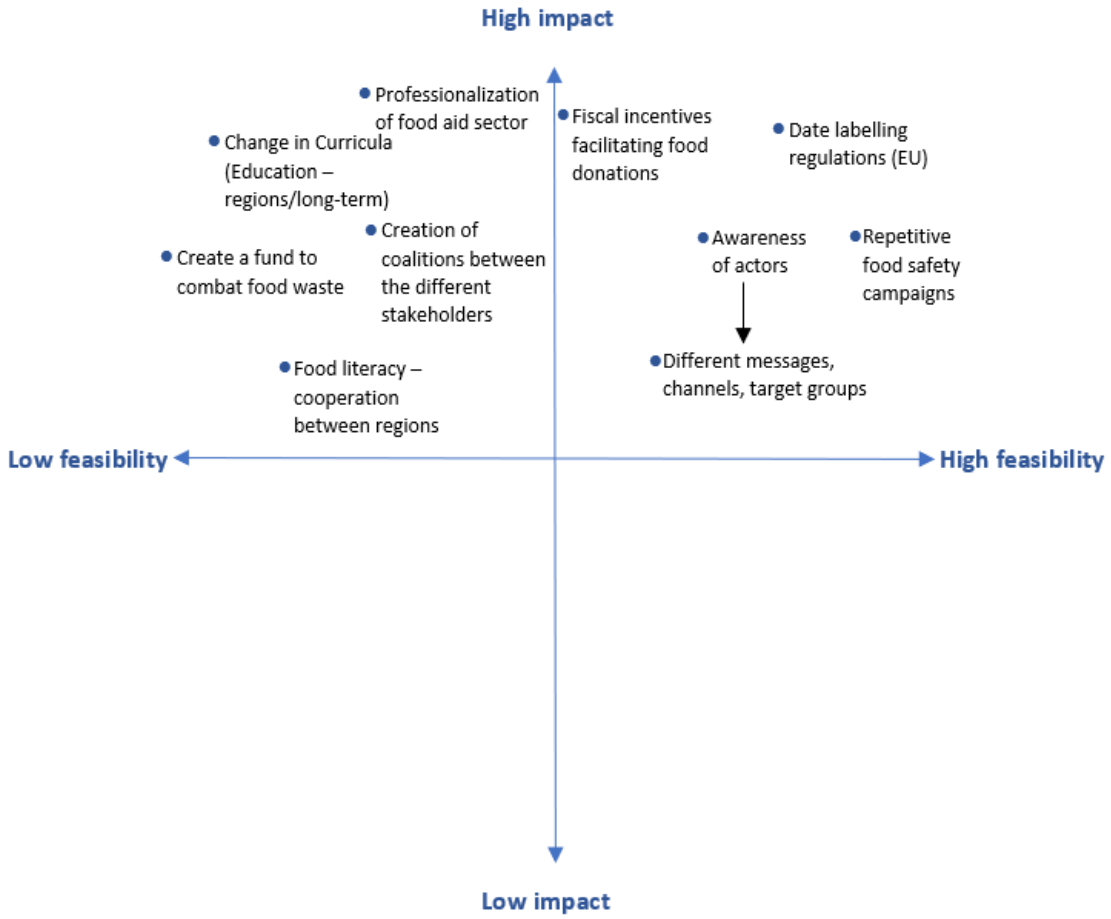

Figure 16. Impact-feasibility matrix of policy actions to help reduce food waste in Belgium

We identified that raising public awareness through campaigns is a critical step, albeit one that demands substantial financial resources. These campaigns could deliver tailored messages using diverse communication channels and focus on improving the understanding and proper use of food labels. Establishing a dedicated food waste fund could provide the necessary financial support for such repeated efforts.

Education and behavioural change emerged as another powerful area of intervention. Incorporating food waste education into school curricula can drive long-term changes in consumer behaviour. However, this requires significant collaboration across regions and robust support at the federal level. While the potential impact of this strategy is transformative, its results may take time to materialise.

The importance of collaboration between governments, retailers, and industry stakeholders was also highlighted. Building coalitions and professionalising the food donation sector can foster sustainable, coordinated actions. Fiscal incentives, such as tax exemptions for food donations, were also identified as highly effective in encouraging surplus food redistribution. However, scaling up such donations would require investments in infrastructure and equipment, which could also benefit from the proposed food waste fund.

Lastly, the importance of tailoring strategies to different target groups was emphasised. Reaching disengaged individuals may pose greater challenges and require innovative approaches, but addressing these groups is essential to achieving comprehensive and lasting reductions in food waste. By using this matrix, we ensured that proposed actions are both practical and impactful, paving the way for a coordinated and effective response to the food waste challenge.

Conclusions on food wase policy recommendations

Tackling food waste effectively necessitates a coordinated and multi-layered response. By addressing misunderstandings about labelling, enhancing consumer education, and fostering collaboration across stakeholders, meaningful reductions in food waste can be achieved. These measures, supported by data-driven monitoring and adaptive strategies, pave the way for a more sustainable and resource-efficient future.

ELECTRONIC WASTE POLICY RECOMMENDATIONS

The electronic waste breakout group discussed several potential strategies to reduce e-waste in Belgium, focusing on both high-impact and feasible measures. These suggestions represent a range of diverse viewpoints and ideas, which require further exploration, consensus-building, and adaptation to the Belgian context. While some measures were widely supported, not all stakeholders fully agreed on all suggestions. Below is a summary of the key policy recommendations and aspects discussed.

Key Strategies for Reducing Electronic Waste

A major area of focus was encouraging the return of discarded electronic products through attractive consumer incentives, such as in-store rewards or deposit schemes. By making the return process more appealing, consumers would be more likely to dispose of their electronics responsibly. Raising awareness of electronic waste collection points and improving their accessibility was also seen as a critical step in facilitating proper disposal.

Moreover, the discussion highlighted the need for integrated studies on consumer behaviour, particularly the emotional or psychological factors behind hoarding electronic devices. Understanding these motivations can help design interventions that encourage responsible disposal and recycling. One suggestion was to implement periodic reminders for consumers, for example, every 3-5 years, asking whether they were still using their devices and, if not, encouraging proper disposal.

Educational initiatives were identified as key to fostering long-term behavioural change, similar to the widespread success of waste separation practices in Belgium. Early education on electronic waste management, integrated into school curricula, could instil responsible habits in future generations.

Additionally, awareness campaigns targeting diverse groups, including non-native speakers and workers in the waste management sector, could help reach broader audiences.

Financial incentives, such as reducing VAT on repair services, were discussed as a way to make repairs more affordable and promote sustainability. Lowering labour costs and supporting repair services with quality certifications would further encourage consumers to choose repair over replacement. This ties into broader initiatives such as the Repairability Index and Eco-Design regulations, aimed at improving the sustainability of electronic products.

Several policy recommendations were deemed both impactful and feasible, and should be prioritised as shown in the Figure below:

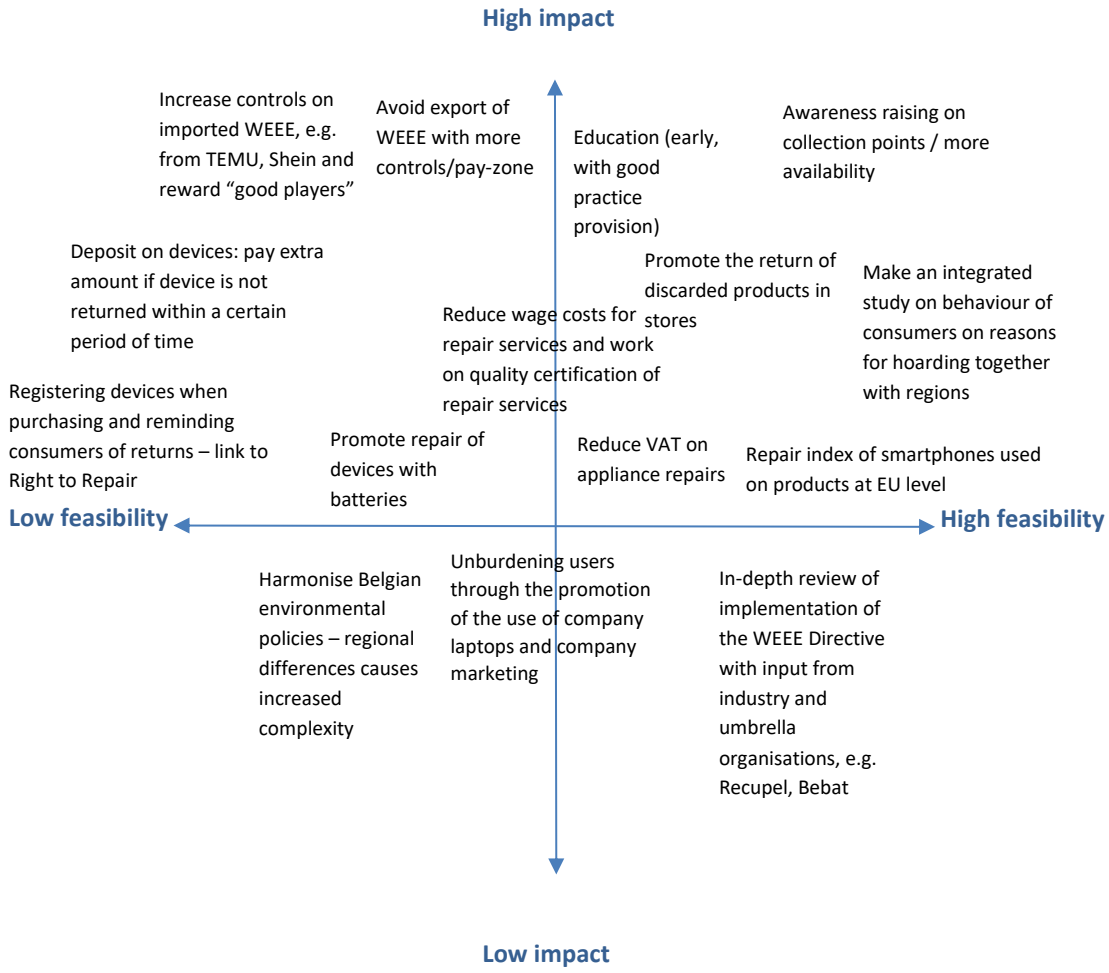

Figure 17. Impact-feasibility matrix of policy actions to help reduce electronic waste in Belgium

High Impact, High Feasibility Measures: Several strategies offer both high impact and high feasibility in addressing electronic waste management. Collection Points Awareness should be increased to ensure that more consumers are aware of electronic waste collection points and can easily access them. Public awareness campaigns can make a significant difference in improving recycling rates and ensuring proper disposal of electronic waste. Encourage Returns by implementing strategies that

incentivise consumers to return discarded electronics to stores, such as deposit systems or in-store rewards. These strategies can significantly increase the return rates and encourage more responsible disposal of electronic waste. Behavioural Insights are crucial for understanding the psychological causes of hoarding and household electronic waste. Conducting studies in collaboration with regional partners will provide valuable insights into these behavioural drivers, helping to inform more effective waste reduction strategies. Educational Initiatives are essential for fostering long-term sustainable habits. By incorporating electronic waste management into school curricula, young generations can be educated on the importance of responsible disposal, instilling a sense of responsibility for e-waste from an early age. Furthermore, examples such as the Maakbar Leuven app, which registers devices and raises awareness about unused electronics, and Bebat campaigns in schools that promote battery recycling and involve school visits to recycling facilities, allowing children to educate their parents. To address diversity, the campaigns would need to be tailored to non-native speakers and workers in the waste management sector. Various tools, including scannable apps, decision trees, and reminder notifications, could be used to nudge consumers toward recycling and/or donating their electronics. Tax Incentives such as reducing VAT on appliance repair services can make repairs more affordable and appealing. By making repairs a more financially viable option, consumers may choose to repair their electronics rather than discard them, leading to less waste and more sustainable consumption patterns. This could create a business case for e-waste management, including repair and recycling. At the moment, the current business model is not economically feasible for most consumers. This idea is intertwined with the Repairability Index and Eco-Design regulations, which aim to improve the sustainability of electronic products. The Repair Index for smartphones will help guide consumers toward more sustainable choices. This index would highlight repairable devices and encourage the purchase of electronics that are easier to repair, extending their lifespan and reducing electronic waste. Ensuring consumers fully understand this repair index is key to success. Finally, providing Support for Repair Services is crucial. Lowering wage costs for repair professionals and introducing quality certifications will help make repairs more accessible and reliable, encouraging consumers to opt for repairs over replacements.

High Impact, Lower Feasibility Measures: Some proposals offer high potential impact but face greater challenges in implementation. Tighter Controls on Imports is one such proposal that would strengthen the monitoring of waste electrical and electronic equipment (WEEE) imports, including products from platforms like TEMU and Shein. This would help reduce electronic waste by reducing the influx of non-sustainable products into the Belgian market while rewarding eco-friendly businesses for their efforts. WEEE Export Restrictions would implement stricter controls on the export of electronic waste to ensure that waste is managed domestically. By reducing the export of WEEE, Belgium can better manage its waste and prevent harmful disposal practices abroad, promoting more sustainable waste management practices. Introducing Deposit Systems would involve charging consumers an additional fee on electronic devices, which could be refunded upon return within a specified timeframe. This scheme would incentivise returns, reducing the number of devices discarded and contributing to the circular economy. Battery Removability is another important area of focus. Promoting the repairability of devices, especially those with integrated batteries, would extend their lifespan and reduce waste. Encouraging manufacturers to design devices with removable batteries would make repairs easier and less costly, further reducing electronic waste. Finally, Device Registration at the time of purchase, along with periodic reminders to encourage returns, would align with the Right to Repair framework.

This measure would help track devices throughout their lifecycle, ensuring proper disposal and encouraging responsible consumer behaviour.

Low Impact, High Feasibility Measures: Some initiatives are easy to implement but have a limited direct impact. However, they can still complement broader strategies. Corporate Initiatives could involve encouraging businesses to promote the use of company devices, which would simplify the consumer's responsibility for managing end-of-life electronics. By ensuring that businesses are responsible for their devices, e-waste management would be more streamlined. A Directive Review is also an important measure. Reviewing the implementation of the WEEE directive, incorporating feedback from stakeholders and organisations such as Recupel and Bebat, would ensure that the directive is up to date and effectively addresses the current challenges of electronic waste management.

Low Impact, Low Feasibility Measures: Harmonising environmental policies across Belgium could simplify processes, but the regional variations in waste management pose significant challenges. These differences must be addressed in order to achieve greater uniformity in policy implementation. Ensuring that e-waste management is consistent across regions would be crucial to improving Belgium's overall waste management strategy.

Conclusions on electronic waste policy recommendations: To effectively manage electronic waste, a balanced approach is needed. This should combine high-impact strategies with feasible measures. Policy recommendations must focus on raising awareness, incentivising repair and recycling, and fostering behavioural change through education and financial incentives. The federal government plays a key role in guiding regional efforts and adapting policies to local needs. By integrating these recommendations with ongoing research and collaboration with stakeholders, Belgium can make significant progress toward more sustainable electronic waste management.

Conclusions of policy recommendations

To effectively reduce food and electronic waste, we recommend prioritising high-impact, high-feasibility measures and delivering "quick wins" to build momentum and demonstrate progress. For instance, short-term goals may include raising public awareness through campaigns or tax or other fiscal incentives, while medium- and long-term objectives could focus on policies such as deposit-return schemes promoting device repairability for electronic waste and changing school curricula to increase food label literacy.

As circumstances evolve—whether through shifts in funding, technological advancements, or public support—the feasibility of certain measures may change. For example, an initiative once deemed low-feasibility, such as device registration, may become achievable with technological advancements or increased demand for accountability. BEvitalise results of guaranteeing data removal through certification should be taken into account, as it came out as a key consumer preference in the study in order to dispose of devcies. Resources could be reallocated as needed, and stakeholder engagement—across governments, industry, and NGOs—will be vital to maintaining momentum. Furthermore, establishing a dedicated fund for food and electronic waste, for instance, could support sustained public awareness campaigns and initiatives focused on e.g. improving the clarity and use of food labels.

Broader Strategic Considerations

Reducing waste requires a coordinated approach across multiple levels, including federal and regional governance, as well as individual behavioural changes. Collaboration is key. Tailoring strategies to different target groups is also essential: as was seen in the BEvitalise results, younger people were more likely to waste food. Reaching disengaged individuals may require innovative approaches, but targeting these groups is crucial to achieving comprehensive reductions in food and electronic waste. With a strategic, coordinated effort and continuous adaptation, policymakers can ensure that proposed actions are both practical and impactful, leading to sustained improvements in food and electronic waste reduction in Belgium .

5. DISSEMINATION AND VALORISATION

BEvitalise considers that the principal goal regarding the valorisation of its results is to increase the impact of its research and influence current policies in Belgium on the transition to a circular economy. We have ensured that data and research results are transformed so that they can contribute to improving knowledge on the creation of sustainable processes and services that bring economic value and benefit society – specifically, increasing circular consumption in Belgium. In order to do so, we have paid particular attention to make sure our studies have been generalisable to the Belgian population, and we have sought to capture the reasons why circular policy targets regarding household food waste and electronic waste have fallen short of targets at European, federal, and regional levels, and importantly – how this can be addressed.

Throughout the project, we have conducted several expert and consumer feedback sessions to capture ongoing academic and policy discussions, also thanks to our follow-up committee, which is composed of academics, policymakers, and civil society. Follow-up committee meetings, which invited all members to attend, were held in March 2023 and November 2023. During these meetings, the BEvitalise team provided an update on the research undertaken, and during interactive sessions, members of the follow-up committee provided feedback, advice and suggestions for change. Additional one-to-one meetings were also held with experts from the follow-up committee, where their experience was relevant to ongoing research. In the case of the stakeholder mapping and impact assessment exercise, written review and validation were sought from follow-up committee members as well. Furthermore, consumer and expert focus groups were also conducted in preparation of the discrete choice experiments to valorise our studies and results.

With the help of the BEvitalise stakeholder mapping and impact assessment, we organised the final project meeting and follow-up committee meeting as an interactive meeting with Belgian stakeholders at the end of November 2024, including members of civil society, industry, subject-matter experts, researchers and policymakers working in the fields of food waste and electronic waste. The objective of the meeting was to build on the results attained in BEvitalise and formulate actionable policy recommendations by leveraging the expertise, experiences, and perspectives of stakeholders that can be taken into use by the federal Belgian government. The participants of this meeting can be considered to be part of a 'BEvitalise Knowledge Network' that can further encourage collaboration amongst Belgian policymakers, industry and civil society working towards reducing electronic and food waste.

The BEvitalise team has ongoing exchanges with Steunpunt Circulaire Economie (also linked to the Environmental Economics Research Group at the University of Antwerp) via the Circular Economy

Policy Research Center, making sure we are informed of the latest developments in the Belgian circular economy policy sphere. Furthermore, as researchers and members of the executive committee of the EU-funded Horizon Europe project 'PATTERN: Providing operational economic appraisal methods and practices for informed decision-making in climate and environmental policies', the BEvitalise team has been able to develop the BEvitalise DCEs in conjunction with ongoing research at EU-level. As part of the Food System Dynamics network led by the University of Bonn, we are also regularly updated on academic research in the field of food systems.

Dissemination of communication and results is an important component of the objectives of BEvitalise. Given that final results have now been obtained at the end of the project, dissemination of our project results can begin: first of all through the publication of results in Web of Science journals. Further, an informative article with the key take-home messages from the project will be published in the 'Nieuwsbrief Milieu & Economie' thanks to Prof Rousseau and Prof Van Passel's involvement in the editorial board of this newsletter. Participation in national and international expert meetings, workshops, conferences have formed an important part of the work of developing the BEvitalise studies, including sessions on food waste at the International Conference of Agricultural Economists in India, in August 2024, and a workshop on DCEs led by Prof Stephane Hess (Leeds University) at Paris Saclay University, France attended by Dr Anougmar. We will seek to present the final results at the conference of European Association of Environmental and Resource Economists.

6. PUBLICATIONS

Anougmar, S., Van Schoubroeck, S., van den Berg, M., Hanssen, T., Rousseau, S., Van Passel, S., Bjornavold, A. (2025) From Plate to Bin: What Drives Belgians to Discard Food? Insights from a Mixed-Methods ApproachForthcoming

Van Schoubroeck, S., Anougmar, S., Engels, U., Giannopoulou, D., Rousseau, S., Van Passel, S., Bjornavold, A. (2025). What Drives Belgian Consumers to Return Unused Mobile Phones and Laptops? Evidence from a Discrete Choice Experiment. Forthcoming

7. ACKNOWLEDGEMENTS

We would like to express our gratitude to all those who contributed to the successful completion of this project.

First and foremost, we extend our sincere thanks to Aziz Naji, from BELSPO, as well as Frans Van Laer and Tessa Bogers from FPS Economy for their continuous guidance and support throughout the two years of this project. Your expertise and commitment have been instrumental.

We are grateful to the members of our follow-up committee, whose constructive feedback and insightful recommendations ensured that the project remained both policy-relevant and impactful in addressing food waste and electronic waste in Belgium. In particular, we would like to thank Tom Anthuenis (PPS Social Integration), Christian Ferdinand (FPS Economy), Mark Looman (FPS Public Health), Carl Berthot (FPS Public Health), Stein Janssens (Circular Flanders), Maud De Hemptinne (FoodWIN), Emma Van Steenweghen (Boerenbond), Prof. Hossein Azadi (ULiège), and Prof. Ellen Van Loo (Wageningen University).

Our sincere appreciation also goes to the participants of the final BEvitalise meeting, who played a crucial role in formulating actionable policy recommendations and fostering inspiring discussions on improving Belgium's policy landscape for reducing food and electronic waste.

Lastly, we are thankful to the participants of the numerous consumer and expert focus groups conducted during the development of the DCEs. Their input and perspectives have been fundamental to the success of this research.

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